General overviews and future perspectives of disaster information systems in Japan

by

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ABSTRACT:

After the Hanshin/Awaji Earthquake, Japanese government enforced improvement of disaster information management systems. Because the lack and shortage of the disaster information and communications among the ministries, agencies and public became obstructs for quick response and recovery from the disaster. For 8 years after the earthquake, each ministries and agencies developed information systems in its system and it makes possible to collect and transform information quickly. In these days, there occur new problems in government, especially; the lack of information exchange between the systems that constructed by different organizations is one of the large problems. The Central Disaster Prevention Council determined "the Basic Policies for Improvement of Disaster Information Systems" in March 2003. This Basic policy consist of the following five discrete policies; (1) Assuring information coverage - in both time and area, (2) Establishing mechanisms for better use of information, (3) Sharing and utilizing information during usual times to assist in emergency measures, (4) Building the e-government for disaster management, and (5) Establishing an organization responsible for promoting implementation of disaster information systems. Japanese government will establish the e-government for disaster management in three years.

KEYWORDS: Information system, Information sharing, the e-government for disaster management

1. ISSUES FOR DISASTER INFORMATION SYSTEMS IN JAPAN

1.1 Assuring Information Coverage - in Both Time and Geographical Area

The Great Hanshin/Awaji Earthquake that hit Japan in 1995 posed several major issues for disaster information systems in Japan. Prompt and effective rescue activities presuppose accurate and immediate identification of the scale of the disaster and allocation of appropriate supplies and human resources across a large area. The larger the scale of the disaster is, and the greater the area

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affected is, more and more information is required to facilitate such activities; however, exactly the opposite may happen - the amount of information which can be gathered may be limited in major disasters, and the time it takes tends to be long. This is because the information systems available may be directly impaired by the disaster, such as disruption of communication network, inability to dispatch human resources due to breakdown of transportation networks, and system failure due to power outage. Such circumstances create information void; void in terms of time, meaning no information at all may be available immediately after the disaster struck, and void in terms of area, meaning no information may be available particularly concerning the most heavily hit area due to impaired information gathering activities.

Fig.1 graphically shows the relationship between the casualty count and the number of missing people in the Great Hanshin/Awaji Earthquake, shown against time elapsed since the quake struck. Casualty and missing count data is one of the most crucial indicators to identify the totality of a natural disaster. As this quake was a major one affecting a large geographical area, it greatly impaired the information collection activities immediately after the quake. The graph shows that it took almost three days until the government reached the final count of dead and missing people. It is notable that at eight-thirty, almost three hours after the quake hit at 5:46, only 27 dead and missing were reported; it is obvious that there was information void in time during this time.

In Hokudan-cho, the most heavily hit area in Awaji Island across from Kobe, there was delay in the identification of the extent of the damage compared to the surrounding area, which suffered limited damages, and this town was the last to call for help to the prefecture government. By the time Hokudan-cho was able to reach the prefecture government, supporting personnel had already been dispatched to other towns, and no help could be provided to this town. Such information void, this time in terms of area coverage, becomes an obstacle for taking effective rescue actions. Thus we need to eliminate such information void in terms of time and space.

1.2 Facilitating Better Use of Information

In disasters affecting a large geographical area, different disaster-related organizations need to closely and flexibly liaise with one another when taking actions. In the case of the Great Hanshin/Awaji Earthquake, there was insufficient interaction and collaboration among the various disaster-related institutions involved. Since then, those institutions have been striving to establish multitudes of disaster information systems to help with prompt information collection and communications. However, it must be noted that each of those systems was built independently of others, meaning that each is effective in promptly communicating accurate disaster-related information to the upper-level unit within the same line organization. At the same time, municipal government bodies close to the area

suffering from disasters, including city, town, village as well as prefecture governments, are required to send the same information to different upper-level institutions in different formats as required by such entities, and such procedure can cause considerable delay in initiating immediate disaster recovery/prevention activities. Furthermore, even though there may be systems to send individual pieces of information gathered by the regional branch office of national disaster-prevention institutions or by the city/town/village or prefecture government bodies to their respective upper-level institutions, where they are compiled to identify the total view of the disaster, there is no appropriate mechanism to provide feedback to the originating municipal bodies. Because of this lack of feedback mechanisms, there may be no information sharing across the different branch institutions taking rescue actions at the disaster site; there is insufficient collaboration among such institutions; or information on a disaster that happened in one town may not be available to the head of that town except through mass media. There is a need to establish mechanism to help with better and full use of information, as well as improving collection and communication of disaster-related information.

1.3 Good Practice of Sharing and Utilizing Disaster Information during Usual times

Since the Great Hanshin/Awaji Earthquake, different disaster-related governmental bodies and institutions have established various disaster information systems. Such information systems are equipped with functions assuming use during emergencies of course, but the more complex and equipped with more functions those systems are, the rarer they are used, particularly during usual times. Therefore, in the midst of confusion during emergency, the emergency personnel may be unable to operate the system effectively, and even worse, the systems themselves may fail to function because they are left unattended during usual times.

One example is that of communication lines. Disaster-related governmental bodies were ready with priority communication lines in preparation for emergencies. However, during usual times, they used the lines with LCR (Least Cost Routing) device, which selects the lowest cost phone carrier, for cost consideration. So it happened even during the Hanshin/Awaji Earthquake the phone equipment selected lines other than the priority line, leading to communication disruption, just as other phone lines for the general public, because of the heavy traffic.

Recent IT developments have led to extensive functions of communication tools such as mobile phones, and they may become useful as tools to provide information to the general public. However, some of the population, including senior citizens, are not used to using such mobile terminals including phones, therefore may not be in the habit of carrying one on themselves at all times, and they may not be able to operate the mobile to access the information.

In the case of the Mt. Usu eruption in 2000, the

local residents and the municipal government bodies had, well in advance of the eruption, prepared hazard maps, and there had already been established a close collaboration on emergency actions between relevant institutions and the residents. When the eruption hit, the communication to the residents on evacuation and other actions went very smoothly and adequately, because it was an extension of the already existing close cooperation, therefore, there was not even one casualty. As this example shows, there is a need to maintain a practice of sharing and utilizing disaster-related information during usual times, and also to assure that the population and the governmental bodies are familiar with the use of information tools.

1.4 Building an e-Government Focused on Disaster Management

Advances in information technology enabled the various disaster prevention authorities to exchange large volume data, including obtaining visual image data of the disaster site to help them understand the exact situation; the volume of information handled by such authorities and relevant institutions has gone through a dramatic increase. However, different formats used for communicating information may hinder smooth and adequate information collection, communication, or storage. For example, disaster information system and the GIS system used by individual prefectures are not compatible with one another. This can create problems in cases of disasters affecting a multiple of municipal government districts, such as inability to compile statistics, including damage estimate, or to arrange for supply shipments across the prefecture borders. Introducing systems from other prefectures would require the municipal governments to install multiple computer terminals. In order to establish a “community of collaboration prepared for emergency,” consisting not only of “public support” provided by national, regional/municipal governmental bodies and other relevant authorities in times of disasters, but also of “self support” where the residents themselves strive to protect their own lives and assets, and “mutual support” where residents and other parties including NPO’s act together to protect one another’s lives and assets, all functioning with a good balance, all parties involved in disaster/emergency support activities, including disaster-related governmental bodies, residents, NPO’s for disaster rescue activities, and private sector businesses, need to work together to establish an IT-enabled disaster information systems and mechanisms, that help all parities to efficiently share and make full use of disaster information through advanced IT.

2. Looking back on programs to date in Japan

Disaster information systems in Japan have shown rapid progress, particularly since the Great Hanshin/Awaji Earthquake. The following are examples of programs and efforts undertaken by the Cabinet Office.

2.1 Assuring information coverage - in both time

and area

Cabinet Office is in the process of establishing DIS, Disaster Information System, to eliminate the information void, in time and area, at the very initial stage after the occurrence of a disaster. DIS, as shown in Fig. 2, aims to resolve the dilemma between the limited information available at the time of a disaster affecting a large area, and the need for greater volume of information to provide better support. In order to realize this, DIS uses central disaster radio network to connect between different disaster-related authorities and governmental bodies to help with better information sharing, as well as complimenting the limited volume of information with estimates. EES, a sub-system of DIS, combines seismic intensity measured at the designated observation points, which is provided on-line from the Japan Meteorological Agency, with pre-entered data on ground, structures/buildings, and population, and is capable of estimating, within 30 minutes of the quake, personal injuries due to destruction of buildings. The output is provided on-line to relevant authorities. EMS, another sub-system of DIS, is capable of combining and overlaying various types of disaster information on one same terminal to extract useful information, thus different institutions can utilize such information for taking emergency rescue actions. Information provided by EMS includes data on various disaster-related authorities, discontinuation of critical “lifeline” utilities such as electricity and gas, and information on damages to infrastructure such as roads. In addition, Cabinet Office is in the process of developing a system utilizing artificial satellite image technology as a new tool to gather information and to identify the extent of damages. This system compares, and detects the differences in, the artificial satellite image taken after the disaster from the one taken before the event to help identify the extent of damages across a large area. The information detected by this system will be that on distribution of damages across geographical areas and that on damages to selected and pre-registered major structures and buildings. All this information can be shared among relevant authorities via DIS. Currently DIS connects 15 governmental agencies and institutions and 4 other designated institutions, with plans for expansion (Fig. 3).

2.2 Establishing the Disaster Prevention Radio Communications System (Fig.4)

In order to assure collection and communication of information between Cabinet Office (responsible for disaster prevention/rescue) and relevant disaster-related authorities, and to facilitate emergency activities, Cabinet Office, in fiscal year 1978, launched on a project to establish a fixed line communication network connecting disaster-related institutions and bodies including designated administrative bodies in Central Tokyo and other designated public entities. Subsequently, starting in fiscal year 1991, the project extended to digitize the equipment in their replacement cycle, and this changeover was

almost fully completed within fiscal year 2000. Also, the following projects were undertaken with great urgency since the Great Hanshin/Awaji Earthquake.

2.2.1 To be prepared for possible damages in the Metropolitan area incurred by natural disasters such as earthquakes with seismic center right below Southern Kanto area, a fixed line communication network connecting nine disaster prevention institutions located in Tachikawa Wide Area Disaster Prevention & Relief Base.

2.2.2 To secure a hot line communication in case of emergency between 47 prefectures and central governmental agencies and ministries including the Prime Minister's Public Residence and Emergency/Disaster Countermeasure Headquarters, an emergency line via line of Ministry of Land, Infrastructure & Transport was established.

2.2.3 Because of the criticality of visual information for adequate initial actions in large scale disasters, visual data communication pathways have been established between ministries that are capable of collecting visual data via helicopters (namely Defense Agency, National Police Agency, Fire & Disaster Management Agency, Japan Coast Guard, and Ministry of Land, Infrastructure & Transport), Prime Minister's Public Residence and Cabinet Office (responsible for disaster prevention), as well as relevant bodies located inside the Tachikawa Wide Area Disaster Prevention & Relief Base. Further efforts are being made to expand the scope of such visual data transmission network to include other designated administrative bodies.

2.2.4 A project is underway to establish a ground station for satellite communication network, which will connect entities for which disaster recovery is urgent, including regional utility companies, as well as designated public institutions including Japan Railway and NTT.

2.2.5 In order to be prepared for the situation where a major earthquake occurs right below Tokyo, which may destroy buildings and thus disable existing public communication network and central disaster prevention radio network, a project is underway to establish a ground station for satellite communication, that can be used independently thus provides the minimum means of communication for the government.

3. For the Future

3.1 Basic Policies for Improvement of Disaster Information Systems

So far, each of the disaster information systems of governmental bodies that are involved in disaster prevention tended to be built independently by the respective body. As a result, communication of information within one body has greatly improved in accuracy and speed, but some issues remain, such as insufficient sharing of information across multiple

organizations. Recent IT developments brought disaster information systems to a higher level, creating the need for formulating basic policies common to all relevant governmental bodies, so that they can work closely together to build a disaster prevention information systems and to share such information. The "Central Disaster Prevention Council" of the national government has established a "Specialist Investigation Committee on Sharing of Information for Disaster Prevention," and has had discussions on how disaster-related information should be shared in national and municipal government bodies, among residents, among/in private sector businesses, and NPO, and how scientific disaster prevention information should be provided. Based on these discussions, "Basic Policies for Improvement of Disaster Information Systems" were formulated, and were adopted by the Central Disaster Prevention Council as the national government's basic policies.

Basic policies consist of the following five discrete policies:
(1) Assuring information coverage - in both time and area,
(2) Establishing mechanisms for better use of information,
(3) Sharing and utilizing information during usual times to assist in emergency measures,
(4) Building the e-government for disaster management,
and
(5) Establishing an organization responsible for promoting implementation of disaster information systems.

It was also determined that the organization responsible for promoting implementing disaster information systems should formulate action plans and promote system implementation with a three-year target time frame, and that a conference for promoting sharing of disaster-related information should be established to help in any follow-up as required and overall coordination for the progress status.

The specifics of the measures proposed under the basic policies shall be described in the following section.

3.2 Specifics Measures - Overview

3.2.1 Combine actual damages and estimated information to facilitate identification of the total damages incurred (Fig.5)

Cabinet Office, as described earlier, uses EES to estimate the damages in order to eliminate any information void, both in time and area coverage, immediately after the disaster hits. At the same time, artificial satellites and aircrafts will be utilized to identify the distribution of actual damages across the geographical area. In addition, "lifeline" entities including some of the utility and gas companies will be connected with DIS, so that facility control information, such as power outage and gas supply stoppage, can be collected on-line. Gathering different types of information from varied sources provides the

relevant authorities with mutually complementary information, and helps to assure full time and area coverage of information. Sending such comprehensive information to all parties involved, including Prime Minister's Public Residence, national government's disaster prevention related agencies & ministries, municipal governmental bodies including prefectures, as well as lifeline utility providers and residents, not to mention the on-site emergency support center and medical institutions, will contribute to more effective emergency activities. Next step will be to gather information from extended sources, such as regional residents and taxi or truck drivers; this is expected to provide more detailed information and help to fill any part missing from fully understanding the extent of the disaster.

3.2.2 Emergency communication through shared use of communication networks

Each of the governmental institutions involved in disaster prevention has its own information communication network suited to its own needs. Each of those systems has its own purpose for existence and intended use, and its use for other purposes is in principle not allowed. It is permitted however to use such networks among governmental bodies for non-designated purposes in case of emergencies, such as a network failure due to damage by disaster; yet the specific procedures for use and the detailed rules have not been determined. Also, while it is desirable that communication of disaster or disaster prevention-related information is maintained continually during usual times, instead of limited to the time of actual emergencies, there may be some institutional restrictions on shared use of information networks during usual times. Building specific and practical mechanisms toward shared use during emergencies, and a study on mechanisms allowing shared use in times other than emergencies, are required.

3.2.3 Integrating disaster-related information through the use of GIS (Geographical Information System) (Fig.6)

Disaster information systems established by various institutions vary in the information contained and format used. If the systems are connected among various institutions as they are currently, there may be some practical problems; different institutions may need to install separate terminals, or they may be unable to compare similar data from different sources due to format differences. Disaster-related information held in different systems need to be standardized in their contents and format to facilitate better use. In particular, GIS (Geographical Information System) is an effective tool for information sharing, and its use needs to be promoted. For example, in case of a disaster, different types of information, including traffic information such as congestion and roadblocks, disaster prevention information such as rescue and support activities, and geographical information on heliports, villages, and hospitals, can be combined and overlaid on GIS. This will help to identify the extent of damages to houses, and will form the

basis for making different types of decisions required, such as selecting the route for transporting emergency patients.

3.2.4 Establishing a common platform for disaster prevention information

The flow of information in case of emergencies is, in principle, as follows: information collected by the local branch offices of national governmental organizations is sent to their respective upper-level organization, and ultimately it reaches the Prime Minister's Public Residence and Cabinet Secretariat, where it is compiled together. As the information flows only within each relevant organization, information required by each institution is communicated very promptly and accurately. However, cross-functional collaboration is insufficient, and prefecture government bodies are said to be required to send out collected information to over 200 locations in over 100 different formats. Building a common platform for sharing disaster-related information will, without losing the advantages of the current information flow, help to assure cross-organizational sharing of information, and will also reduce the workload for the regional governmental bodies to prepare reports.

3.3 Issues for the future

Since the Great Hanshin/Awaji Earthquake, which caused an unprecedented degree of damages, disaster prevention information systems by administrative bodies have gone through major progress. However, it cannot be denied that, precisely because its progress was quick, such systems were built without sufficient sense of collaboration among governmental bodies. For the future, based on a comprehensive blueprint for all relevant authorities, coordinated efforts need to be made to bring a common system into reality. So far, the basic policies, i. e., the comprehensive blueprint, have been formulated; yet the government has yet to formulate action plans prescribing the roles and schedule for each of the relevant authorities, and proceed to the next stage of actual system implementation, with coordination efforts made as needed.

Furthermore, in order to build a community of collaboration for disaster prevention, with well-balanced combination among self-support, mutual support, and public support, the administration needs to support self-support and mutual support through provision of crucial information. Yet, there has not been enough study made on how information should be communicated between governmental bodies and other parties such as residents. For the future, with Central Disaster Prevention Council's "Specialist Investigation Committee on Sharing of Disaster Prevention Information" taking the initiative, there needs to be more progress seen on formulation of basic policies of the government, formulation of specific actions plans and their implementation.

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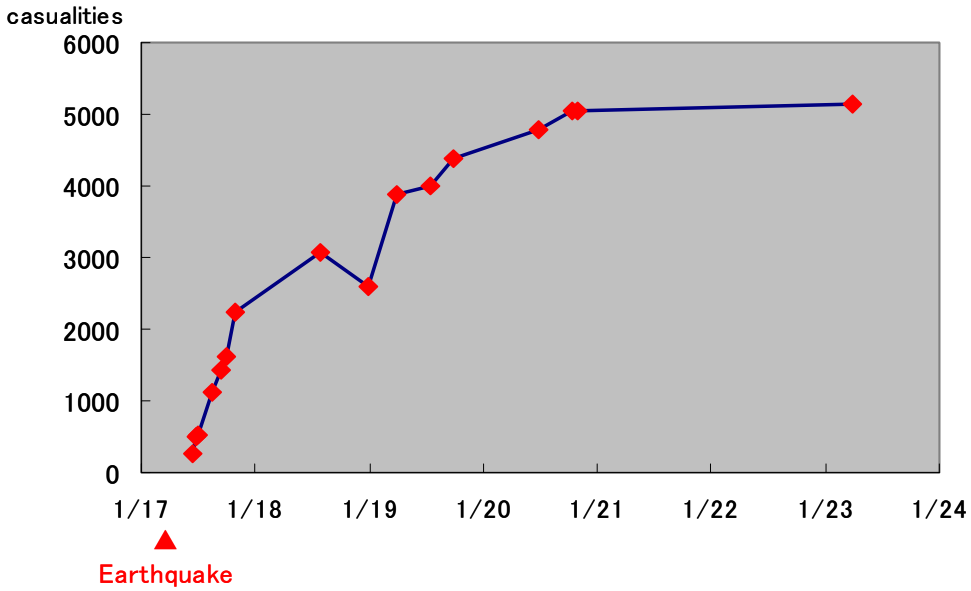

Fig.1 Time transition for Determining dead/missing in the Great Hanshin/Awaji Earthquake

阪神・淡路大震災における死者／行方不明者把握状況の推移

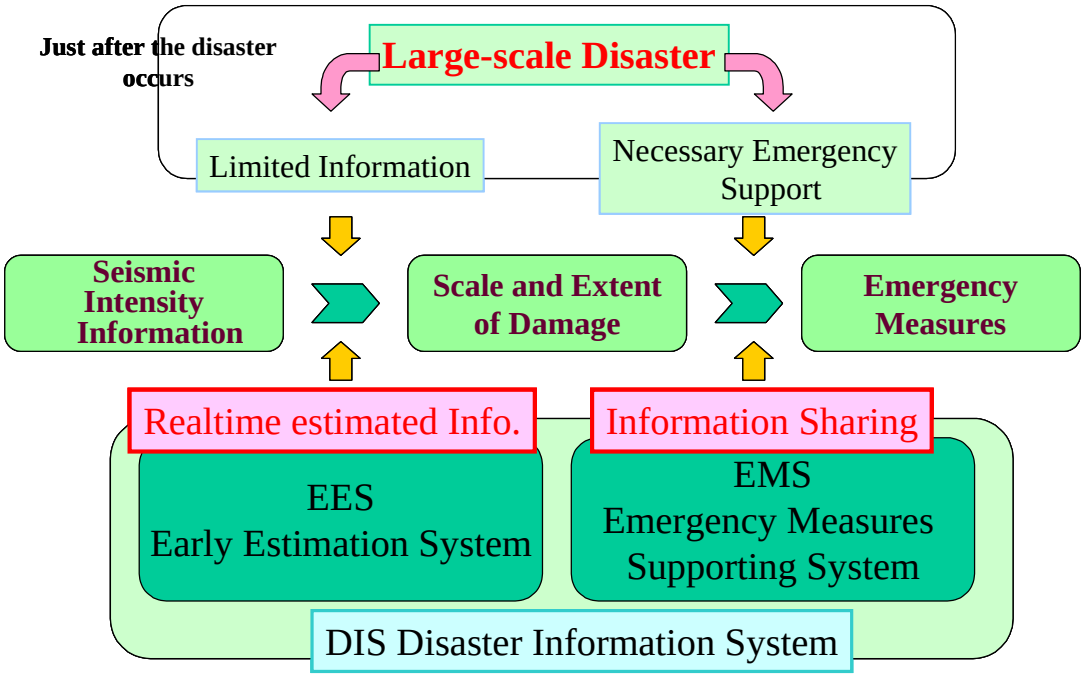

Fig.2 The Aim of the DIS

地震被害早期評価システムの狙い

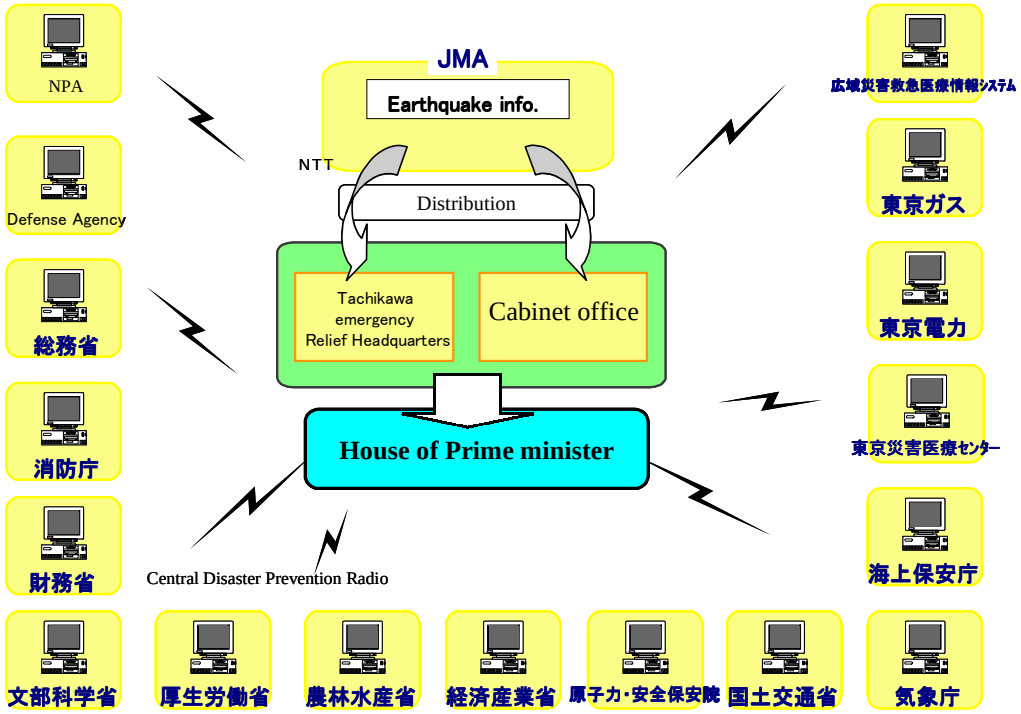

Fig.3 Overview of Central Disaster Prevention Radio Network

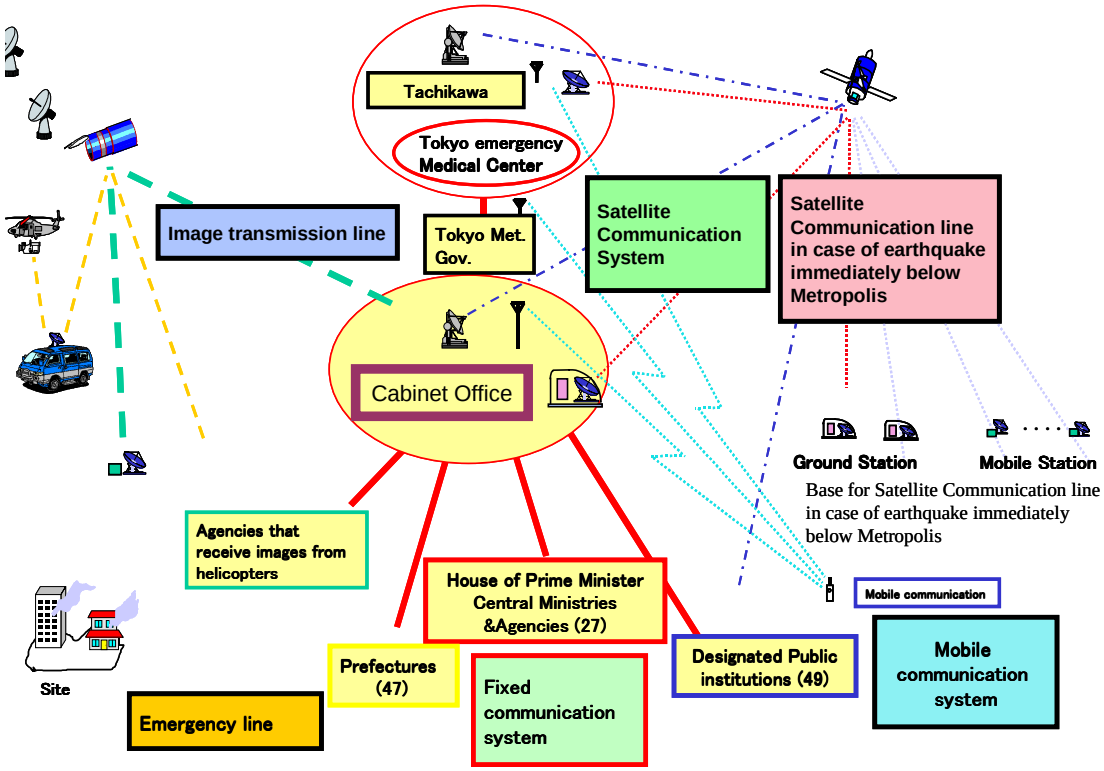

Fig.5 Network of Governmental Bodies
involved in Disaster Prevention & Relief

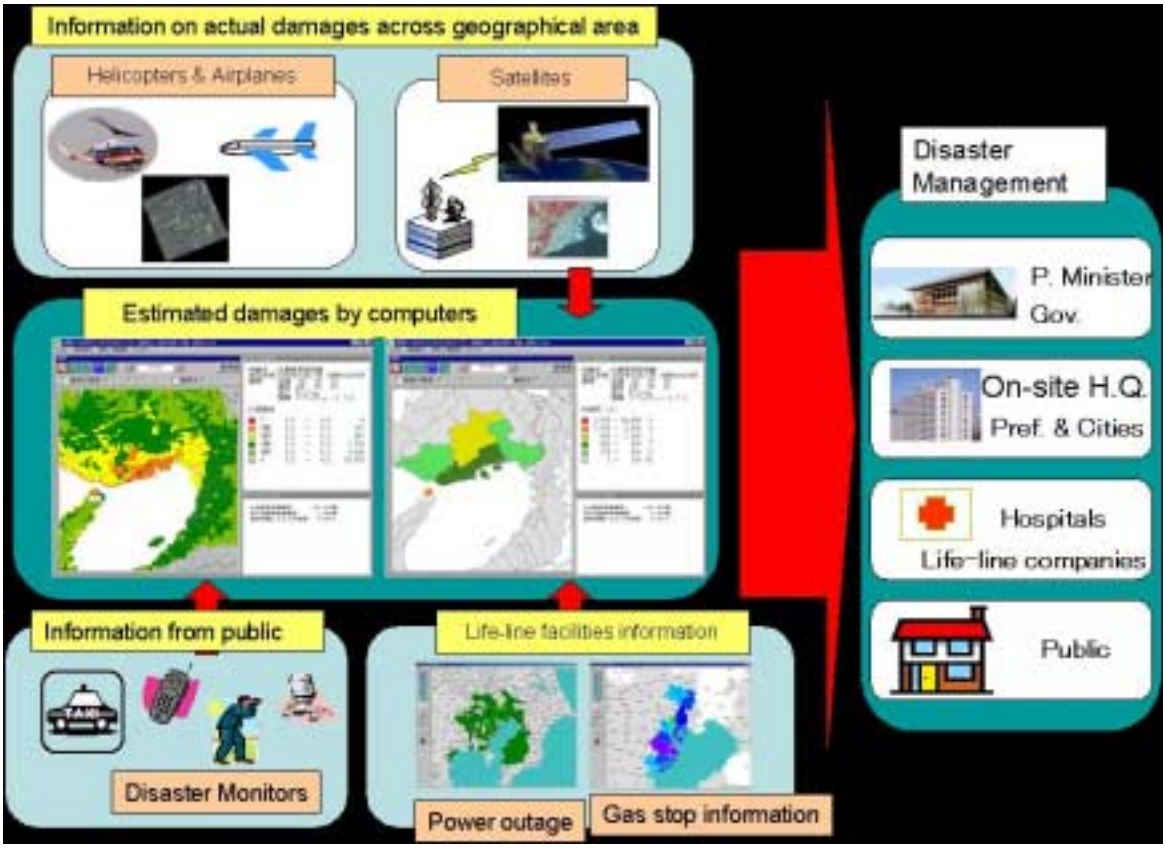

Fig.5 Combine actual damages and estimated information to facilitate identification of the total damages incurred

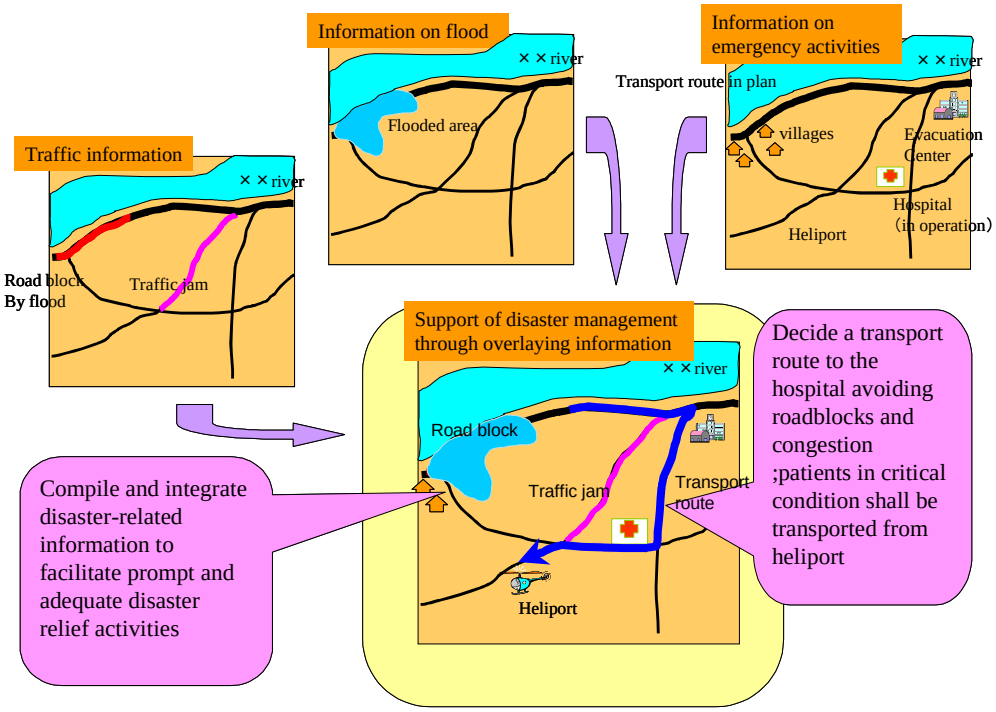

Fig.6 Integrating disaster-related information through the use of GIS