STUDY OF EMERGENCY COMMUNICATION SYSTEM

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Abstract: After the Ji-Ji earthquake, almost all communications were paralyzed. Therefore, the damage reports could not be collected quickly, and the rescue effort could not be initiated responsively. This clearly demonstrated the urgent needs to establish a disaster communication system that serves as the nerve center of disaster mitigation. It requires the design and incorporation of special equipment, redundant system, and high-tech tools such as wire, wireless, and satellite communications. This paper addresses the design principles and requirements for such emergency systems, and the f The ocus is set at the county or city level.

Keywords: Ji-Ji earthquake, emergency communication system, disaster mitigation

1. INTRODUCTION

Even though the modern science and technology are progressing at an unparalleled pace, we are still unable to prevent the natural disasters from happening. Once a nature disaster occurs, it seriously threatens our lives and properties. However, no one single organization or agency could handle these disasters. To organize the command, coordination, rescue control, restoration, and rebuilding arrangements, county (or city) governments have established the "Disaster Response Centers" [1] to improve the disaster control, integrate rescue resources, and prevent the disasters from expanding. The objective of this center is to ensure that the lives and properties of the general public are protected.

The 921 Ji-Ji earthquake disrupted and paralyzed phone systems and radio communications for those counties (or cities) that are close to the epicenter. It caused blind points at the initial stage of the rescue effort, and disabled the communication systems. Since the communication and information technology advances with each passing day, we should equip the disaster response centers with the most up-to-date technology to achieve the goal of disaster prevention and communication.

2. THE CURRENT STATE OF THE DISASTER PREVENTION COMMUNICATION IN TAIWAN

Since the announcement of the "Disaster Rescue Plan" by the Executive Yuan [2], a complete disaster prevention system from the central to the local governments has taken root. In this plan, the disaster response centers at all levels are mostly managed by the fire departments and currently being designed and implemented.

In Taiwan, the disaster prevention system is divided into three levels—the central government level, the county (or city) level, and the village (city, or town) level. The communication system is mainly a wire communication system that includes telephones, faxes, and the Internet. Wireless communication such as two-way radios, beepers, cellular phones, and satellite phones are also available to a limited extent.

After the 921 Ji-Ji earthquake, the application of satellite communications on disaster rescues has been taken into account by the government agencies. Due to its real-time nature and mobility, satellite communication is an effective means of communication after the occurrences of disasters. The disaster communication system at the county (city) level is summarized as follows.

1. Wire communications: Including the PSTN, the special-purpose lines, the ISDN, and the police telecommunication network.
   (1) PSTN: Phones are connected directly with each other. All of the disaster rescue organizations are equipped with PSTN.
   (2) Special-purpose lines: The phone lines that are connected to a specific office at all times. Just pick up the phone and it will establish a connection with the desired office. It is especially suitable for urgent communications.
   (3) ISDN: ISDN is capable of transmitting images, data and facsimiles.
   (4) Police telecommunication network: This network is extended all over the police departments, fire departments, and county (city) governments for the use of regular communication.
2. Wireless communications: Including two-way radios, beepers, cellular phones, and satellite phones.
   (1) Two-way radios: The quality of communication is easily interfered by high-raised buildings in the cities or mountains in the remote mountainous areas.
   (2) Beepers: The beepers are able to display characters. Therefore, it can reduce the amount of time needed for communication during an emergency.
   (3) Cellular phones: There are single and dual-frequency cellular phones. The signals are transmitted to another cellular phone or an ordinary telephone system through cellular towers.
   (4) Satellite phones: The current available satellite communication in Taiwan is the INMARSAT. Only the ministry of national defense, the ministry of foreign affairs, the police administration, and the fire administration are equipped with satellite phones. Normally the satellite phones are used as a backup communication system.

3. EMERGENCY COMMUNICATION IN THE JI-JI EARTHQUAKE

After the Ji-Ji Earthquake, the communication with the disaster area was almost entirely paralyzed. The conditions of collapsed buildings, the number of

casualties, and the emergency supplies needed in the disaster area were not understood by the outside world. It directly affected the assessment of the extent of the disaster and the coordination of the rescue actions. The Ji-Ji earthquake clearly demonstrated that the government lacks the capability of emergency response. At the initial stages of the earthquake, the conditions of the disaster area were not known quickly and sufficiently. This influenced the communication, coordination, and command of the rescue teams.

From this disaster, it is observed that in the most seriously damaged areas such as the town of Pu-Li and the town of Dong-See, communication facilities were damaged due to broken and obstructed bridges and roads. The effect of the disaster could not be known until later. As a result, the best opportunity to rescue survivors was lost. It proved that the emergency rescue system was not in place. The emergency communication system is the nerve center of the in-disaster response actions. Without the emergency communication, it is impossible to understand the latest conditions of a disaster, to forward the information, and to coordinate the rescue efforts, let alone the successful rescues and the post-disaster reconstruction.

4. EMERGENCY RESPONSE SYSTEM OF COUNTY OR CITY GOVERNMENTS

Timing is everything for the rescue efforts after a disaster. It relies on the emergency communication system for early warning, disaster preparedness, disaster mitigation, resources mobilization, in-disaster response, information feedback, system coordination, and disaster assessment. All information of the disaster area should be obtained swiftly to learn the conditions of a disaster. Wire, wireless and satellite telecommunication systems should be established to handle vital disaster information in an emergency. Disaster response centers at all levels should be set up to form an integrated rescue system. Using the latest communication and information technologies, a prompt and reliable communication network can be set up to facilitate the communication and coordination of different agencies. An integrated rescue system should possess the following functions:

4.1 The function as an integrated communication network

Using integrated communication interface to build an integrated communication network that includes satellites, wire and wireless communications. It should be connected to the disaster response centers, the rescue command centers of fire departments, and the local command posts to transmit text, voice, and video accurately and instantly.

4.2 The function to transmit disaster conditions

Understand the latest disaster conditions by using microwave transmissions, video cameras at selected controlling points, or camera-equipped helicopters. Also, integrate the domestically developed disaster simulation systems to provide additional information to the rescue plan at the initial stages of the rescue actions.

4.3 The function to form a unified strategic command center

A unified strategic command center is also an information center. It collects all information of a disaster, unifies controls, and provides necessary information to the decision-maker using the most accurate data. The decision-maker can then assess the condition, make strategic decisions, and command rescue arrangements.

4.4 The function as a complete database

A successful strategic decision relies on accurate and reliable information. Integrating the databases of geographical information, emergency resources, and disaster data could help to make better decisions and

rapid rescue actions. Since the geographic information system displays information in the form of a map, it helps the decision-maker to easily visualize the essential information. The framework of the integrated disaster rescue system is illustrated in Fig. 1.

4.5 The function to ensure the operation of the system

To prevent the integrated rescue system from being paralyzed after a disaster, uninterrupted power systems, emergency power supplies, shake-proof facilities, and a backup system should be considered.

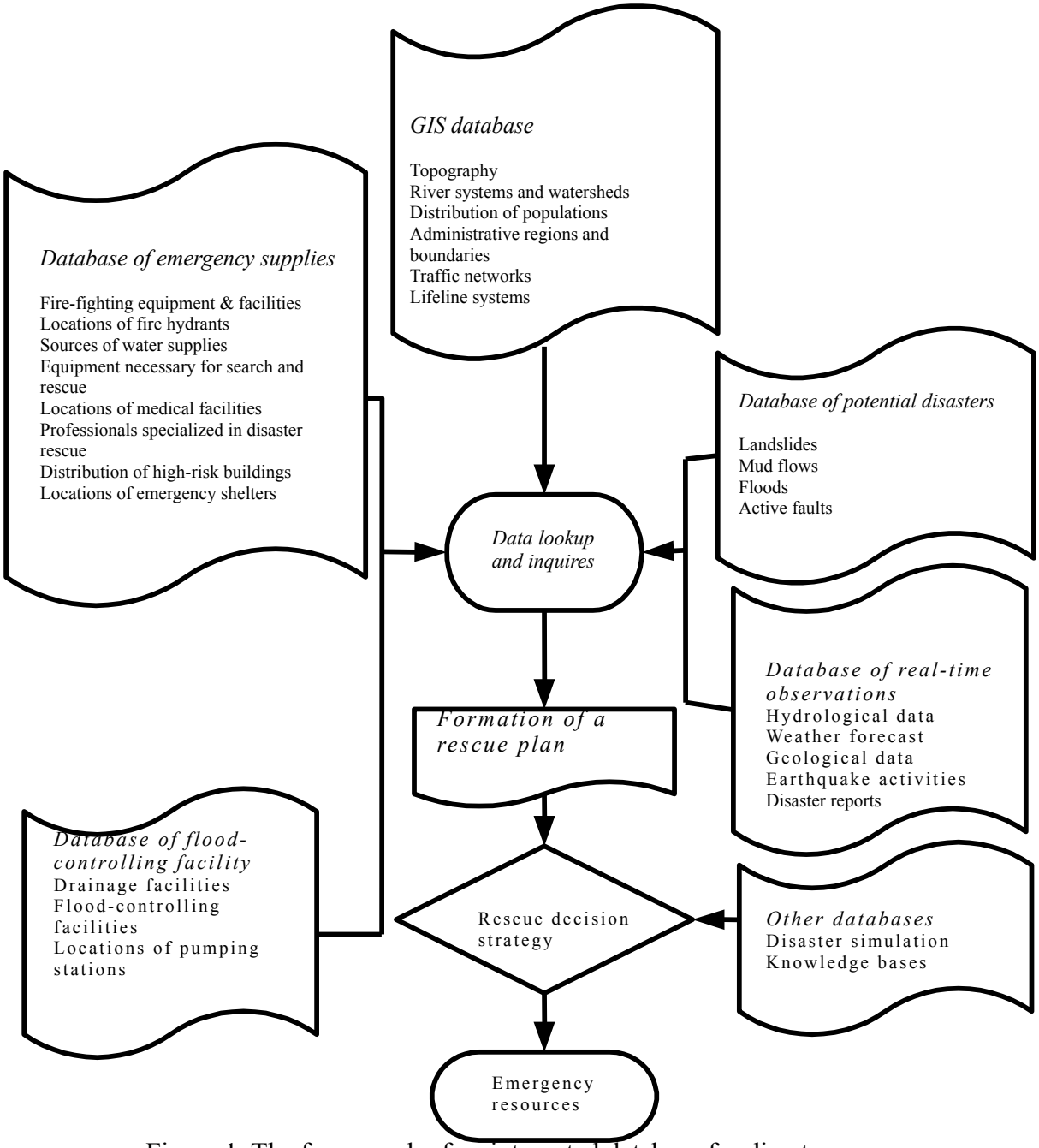

Figure 1. The framework of an integrated database for disaster response and rescues

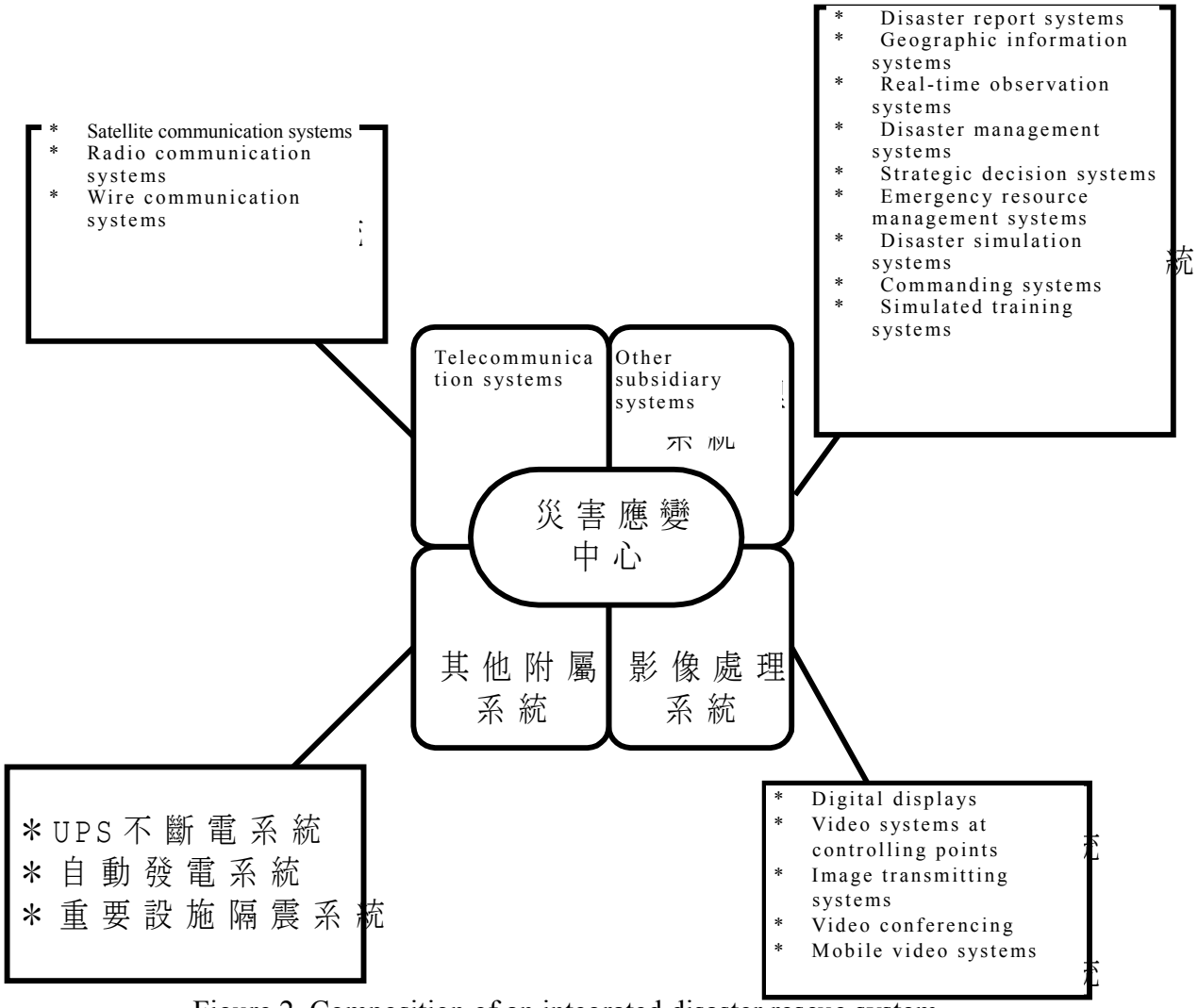

Figure 2. Composition of an integrated disaster rescue system

On account of the required functions described above, the composition of an integrated disaster rescue system can be illustrated as Fig. 2, which can be divided into the communication system, the information process system, the image management system and other accessory systems. Among these systems, the communication system includes satellites, wire communication systems, and wireless communication systems. The information processing system contains the disaster data processing, the real-time data processing, the strategic decision management, the emergency resource management, the disaster simulation & forecast, the incident command, and the disaster declaration subsystems. Image system includes a large digital display, video cameras at controlling points, the image transmitting equipment, and the videoconference systems. Other accessory

equipment includes uninterrupted power supply systems, emergency power supplies, shock absorption facilities and rescuing equipment.

Disaster response centers at all levels should set up integrated disaster management system as shown in Fig. 3. The expected benefits are:

1. Better emergency response with the modernized disaster response centers.
2. Enhanced decision-making capability with integrated high-tech information and communication products.
3. Reduces damages and secondary disasters with a better overall planning of emergency resources.
4. Accelerated rescue efforts and faster post-disaster reconstruction.

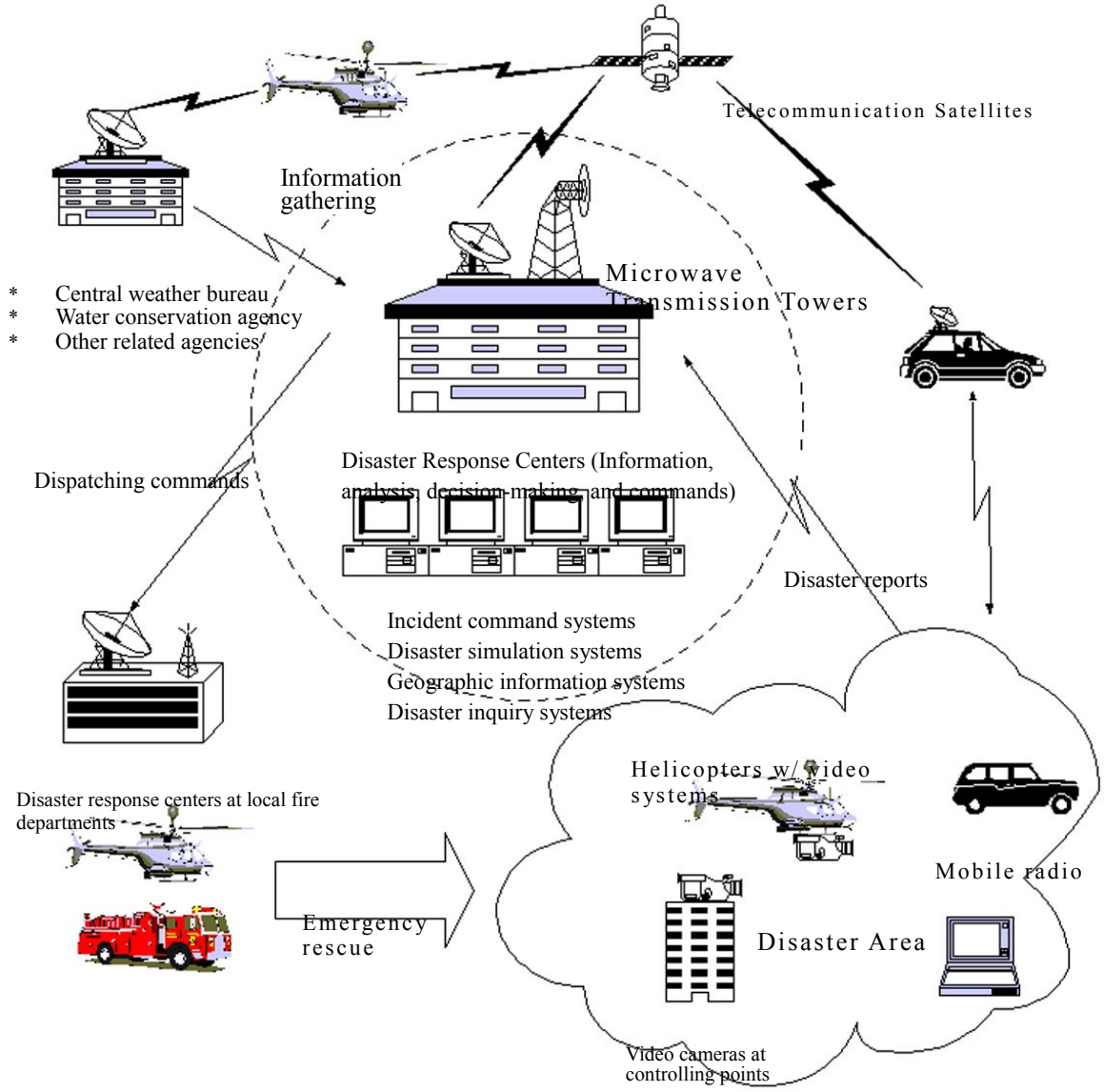

Figure 3. Framework of the integrated disaster management system

5. CONCLUSION

Internet in the 21st century will break the space and time barriers that have governed human for a long time. The combination of computers and Internet will help us to communicate with each other instantly. Portable wireless communication equipment not only possesses the function of a telephone, but also doubles as a terminal to the Internet. To manage large disasters or activities, disaster response centers at all levels should set up rapid and efficient broadband communication networks as soon as possible to modernize the emergency rescue systems.

In consideration of the communication difficulties after the Ji-Ji Earthquake in the disaster areas of central Taiwan, administrations at different levels in Taiwan are strengthening the satellite communication networks for emergency communications. As a result, voice, image, and text can be transmitted by broadband communication through satellites within 30 seconds once a major disaster strikes. In conclusion, it is extremely important for the emergency response and rescues command centers to set up integrated disaster warning systems to manage the disaster related information, and to unify the command structure during the disaster. The education of early warnings, the training of rescue professionals, and the establishment of regional cooperation are all indispensable for a modern and effective disaster response center.

REFERENCES

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