

## Earthquake Rescue Site Emergency Communication Research

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**Keywords:** Manet technology and Hoc Ad technology; short\microwave; wireless local area network; satellite communication; multi communication mode combination

**Abstract.** In recent years the previous global earthquake, the earthquake relief and gold 72 hours in the first place, but the communication and network environment in the earthquake stricken area is very complex, the conventional network access mode at the time of the disaster is very difficult to guarantee the site and command decision-making departments of real time data transmission and communication. According to a serious destructive earthquake occurred in recent years, especially in Wenchuan, Yushu earthquake rescue and post disaster damage, according to the specific situation of earthquake field communication, as well as the earthquake rescue scene network communication needs, to ensure the communication system of earthquake field can smooth, ensure the communication between the front and rear decision Department of non clogging problems, research on earthquake emergency communication system, and put forward their own views and opinions.

### Introduction

Over the years the countless times of earthquake again prove to us, whether it's the scene of the earthquake relief department or the rear command department can get real data in seismic field is in the first time and how important it is. Today the development of computer and communication technology, created a possible for us to achieve this goal. The purpose of this article is the study of earthquake field of communication system, in order to solve some practical problems encountered in the earthquake field emergency communication.

After the big earthquake usually cause common communication facilities damage caused serious damage, even cause the disaster area can't contact to the outside world cannot for disaster rescue operation, makes relief work very passive. So need to quickly and effectively for use at a disaster site to form a covering area of the temporary emergency safeguard network information upload to complete real-time disaster, for disaster relief, and leadership decision-making, coordination command, such as to provide powerful guarantee, minimize the loss caused by disasters, maintain the stability of the production and living order. Earthquake field emergency communication platform, in addition to the need to meet the time urgency, positional uncertainty, task and urgent message complexity rigid requirements, should also be easy to deploy and expand, possesses the characteristics of stability and expansibility, and economy and can provide efficient and stable information transmission services [1].

### Demand and Status of Earthquake Emergency Communication System

A destructive earthquake disaster relief work, in fact is mobilize social forces to deal with catastrophic disasters to be completed, if want to mobilize as much as possible in the effective time of manpower and material resources, into the earthquake relief and effective, timely and effectively convey the rear command communication system becomes rapidly the key, in order to carry out disaster relief work. In destructive earthquakes occur, regular communications platform by varying degrees of damage, even completely paralyzed. Communication to ensure the stability of the ground and the rear decision-making departments to establish communication links, build a suitable for all kinds of disaster rescue site environment, efficient and stable communication platform is to make the important guarantee of post-disaster relief can smoothly. Due to disaster relief, the overall environment of the on site is poor, therefore, the scene of the disaster communications must be of

high reliability, certain mobility, independence and extend ability of the emergency communications platform, can under the condition of not based on a general communication platform, the scene of the disaster relief communication security task independently, to adapt to the rear headquarters at all levels of earthquake rescue work request [9]. After the earthquake, the communications can cause considerable influence in the affected areas: (1) the seismic electric and magnetic field affected the land; (2) the earthquake caused communication platform hardware damage; (3) the earthquake disaster area of communications networks and facilities, is bound to make a big load interruption of communication will appear.

**The Research Status at Home and Abroad.** In recent years, along with all kinds of frequent natural disasters, the research of emergency communication technology at home and abroad have a certain progress, for the application of emergency communication technology and related industry standards have also made a lot of achievements and great progress.

Many countries with developed science and technology, and a large earthquake earthquake-prone country on disaster relief communication technology research and development and promotion has obtained certain achievement. Through the study found that in recent years, natural disasters and public events, emergency communications platform need to be done or proprietary network and public network integration, equipment, especially the communication between the search and rescue units at all levels need to each other. With technical personnel proposed using new technology to establish the organizational communication platform, the platform can be freedom network, can use its versatility and robustness in a short time to solve the disaster scene communication demand [4]. Based on Manet research in recent years, the use of special network composed of multiple hops technology platform for research has made many achievements. Using special network communication facilities undisturbed platform can carry out wireless extensions; Through the vehicle of Manet technology to achieve the communication platform in communication between the teams, through the sensor network can monitor the disaster scene data, these techniques can ensure quick restore network communication ability at the scene of the disaster.

**The Research Status at Home and Abroad.** Because of the difference of the economic development level and the different systems of our country, there is still a certain gap in the research of post-disaster rescue communication technology compared with the developed countries in the field of communication technology research in disaster relief. In recent years, due to frequent domestic destructive disasters and China's economic strength continues to increase, the Chinese government after the earthquake disaster relief and emergency communications support the construction of a clear instructions and guidance. In view of the specific situation in China, many scientists in this field began to study the actual needs of China's emergency communications technology and management system [5]. In order to solve the communication problems of emergency communication platform, an integrated communication system based on Internet protocol is presented. The system is a good solution to solve the mutual communication problem. It proposes how to build the post-disaster emergency rescue communication platform. Researchers have proposed a satellite communication, Ad Hoc and Mesh technology can be integrated with each other interconnection communications solutions, the solution to the completion of the earthquake rescue site emergency communication task is that the platform can bear the disaster site and the rear end user (Fixed) between the terminals can communicate with each other, for such as early warning monitoring technology, network capacity assessment of disaster recovery technology, emergency communications and other aspects of the study are related.

### Earthquake Field Emergency Communications

Conventional means of emergency communication has a lot of, digital clustering communication, satellite communication, micro wave (short) communication, etc. Each country has its own special emergency communication guarantee system, these is only open to the society in the event of an emergency. To protect communications, allowing civilian communications network in the event of an emergency conversion for emergency communication network, from the application point of

view, the current emergency communication satellite communication, mobile station, digital clustering communication, self-organizing networks, tell from the way, we can be divided into both wired and wireless emergency communications.

**Satellite Communication System.** According to the division of communication, satellite communication can be divided into fixed mobile satellite communications, satellite communications, radio and satellite communications. The adoption of more mobile and fixed on emergency communications satellite communication more. Fixed satellite communications relying on fixed earth stations, aircraft, vehicles, ships, etc by mobile satellite communication, this can lead to communication between mobile terminal and communication between fixed earth stations and guaranteed. The earth synchronous orbit satellite can reach 18000 km theory of the maximum communication distance, maintenance cost is relatively small, basic is not affected by geographical environment conditions. The distance between the earth station and geographical environment can cause larger on the ground of the ordinary communication mode interference. As long as the satellite communications in the area of the satellite coverage can be achieved more direction, multiple address of connectivity, because it was based on the radio works, but the ground communication mode basically adopts the trunk or point-to-point communication, so the relative has the characteristics of high efficiency and flexible satellite communications. Satellite communication has the very good network compatibility, and large capacity of data, can provide more types of business. The earth synchronous orbit satellite can reach nearly one thousand MHZ available frequencies, including Ku band and C band [6]. Improve the communication ability of the satellite can also be combined with the current relatively popular in the Internet protocol technology, speech video compression technology. For disaster relief in the case of an emergency communications, satellite communications can play to the characteristics of flexible, very small terminal (VSAT) equipment can be installed in the car, transportation equipment, as a result of this characteristic can even man-portable [8].

**Digital Trunking Communication System.** As a kind of can perform many tasks, high efficiency wireless communication platform, digital trunking communication system of the communication link is common to all the clients. With the development of science and technology, the cost of all kinds of communication technology have been reduced to conform to the public individual acceptance of mobile communication. The main characteristic of cluster communication is common frequency, common facilities, share the coverage area, sharing communication service. This technology has been applied in various aspects of social life, such as the logistics industry, leasing industry, property management, etc., and even important to national economy and people's livelihood industry and government departments - the rail system, public security, armed police, army, civil aviation, fire departments and so on have been widely used cluster communication [8]. Because the cluster communication is quite powerful features: can be dynamic network and the emergency call, can switch interconnection and the cable, with functions of data transmission, fax and voice business, can quickly access and out of the channel, with functions of automatic monitoring and alarm, etc., so it has become an important part of emergency communication. Only a minority of users in individual cases with double work way, often work with simplex method, the technology above given this technology has the characteristics and advantages, so it is also a kind of command, scheduling system.

**Short-Wave Communication.** In the earthquake, all kinds of complicated conditions can occur, such as communication operator stations damaged, satellite link is unusual, cluster set up is not perfect, but can rely on the shortwave communication from the network hub and the characteristics of the relay restriction can play an important role. Compared with satellite communication and cluster communication, short-wave radio is still a more reliable means of communication and will not be abandoned. Short-wave communication has the following characteristics: 1. The short-wave communication is free to use compared with satellite communication has advantages in operating costs. 2. Its ability to resist against the strong, can cover area of ultra short wave can't cover, able to cope with all kinds of complex terrain [8]. 3. While short-wave communication quality and the reliability of the radio signal has some deficiencies, but at the same time its rely on equipment

simple and simple point-to-point communication platform for the construction of disaster emergency communications is a good choice.

**Microwave Communication System.** By microwave can provide a variety of business types, such as voice, data, images, fax, etc., so often used in remote areas or emergency communication construction [10]. Microwave communication is the main way of the line-of-sight communications, microwave reflection ability makes it is not easy to be ionization atmosphere reflect, and because it is a kind of linear transmission of wireless communication, so its transmission frequency is in commonly 300 MHZ to 300 GHZ. If within fifty miles per set microwave relay, can achieve long-distance transmission, microwave relay in the form of a flexible, can for the corresponding emergency communications base station or car.

**On-board Emergency Communication System.** All communication equipment placed in a car, use the equipment of communication system, establishing emergency communications network. Equipment vehicles during the disaster to the communication interrupt or network instability caused by all kinds of disasters at the scene of the rescue, will live access to all kinds of acoustic, visual, graphic information such as network communication with other format or frequency, at the same time, the platform also can be used to real-time will all kinds of information back to the rear command center or from its access to relevant information, such a system is called on-board emergency communication system, establishing emergency communications network. Through this kind of the construction of the emergency communication system, can very good security rear headquarters and the site of real-time communication, efficient and orderly command scheduling.

### **Build Earthquake Field Emergency Communication System**

Earthquake emergency communication system should be composed of earthquake field work system and regional field seismic work system, each system by the network system, communications network systems and rear command platform of communication system. At the scene of the disaster relief work according to the deployment platform can be used in a portable (small) deployment system or car motor system, when after the earthquake, especially after destructive earthquake field emergency rescue department system must be allocated to rescue the scene and immediately create relief headquarters at the scene to coordinate the rescue site work, complete the scene of the rescue relief command and deploy [6], to be able to support the disaster scene and rear command platform or a higher command center of communication functions such as voice, video, data and image.

**Earthquake Rescue Site Information Flow Analysis.** First analysis of the flow of speech information, at the scene of the accident, the disaster relief headquarters will be distributed to all the rescue department telephone and other communication equipment unit, as a headquarters and the rescue team to achieve communication tool, can be a one-to-many call or one on one call. The rescue team internal use their own configuration of wireless communication tools (including cluster phone, mobile phones, walkie-talkies), rescue squads and achieve one-to-many calls between the search and rescue team players, one on one call. The scene of the earthquake disaster relief disaster information transfer with a specific process as shown in figure 4-1, from behind the commands to the scene of the rescue command center, again by the command center is passed to the division of the command center, and then passed to the rescue team and the masses. Teams can relief headquarters at all levels to provide a public communication platform for communication. In some special areas such as mountains, remote areas, the complex terrain region, there is no public complex situation, should be equipped with satellite phones, short-wave communications, realizes the headquarters and the rescue team, rescue teams and players, one-to-many and one-to-one communication.

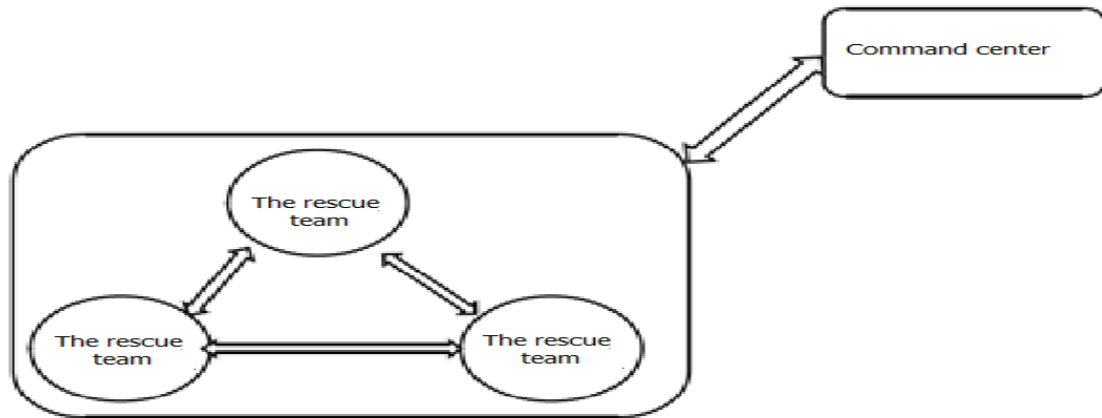


Figure 1 rescue team scene information network diagram

Because in many disaster scene, communication command vehicle is unable to enter, then only use individual portable devices, the site location, multi-angle image transfer back to headquarters. Headquarters often need to through the video information flow from many angles, understand the scene of the rescue situation, especially the earthquake caused the collapse, the feasible way for: individual by itself with a portable transmitter transmit cameras sampled audio information, image and dynamic video to a communications vehicle "vehicle receiving all-in-one", implement all kinds of information transmission, display, storage and query.



Figure 2 rescue scene video information transmission

In addition to the completion of all levels of the rescue brigade rescue orders, and the rear headquarters for communication and information sharing, and the attachment for video transmission via satellite channels to complete the rescue site outside the function of information release, rescue headquarters also take assemble all the communication resources and communication equipment, structures, construction at the scene of the rescue command communication network, the collecting and processing the task of rescue site information. Set up in the center of the field rescue teams at all levels of communication, is in charge of the connection of the rescue team's communication terminals, and internal and rescue teams at all levels for the rescue team instructions and effective transmission of information, and will be collected audio, images, video, etc. Collect information transmitted to the superior command tasks.

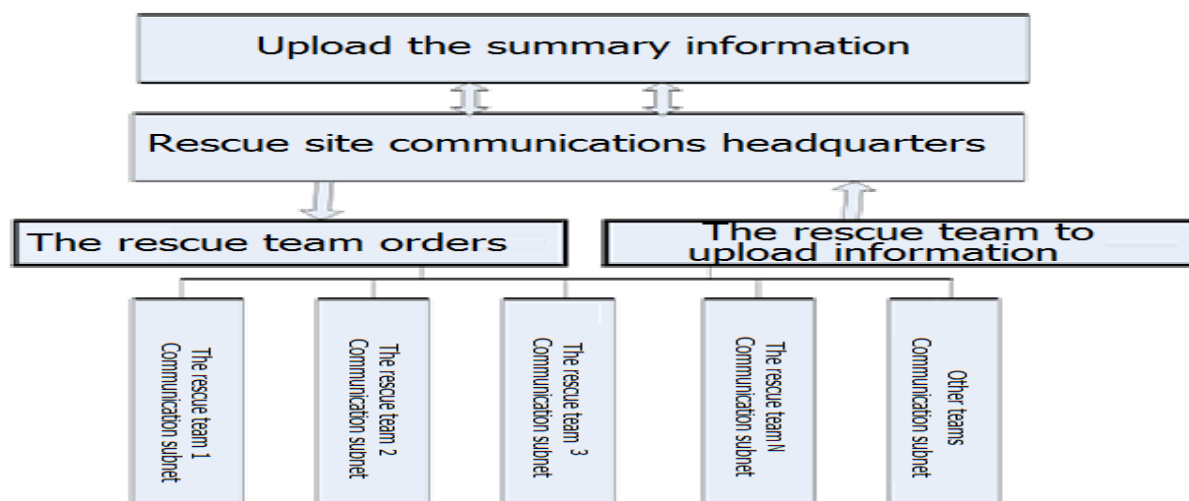


Figure 3 rescue scene information flow diagram

Portable rescue teams receive machine 1 communication subnet rescue team 2 communication subnet rescue team 3 communication subnet rescue team N upload summary information communication subnet, on-scene communications satellite video broadcasting quake rescue headquarters, to various rescue team orders, the rescue team summary information upload other rescue communication subnet.

**Earthquake rescue site emergency communication network architecture.** Emergency communication system consists of four parts, they are shown in Figure 4-5:

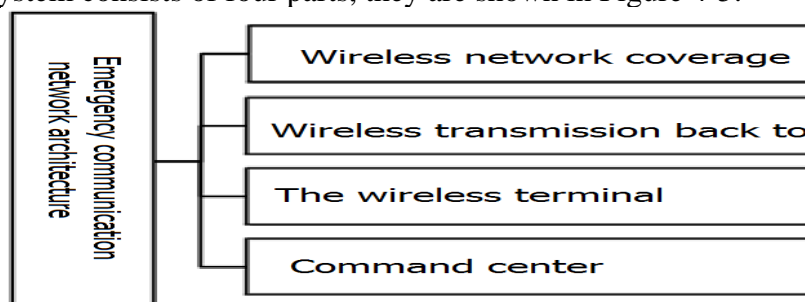


Fig. 4 wireless emergency communication architecture

**Wireless Network Coverage Part.** The wireless network exists in the command and rescue network, the rescue communication sub-network and the on-site rescue communication network. The wireless network coverage is usually applied to the flexible and fast network of the rescue site; and it covers the whole rescue communication system in the earthquake disaster rescue site. Due to the special nature of the earthquake disaster, the cable network is only a few exist in the rescue process. Only to the scene of the earthquake rescue complex communications equipment to achieve the scene of the entire rescue coverage, wireless network equipment can be achieved between the interconnection, to form the entire wireless mesh network.

**Wireless Backhaul Transmission Part.** As part of the wireless backhaul transmission compared to other means of transmission is more abundant, both through the on-site wireless mesh network to complete, but also with fiber optic facilities or satellite communications to complete the return transmission. And because the rescue scene communication sub-network and the rescue command center must be realized between the interconnection, complete voice, data, video communication, wireless backhaul can establish the data link between the scene and the rear command, real-time transmission on-site rescue Situation and disaster situation to the rear command to facilitate command and decision-making.

**The Wireless Terminal Part.** The wireless terminal at the rescue site includes all the facilities and equipment that can support the wireless function.

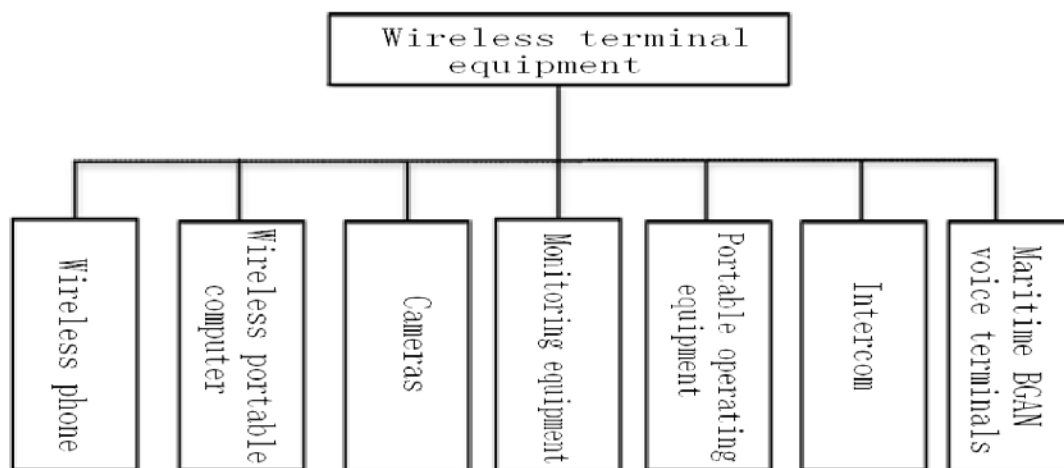


Figure 5 rescue scene wireless terminal equipment

Rescue members of the rescue scene through the wireless terminal equipment, and the above-mentioned series of terminal equipment on-site rescue communication network access. Through the wireless backhaul will be the scene of the disaster collection of information and collected images and video, sent to the rescue site command center or the rear command to complete the rescue communication sub-network and command and rescue center communications to facilitate the rescue command and decision-making deployment.

**Command Center.** The command center's mission is: to rescue the scene rescue unit return image, video information timely analysis and judgment, according to the actual situation of the earthquake scene and then the rescue team issued the correct instructions, command by the emergency communication system to the temporary rescue command center Or directly to the scene rescue team. Therefore, the command center is defined as: the scene of the temporary command and the rear disaster headquarters [3].

**Rescue On-Site Communication Network.** The rescue teams within the earthquake scene to establish communication transmission connection, the rescue team to complete the internal staff between text, voice, video and other information transmission, the maximum guarantee in extreme environments can also establish basic voice communications, constitute the emergency communication transmission Network. And also has the same superior (communication control center, the central and provincial (autonomous regions), city earthquake relief headquarters) to transmit voice or text or image or video information. Rescue site wireless network architecture Figure 6, on-site communication subnet communication network is a subnet of the rescue site, were set up at the scene of the rescue department or the rescue team to connect the various rescue teams and departments of the communication equipment terminal to complete the rescue And the internal units of the effective transmission of instructions and information. Rescue on-site wireless terminal equipment Mobile phone belt with wireless module Portable computer Camera equipment Surveillance equipment Portable man-portable equipment Intercom system Maritime BGAN language terminal.

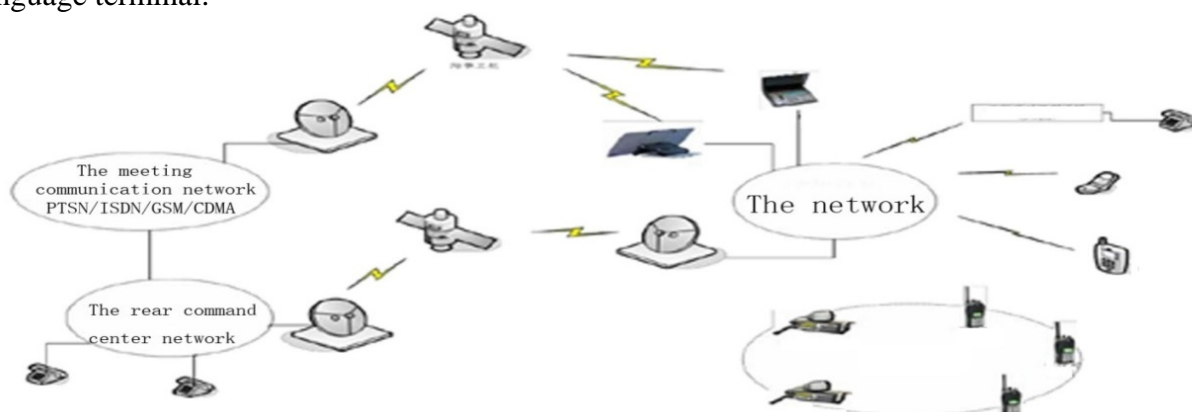


Fig. 6 wireless network architecture of rescue scene

Rescue units need to complete the on-site data, voice, video transmission, mainly using radio stations, mobile phones, satellite communications and other means to work together. Rescue site communication sub-network communication are generally in a small area, so the voice communication can use walkie-talkie, mobile phones, hand-held radio speakers, etc. [3]. Therefore, the rescue on-site communication sub-network can be defined as: different from the rescue site throughout the rescue network, it refers to the implementation of the rescue site of the various teams of the collection, including on-site rescue, medical, fire and other network collection.

**Rescue Command Field Communication Network.** The rescue site requires the rapid establishment of a communication network covering the whole area of the rescue area, linking the communication platform with the network communication equipment terminals of the disaster relief site communication subnets, linking the disaster relief site communication subnets, the disaster emergency rescue teams and the rear headquarters (Communication center, as well as the central or provincial (autonomous regions), the city of earthquake relief command. In addition, the terminal can communicate with each other in a timely manner to complete the communication between the sub-network terminal equipment, voice, text, image, video information transmission; Department) between the voice, text, images, video and other information transmission. So the rescue site command is responsible for organizing personnel rescue coordination, receive the task; also responsible for the organization and command rescue team rescue operations; also responsible for coordinating the rescue during the logistical support and command traffic, medical decision-making. When the rescue operation after the end of the original task to apply for the withdrawal of the headquarters of the organization, approved by the organization evacuated; organize the preparation of rescue operations summary report.

**Rescue On-Site Command and Communication Center.** The communication link is established at the rescue site through the communication command center, and then the voice communication subsystem, the inter-team image transmission subsystem and the network subsystem form the network, connect the rescue teams (communication subnet), and finally complete the instruction and information. Effective transmission, through the public communication network interface and public communication network connection. Such a system set up in the rescue site command center is called the rescue scene command and communication center, and it also has the communication network interface with the rear command center and the social departments to complete the various communication functions of the rescue site.

## Conclusion

It is a systematic project not only in the emergency communication platform where the original communication platform is damaged and cannot be resumed for a short time, but also requires the system to be developed rapidly, Fast connectivity, mobility, and can adapt to harsh environments. System characteristics for the communication area coverage area, real-time strong, burst information, if using a single communication is difficult to meet the needs [2]. Due to space limitations, this paper constructs the structural model of the disaster emergency rescue platform based on the current conventional communication technology-ultra short wave radio, wireless network, satellite communication equipment and wireless interphone. In future work, authors will continue to conduct research and practice in related fields, and will share research results with professionals in order to continuously improve and perfect the system.

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