

## Research on the Freeway Fast Response System Based on “3G” Technology

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### Abstract.

In order to solve the problem of responding slowly to freeway emergency, the construction of fast response system was studied based on the system analysis method, and then the system functions were designed. The key technologies in the fast response system were also analyzed which were termed as “3G”. The command & scheduling system digit platform for the freeway network of Jilin Province was developed and the fast response capability to freeway emergency was realized.

*Keywords: Highway transportation, Fast response, GIS, GPS, GPRS.*

### Introduction

With the rapid development of basic construction and the increase of Car ownership, the highway traffic safety issue of our country has attracted public concern. As our highway warning mechanism and rescue system are not perfect, it results in slow response to unexpected incidents and inappropriate resource deployment, and lead to severe casualties and property lost. The requirement for the traffic administration units to handle sudden accidents promptly with sound and scientific scheme, which leads to the urgent need to construct the highway quick response system.

The developed countries have gained Significant benefits depending on highway quick response system, the Allgemeine Deutsche Automobil Club (ADAC), The traffic accident management of America FIMS), Emergency Relief (ER), the

User's insurance system (UIS) of Brasil are just some examples. In China, the research and applications are on the early stage. Chen Rui<sup>[2]</sup> developed the Shanghai Highway emergency rescue and command sytem based on the monitoring system. Yang Xiaoguang put forwarded the Highway Emergency rescue system based on the Framework of ITS<sup>[3]</sup>. Li Jiang et al, on the bases of road traffic accidents, have carried out research on accident reappearance theoretical model and method<sup>[6]</sup>, the conflict theoretical model and method between accident and traffic in city road traffic<sup>[7]</sup>, and Passive Acoustic detection technology for Highway traffic flow characteristic parameters detection<sup>[8]</sup>. Yu Lian et al, have systemetically studied the rescue organization based on the harm Fundamental theory<sup>[4]</sup>. In this paper, on the bases of advanced information technology, the design and realization of Highway rapid response system have been studied guided by the system engineering.

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## **1 System analysis**

The rapid response for sudden accident is the principal issue for Highway command and dispatch center construction. The rapid response system comprehensively handles various telephone calls for help, including the alarm calls, calls for assistance, Roadside emergency telephone, and accomplishes receiving alarm; provide Auxiliary decision command means based on the shared incidence information and response resource information; and realize command and dispatch and rapid response for emergency rescue, with means of Seamless integrated speech transmission and communication system, central computer system, GPS Vehicle positioning system, Emergency telephone alarm system and GIS (geographic information system).

## **2 System Design**

### **2.1 System Architecture**

Rapid Response System handles emergencies with the flow chart: answering alarm→confirming→dispatching→receiving feedback→modified scheduling. After answering alarm, the event information and vehicle position information is input into the system; The command crew make the plan and dispatch the respective departments to respond quickly, adjust the plan in time according to the scene information feedback, and finally, release the real-time incident event handling progress and results.

Rapid Response System is composed of geographical information system (including the proscenium electronic map and backstage database), traffic condition monitoring, pre-arranged planning administration, command and dispatch, and rescue operation. The architecture is shown in Fig.1.

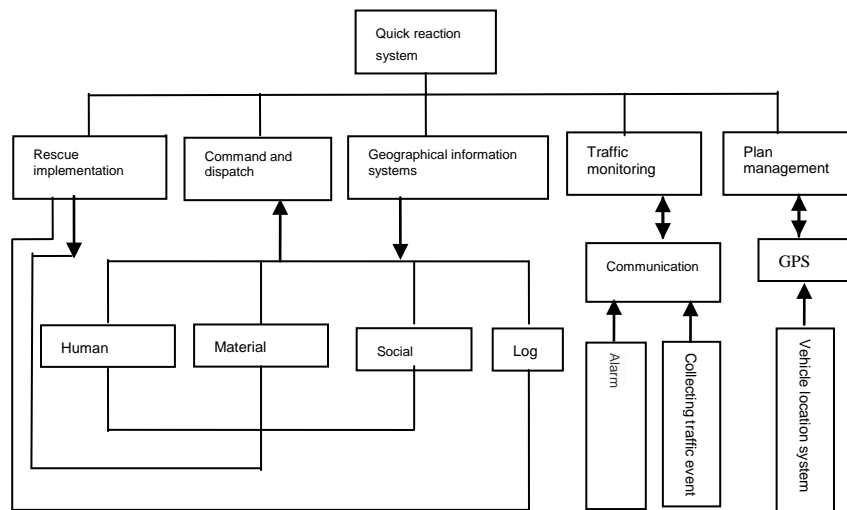


Fig. 1 Rapid response system architecture

Geographical information system is the system centre, it can provide visualized operation interface, and at the same time, combine and integrate the respective information, and construct unified data storage and administration system. The traffic condition monitoring is event alarming prompt or the event information inquiry. The pre-arranged planning administration provide the event handling procedures and other supplementary information, including the relevant units resource and power, contact information. The command and dispatch is the core business of the system, in which the command crew, according to the pre-arranged plan, the event and scene condition, the real-time condition of the emergency resources, make the event handling scheme and dispatch the rescue power rushed to the scene. The rescue operation is that the accident handling department, according to the central instruction, carry out the rescue work.

## 2.2 Functional design

(1) GIS basic function. GIS provides flexible map operation, Hierarchical display and control, space information inquiry and maintenance, realizing the zooming, translation, browsing to the high way; it can also display the road planar graph,

inquiry high way ancillary facilities attribute, and integrate the collected data and realize the coupled display handling for the command and dispatch.

(2) Command and dispatch function. Based on the real-time information of the emergency event, the command and dispatch organize the respective units quickly, make the emergency measures, save lives and property. This is the central function of the Rapid Response System.

(3) Pre-arranged plan supplementary and decision function. To establish emergency plan library for the emergency event, form the optimum emergency rescue plan quickly, automatically and in a scientific way, including the rescue power, equipments, route, accident scene and traffic control measure for the affected area; ensuring the activeness of the rapid response, and reduce the loss related to the emergency accident to the largest degree.

(4) Information collection and service function. The command and dispatch centre is, at the same time, the traffic administration information centre, in which the data produced in respective business system are extracted and transformed into the business information of rapid response. The service function reflects in the information supply towards high way operation administration and the public.

(5) GPS vehicle administration function. At the same time in performing supervising and control to the high way emergency vehicles including the patrol cars and the wreckers, to administrate vehicles effectively including vehicle registration, deleting, modifying its attributes, and, at the same time, to realize such functions as vehicle tracking and display, vehicle position attribute inquiry, trail palyback, and backstage processing.

(6) Police records and historical records of events. After an event was handled, the system keeps the emergency event and its handling information in the archives, and reports to and transfer the event and the handling details to the respective departments. The rapid response system accomplishes such functions as answering alarm record, event tracking, accident filing, and historical event inquiry.

### **3 The system development key technologies**

The system development involves many advanced technologies, such as realizing the inducing and carding the collected information with data fusion; the Intelligent Decision Support Analysis Technology provides supports for the aided decision making of pre-arranged planning; the Interface technology accomplishes the unified data input and output of different system and different standard. As the system supporting platform, the 3G technology plays the key role, including GIS, the Geographic Information System, GPS, Global Positioning System, and GPRS, General Packet Radio Service.

(1) GIS is one of the basic supporting frames for high way intelligent traffic system. It is a computer system possessing information collection, storage, administration, analysis, display and applying geographical information, is the general technology for analyzing and processing mass geographical data. The rapid response system has great dependency on geographical space, while GIS plays key role for realizing system visualization, real-time dynamic administration

and aided decision analysis. Presently, the main stream GIS platform includes foreign ArcInfo, MapInfo, GeoMedia, and domestic SuperMap, MapGIS.

(2) GPS is the radio navigation and positioning system based on satellite, possessing all-around global, continuous and real-time navigation and timing and positioning capabilities, can provide for different users accurate 3D coordinates, velocity and time information. GPS vehicle positioning plays important role in rapid response system. The vehicles on high way networks include patrol cars, rescue vehicles and road maintenance vehicles. When GPS receiving and communication equipments are installed on these vehicles, the GPS receiver on the vehicle terminal can receive the positioning data from positioning satellite, calculate its own geological position coordinates, provide GPS data to the vehicle terminal through data interface. The command and dispatch centre can master the vehicle distribution information in certain road network, and dispatch the police power or the rescue vehicles nearby to response when emergency event takes place.

(3) GPRS is wireless grouping and exchange technique based on GSM system. It can provide end-to-end, wide area wireless IP linkage, realize data high speed processing. Vehicles operating on the high way system, taking advantage of GPRS network, send the vehicle position and status information within the GPS communication module to monitoring central server with static IP address, and store these information into the central data library.

#### 4 System realization

In light of the above mentioned system design and key technologies analyses, research group have carried out research and development with regard to the command and dispatch system data platform of Jilin provincial highway road network. The objective of this system is, applying computer technology, modern communication technology as well as GIS/GPS space information technology, research and develop a reliable, convenient and expandable platform, and optimize highway emergency resource arrangements, and provide effective and reliable guarantee for rapid response of emergency event. Fig.2 is the system physical structure. Fig.3 is the system vehicle positioning data flow.

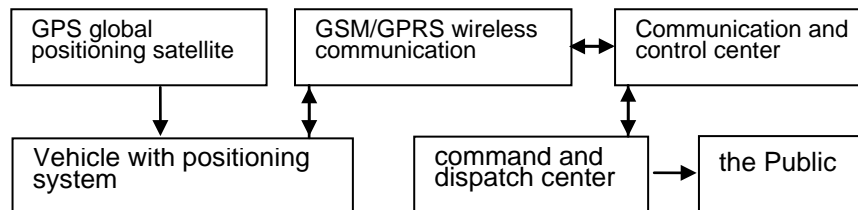


Fig. 2 The system physical structure of RRS

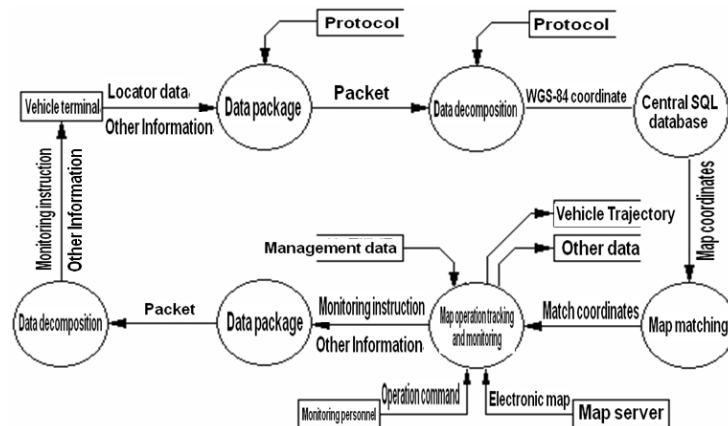


Fig. 3 Vehicle positioning data flow of RRS

The system adopts B/S and C/S combined mode. For the police record, GIS and GPS vehicle administration, C/S mode is adopted, while B/S mode is employed for information release and pre-arranged plan managements. GIS platform software is ArcInfo + ArcSDE + MapObject2.2 + ArcIMS, and the Data library management software adopts Oracle 10g, the server uses Windows Server 2003 Simplified Chinese enterprise version, the developing software is VB. GPS system employs SHEN YANG GPS vehicle terminal developed by Shenzhen Shenjun Scientific and Technological Corporation Limited, which is based on GPS satellite positioning network and GSM/GPRS/CDMA communication network positioning and communication terminal, suitable for the data transfer in indoor condition and outdoor severe environment covered by GPSsatellite signal and GSM/GPRS/CDMA network.

So far, the research group have accomplished electronic map, GPSvehicle management system, pre-arranged management function, information release based on the WebGIS and related business development, and in the stage of system debugging stage.

## 5 Concluding remarks

On the bases of system analyses, the system structure and functions of highway rapid response system have been investigated, and the key technologies for the system realization have been analyzed. The command and dispatch system data platform for Jilin Prov. Highway network has been realized with 3G technique. Presently, the platform is not yet complete and perfect, further work is still needed in the intelligent strategic decision based on the pre-arranged plan management, and in real-time GPS data storage. We firmly believe that, with the improvement and perfection of management system, the effective highway rapid response will surely be realized soon.

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