

# MOBILE OPEN CHANNEL SCHEDULING DECISION SUPPORT SYSTEM AND APPLICATIONS TO LONG DISTANCE WATER DIVERSION PROJECT

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## ABSTRACT

The South-to-North Water Diversion Project is the largest water project in the world presently. It is very important to solve the serious shortage problem of water resources, optimize the allocation of water resources in northern China. But it is too long and scattered with too many water outlet, gates, pumps, inverted siphon, bridges, and other constructs. When found the emergency matters such as piping, landslide, ice-jam and water-overflow, it is difficult to judge, getting help and dealing with. To ensure safely operation of this water project, it is necessary to use wireless communication and mobile phone or moving device to inspect the status of embankment, hydrological, electric transmission lines and structures real time. In this paper, a mobile smart phone dispatch decision-making system is presented based on 3G transmission network. It includes dispatch operation command center with dispatch engineer, the monitoring and decision-making system platform with database server and application software, mobile application terminal services, etc. The remote mobile client applications services include mobile line-inspections, movable water quality automatic monitoring, mobile dispatch & operation services online, mobile emergency dispatch services online, mobile security services, and mobile inquire services.

**Keywords:** *Mobile phone; Decision Support System; South-to-North Water Diversion Project; Transmission of Water; Control*

## 1. INTRODUCTION

The South-to-North Water Diversion Project is the largest water project in the world now. It is a major strategic infrastructure to solve the serious shortage of water resources, optimize the allocation of water resources, and improve the ecological environment in northern China. On the one hand, the line length of channel is very long, total length of Eastern, Middle and Western is about 4350 km, only the length of the first phase of Eastern route reaches 1466.24km with most line passing through the densely populated areas, the accidents such as water pollution, ice jam, falling of motor vehicle, break of machinery facilities is easy to occur, on the other hand, there are a lot of water outlet, gates, pumps, inverted siphon, bridges and embankment with complex geological structure along the line. It is necessary to inspect the status of embankment

(piping, sinks, landslide), hydrological (water level, ice jam, ice cover), electric transmission lines and structures real time and feedback the result to dispatch center without delay. But how to achieve the goal of inspect and feedback the result, get the command from dispatch center to control the gate or pump and deal with the accidents timely at the place without wired communications. Now the dispatch or operation systems based on mobile phone have been implemented in many fields such as citizens' alarming(H.M. Jagtman,2010), Intelligent location-based mobile news service (Chih-Ming Chen,2010), power wireless Network Platform(Wang Jun, 2008), emergency public warnings(Mileti DS,1990) and so on, but the implement of water long distance diversion water project is lack. This paper proposals the mobile smart phone dispatch Decision-making system for

long distance diversion water project-eastern route of South-to-North Water Diversion Project.

## 2. OVERALL SYSTEM ARCHITECTURE

The system use mobile communication equipment such as mobile smart phone, movable water quality automatic monitoring station to build flexible decision-making system with the function of information inquire, dispatch & operation, inspect, water quality test and emergencies dealing, etc. This system is composed of four parts (seeing Figure 1). The first one is the dispatch operation command center with dispatch engineers. The

second one is monitoring and decision-making system platform with database server and application software (such as canal control algorithm, flow simulation, trend analysis and so on). The third one is data transmission network. It uses private network communications network and public mobile communications network. The fourth one is mobile application terminal, being responsible for inspect embankment, hydrological observations, water quality testing, dealing with emergencies etc. along channel line with smart mobile phone. Figure 1 is the sketch map.

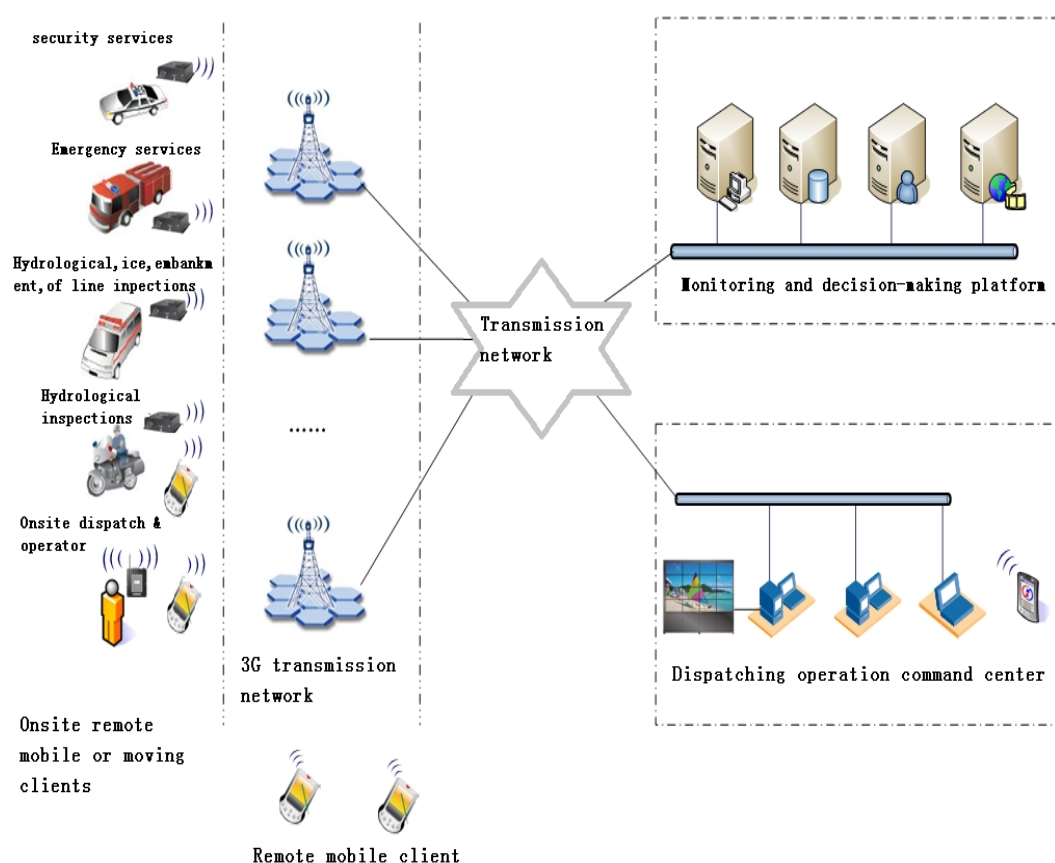


Figure 1: The Sketch Map Of Overall System Architectural Design

## 3. MAIN MODULES AND FUNCTIONS OF REMOTE CLIENT

The main modules include mobile line-inspections, movable water quality automatic monitoring services, mobile dispatch & operation services, mobile emergency dispatch services, security services and mobile inquire services. See figure 2.

### 3.1 The Monitoring And Decision-Making System Platform

The monitoring and decision-making system platform is located at the Total dispatch and command center. It accepts the information from remote clients such as hydrological, ice jam, water quality, messages, pictures, video and other data sent by remote mobile phone or stations. It is operated by dispatch engineers and sends operation

command to mobile phone. It is composed of all kinds of database servers and applications systems such as unsteady flow simulation, ice-jam forecast, optimization of water distribution, gate/pump

control & operation decision-making, emergency decision-making, data analysis, map GIS-assisted and so on.

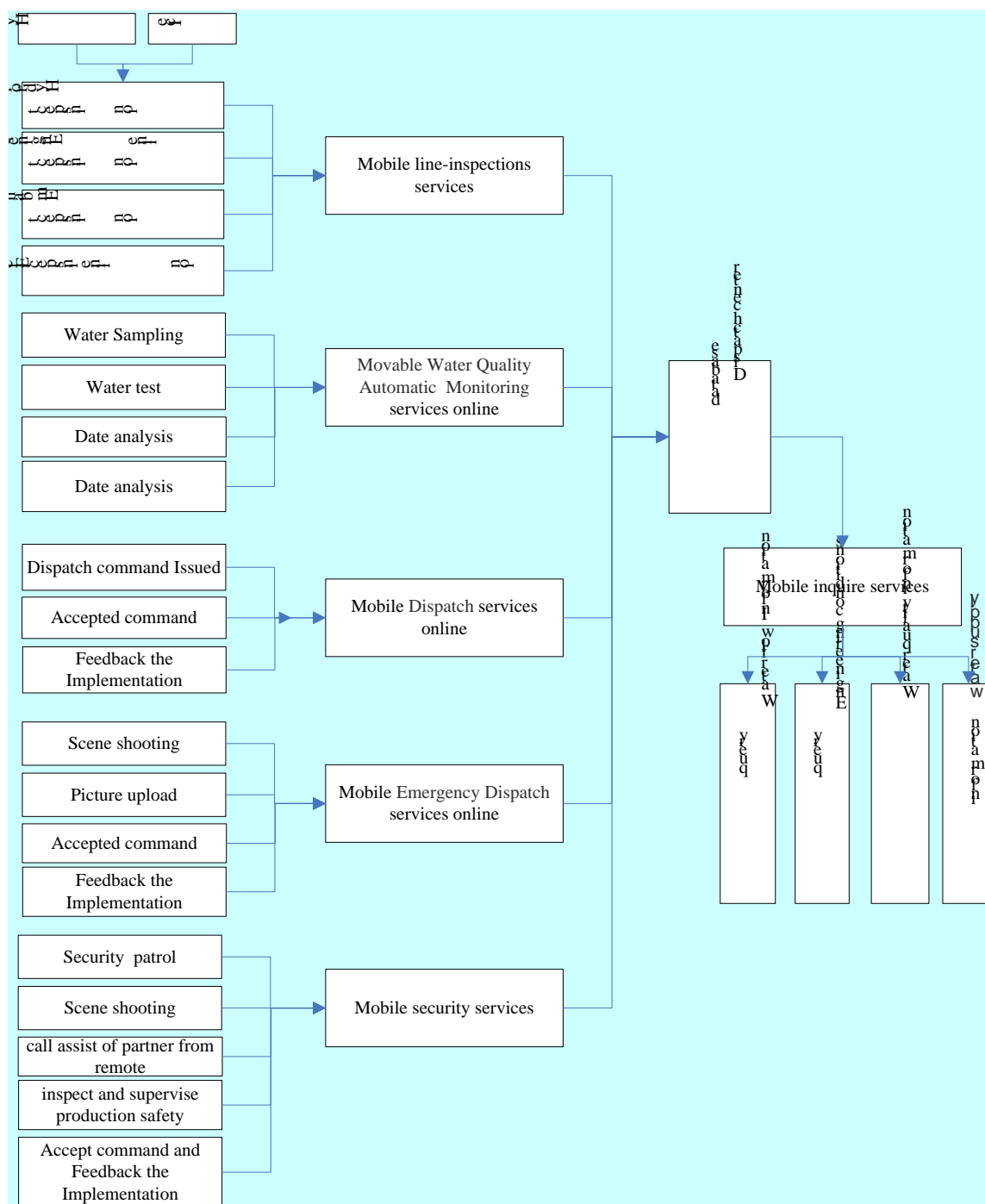


Figure 2: Main Modules And Functions

### 3.2 Mobile Line-Inspections Services

Because the long distance, much scattered points of inspections, it is necessary to report timely the

result of inspections to dispatch center along channel. Especially when emergency incidents occur such as the ice jam, failure of piping,

landslide of canal bank, for a professional dispatch engineer in dispatch center it is needed to learn more about details and judge the seriousness of the matter through picture or videos taken by remote mobile phone.

It is primarily responsible for inspect the state of hydrological, ice, embankment along channel daily. And upload the results and picture to dispatch

center through mobile phone. When find the accidents such as overflow, water pollution, ice-jam, drainage facilities or piping, take picture and upload to relevant departments. Figure 3 is the interface of the mobile inspect services, and figure 4 is the interface of using mobile phone upload ice condition to dispatch center from remote.

### 3.3 Movable Water Quality Automatic Monitoring

Contracts to fixed water quality automatic monitoring station, the advantage of movable water quality automatic monitoring station is that it can monitor the water quality anywhere along channel. Contracts to manual monitoring method, it can test water quality quickly online. It is composed of monitoring vehicles, water quality test instruments and communication facilities. It can automatically complete the water sampling, retain samples, water quality analysis and uploading result data.

### 3.4 Mobile dispatch & operation services online

For South-to-North Water Diversion project, Monitoring system is limited to a part of gate station. For these remaining stations which the monitor system has not been built, it is difficult to accept the command and send the message. So it is important to issued command, feedback the implementation, collection the information through mobile phone.

### 3.5 Mobile emergency dispatch services online

When the accidents occur, we can take picture or shoot a video on scene of accident and send it to dispatch center through mobile phone, accept the dispatch commands online, and feedback the progress of dealing with incidents.

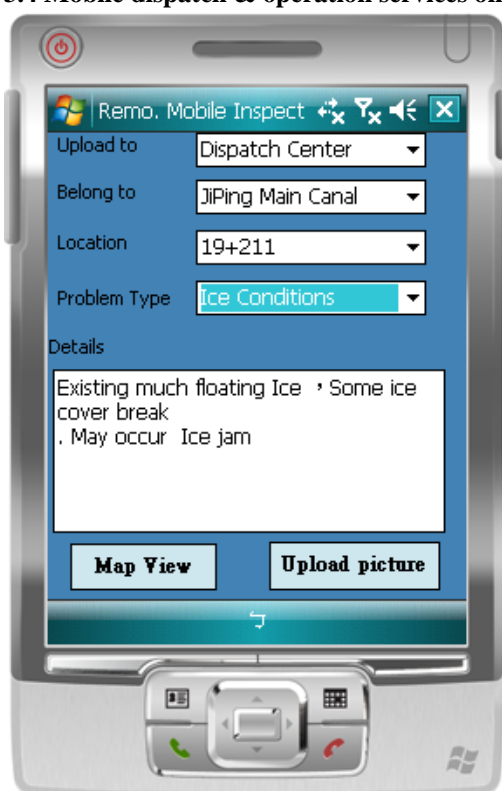


Figure 3: the mobile inspect services

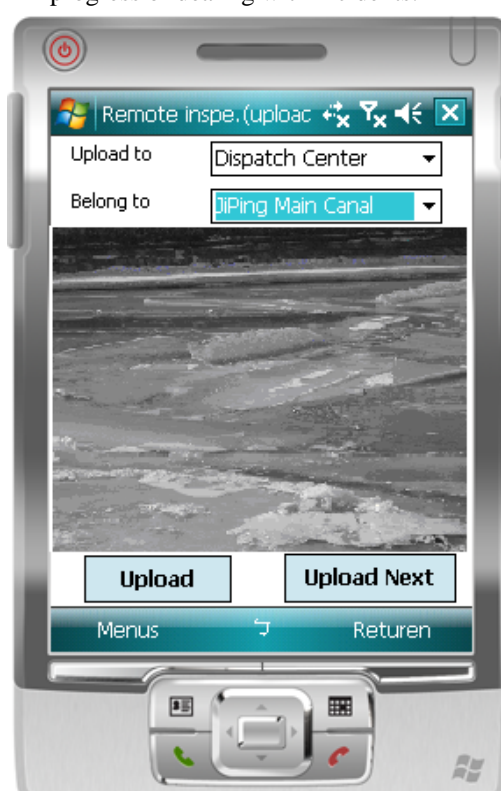


Figure 4: using mobile phone upload ice condition

### 3.6 Mobile security services

This service mainly deal with the security and related matters, includes patrol along channel line to prevent phenomenon of equipment theft, steal

water, poisoning in water and destruction facilities. Obtain evidence using mobile phone, and call assist of partner from remote. The other service is to inspect and supervise production safety, such as the fire safety, electrical safety, and so on.

### 3.7 Remote mobile inquire services

Figure 5 is one of the interface of remote mobile inquire services. It can finish the following work (not limit to).

(1) Water flow Information query: Whether in the office, at home or on business, anytime and anywhere we can inquiry information of water flow state through mobile phone, include water level and flow of channels, volumes of lake and reservoirs, openings of gates, the state of pumps.

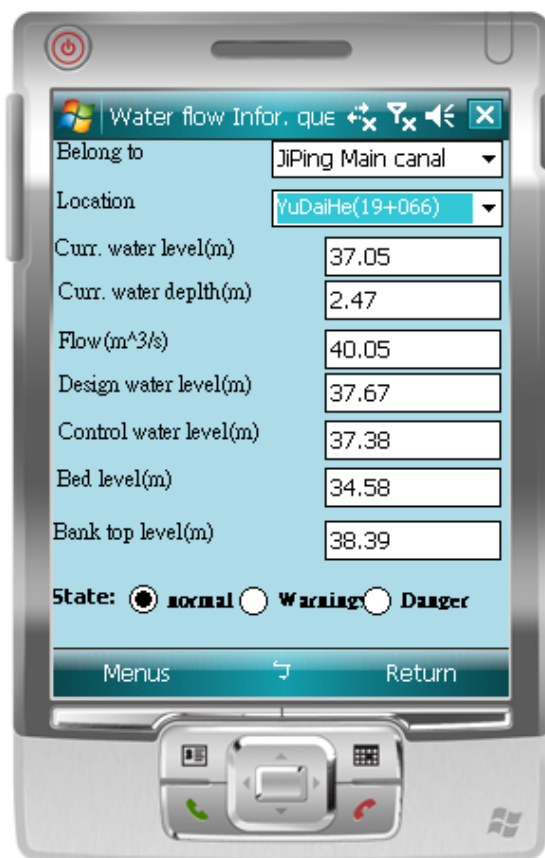


Figure 5 : Remote Mobile Inquire Services

(2) Engineering conditions query: To get the information of Security Health state of channels, pumps, reservoirs, gates and Inverted siphon, such as the value of Uplift pressure of channel bed, Deforms of dams and Embankment.

(3) Water quality information: include Water quality monitoring sites, monitoring types, Current Status of Water Quality etc.

(4) Inquire the Total daily, Monthly or Annual water supply, source Available water, planed diversion amount etc.

(5) Inquire the dispatched command, gate opening, and pump running states.

## 4. CONCLUSIONS

For long distance water project, it is very important and difficult to collect, inspect and feedback timely the states, parameters of hydrological, embankment, electric transmission lines and structures all along the channel line without blank. With the development of mobile phone, developing remote mobile or moving Scheduling Decision Support with the functions of inspection, pictures/videos transmission, water quality monitoring online, emergency dispatch/control online, security services, etc. with mobile phone based on 3G transmission network can easily solve the problem of collection, inspection and feedback real time which help to ensure the safety of project.

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