



Safety Production Monitoring Schemes and Terminal Software Based on TD-SCDMA in Coal Mine

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Abstract

This paper analyses the application of 3G wireless communication system, 3G industrial chains and requirement of new services in coal mine. In order to monitor the production condition exactly and real time in underground and surface of coal mine, a new mobile application solutions scheme based on TD-SCDMA in coal mine is proposed. According to the high speed data service of third generation mobile communication systems, the wireless network of surface scheme was designed by the C/S structure, which can provide mobile communication and information synthesized service application. Wireless distance unit and the special Base Station were used to achieve effective covering of special environment of coal mine according to the different environment of underground tunnel. The wireless interface standard are analysis based on the structure of digital mine, the workflow in application server is suggested too, it studies J2ME application development intergraded with J2EE, then devises workflow in server. It realized the expected functionality using Model-View-Controller(MVC) model based on J2ME development platform in terminal which can provides the technical basis of 3G in coal mine safety production

Keywords: TD-SCDMA, Safety production monitoring, J2ME, Interface standard, Coal mine

1. Introduction

The reliable communication in coal mine is the important guarantee in the safety production. The safe monitoring system is a real time monitoring system in the process of digital mine, which can ensure the safety production and management, which makes management layer obtain interrelated production data fast, timely and exactly and improves the scientific decision, thus the safe accident and property loss can be avoided or reduced owing to mistake decision and the safety production of coal and operation guarantee (Xiaobing Han, *et al*, 2009; Zhao Anxin, *et al*, 2007).

TD-SCDMA, which is firstly proposed internationals criterion by China, It is one of the mainstream standards in 3GPP. All kinds of service based on wireless data application display their special advantages (Guangyi Liu, *et al*, 2006; Hu Xingjun, 2008). Through making full use of merits of 3G network and combining remote monitoring demands of coal mine safety production, it will be applied widely. Remote monitoring technique based on 3G not only saves money and resource for techniques and accomplishes all monitoring maintenance tasks orderly, but ensures efficient production and operation of the enterprise. According to 3G mobile communication network platform, remote monitoring system on coal mine safety production based on TD-SCDMA is designed from application perspective, which provides effective foundation for enterprise mobile application solution scheme after 3G network opening. The Software of Special 3G Terminal was designed.

2. Application model of TD-SCDMA in coal mine

Remote monitoring system on coal mine safety production based on TD-SCDMA is to monitor real-time information of production place of coal mine at any time and any place with 3G mobile terminal, providing rapid information passage of production for administrator.

The entire design scheme is as follows, through arranging all kinds of sensor and monitoring station in coal mine production place to gather production monitoring data, then according to platform data standard all kinds of data gathered can be collected, packed and transmitted to field monitoring work station or server by adopting digitization mine, the remote monitoring workers and administrators can adopt 3G phone which has good interface between people and computer as mobile client terminal to receive and display real time data transmitted by server and provide initiative

calling and rapid information inquiry. The application model based on TD-SCDMA remote monitoring in coal mine safe production is shown in Figure 1. One or many PC is placed to coal mine terminal as server, 3G mobile phone is client. In system, TD-SCDMA wireless mobile network is the basis of communication between 3G mobile phone and server. The service quality TD-SCDMA wireless mobile network provides decides the whole system quality achieved. Data transmission of down link can use HSDPA to make transmission speed reach 2.8 Mbit/s supported by single carrier. 3 carriers can realize 8.4Mbit/s, in practical application it also reaches no less than 2Mbit/s owned by single carrier, which provides a wide protect for 3G data service and fundamental guarantee for the scheme.

In the process of exchanging information between client and server, there is too much needed alternating information, but if network transmission can be done through Http and server, binary system data can only be transmitted, thus binary system data is needed to be serialization. To avoid some problems due to data processed format inconsistency between client and server, the system design should adopt the concept of software system integrated, on the indered basis of database design and software function of each service application software, data standard can be established, data be unified on the IP platform, on the IP platform the consistency of data is guaranteed. By visualization 3G terminal and data linkage of synthesized monitoring system, the information which is dispersed in the production application system of mine can integrate information of each service database, unified inquiry and management of visualization can be realized.

3. Coal mine special network structure based on TD-SCDMA

The solution scheme of safe production remote monitoring system in coal mine based on TD-SCDMA includes ground solution scheme and underground scheme, by overall considering safe production information construction of coal mine (Feng Tian, *et al*, 2009), the solution scheme of mobile special network of coal mine based on TD-SCDMA is designed.

3.1 The ground solution scheme of coal mine special network

An important factor of coal mine safe production is that multi-service monitoring information in coal mine production is needed to be transmitted to communication network system of ground real timely and accurately, which makes production management of ground and safe monitoring system know real time all kinds of information needed by production dispatching circumstance and safe production, thereby, prompt and accurate decision can be done. According to above requirements, the ground solution scheme provides mainly the production of mining area movement of coal mine, work, operation, safe early warning service and broadband mobile communication service on the whole coal mine ground production, life, late period guarantee. The network core of scheme is synthesized dispatching switch, the aim is of scheme to provide mobile communication and information synthesized service application, and the scheme needs to combine sufficiently with exists many system network deployment.

The solution scheme of ground special network consists of system equipment and terminal, the scheme is shown in figure 2, in which, safety early warning supervision function under mobile manner can be offered by mobile phone terminal of 3G multi-media; supporting gas and other safety parameters transfinite alarm, inquiry and image monitoring of monitoring frame of underground; manager can obtain all kinds of safety production information real time anywhere; besides the scheme provides person's location and tracking and supports ensuring location and real time monitoring of activity orbit.

3.2 The underground solution scheme of coal mine special network

In this scheme, synthesized dispatching switch is the core of part of ground, by offering various ports the mixed networking can be realized between current existing coal mine communication system and application system including safety production and operation management service. Wireless distance unit of super BS and its cascade were used to achieve effective covering of special environment of coal mine according to the different environment of underground tunnel.

The underground tunnel of coal mine is with trendiness covering, using concatenation manner of wireless remote terminal unit used in coal mine of super BS to implement wireless covering. Air interface wireless link can connect with BS system equipment based on TD-SCDMA through simple location terminal, 3G mobile phone and wireless data adapter used in coal mine.

In mobile monitoring supervision terminal unit, the link between underground digital sensor and wireless data adapter is serial port RS485/232; in mobile video terminal unit, the linking between underground video instrument and wireless data adapter is IP interface. The structural diagram of solution scheme is shown in figure 3. The purpose of proposing solution scheme coal mine mobile special network based on TD-SCDMA is realize mobile working anytime anywhere: whether in mine area or other place far from mine area, using 3G cell phone to master information of various production data and safety of coal mine anytime anywhere, thus carrying out remote monitoring conduct of safety production of coal mine and realizing mobile working anytime and anywhere. According to requirements of coal mine information construction and design standard of digitization mine, as for mobile special network design of coal mine based on

TD-SCDMA, there are five interfaces as follows: U_u , I_{ub} , A_{i1} , A_{i2} , and G_i .

In which, U_u is the air interface between terminal and wireless access network and utterly opening interface, I_{ub} is the interface between base station(BS) and synthesized dispatching switch, which is used to transmit signaling between BS and synthesized switch and data among wireless interfaces; A_{i1} is the E_1 interface interconnected with coal mine administration switch or PSTN; A_{i2} is the E_1 interface interconnected production dispatching switch of coal mine; G_i is connected with safety monitoring of coal mine, early warning and location system and production operation management system etc, with 100M/bps.

4. Software Design of Special 3G Terminal in Coal Mine

According to the production information demand of different user, mobile terminals directly contact with server and the media of the application development for the needs of the coal mine safety by the users. In the J2ME platform and using MVC model, we successfully realized the function of the mobile terminal software (W.Itani, A.Kayssi ,2004).

Special mobile terminal in coal mine include starting interface module, registration module, login module, personal setting module, information query module, the public interface module, network processing module and records management module, information query module can divided into sensor alarm module and search real-time data module shows as Figure 4.

The software of mobile terminal is designed by monitoring the keystroke. First the mobile terminal user will see is start interface when starting up the application, followed by the main functions interface, including registration, login and personal set options; when you log on normally is coal interface which have been designed, the functions of mine sensor alarm and real-time data query in the interface. Users can choose to enter the corresponding interface according their demands and look over data needed. Category and its function of mobile terminal shown in Table.1

4.1 Starting Interface Module Design

In the J2ME application development platform to use the image format is PNG format, PNG is a kind of format that can stored 32-bit bitmap file, there are some features added in PNG comparison with GIF, such as true color image with 48 bit for each pixel, detecting damage documents by CRC and image quality is far better than GIF. There are a lot of tools can convert image format. Setting start interface of the special 3G terminal in coal mine achieve in the StartUpUI category, come down to API for advanced users including Display, Form, Image Item, etc. When users start application, send a information to the server-side, first, the system completed the initialization and then according to the information, the server-side send the appropriate picture to the mobile phone terminal, the category StartUpUI realize the function of receive and display the picture in the 3G terminal. as shown in Figure 5, realize the start and welcome interface in the simulator. (Note 1)

4.2 Design And Implementation Of Login Module

Using Login module is a key in remote enterprise application development, design of it in Special 3G Terminal in coal mine use MD5 algorithm encrypt it password and then stored in the mobile phone. The use of terminal and server save encrypted password achieve user authentication login.

Draw lessons from "whether or not remember your password" prompt in PC .If you choose "Yes", then the next time you log on do not need to enter any password, and greatly facilitate to use. Through the application of records management system, user can log in automatically, greatly facilitates the user. Login module is designed in the categories of SignOnUI, Account, Preference, MD5 and Record Store. Log in and then send a message to the server, the server received a request turn to deal with checking the user name and password when user login. If validated, then enter the mine interface; if it can not pass validation, then pop-up the failed interface, in this interface users can select the "Back" to log in again.

4.3 Information Query Design and Implementation of Module

The information query in specific 3G terminal in mine designed two functions of Sensor alarm and Real-time data query, Sensor alarm module is only achieve to the function of view the sensor failure information, real-time data query module make the users to view the detailed information of all sensor, to meet the different needs of all users. Information query module achieve in CoalUI category.

After the success of the user log into the "default coal mine" interface, users can choose which mine to query, such as the "XA coal", click on the "enter" button and send real-time request data to the server. server-side based on the user's request message sent by the mine's real-time database which stored in the RMS phone terminal. Call the process of waiting interface GaugeUI to show the wait state. 3G terminal completed to receive information, enter the data query interface, in this program quarry information module provides the functions of "sensor alarm" and "real-time data".

The user are more concerned about the failure of coal production. Is a very troubling thing, if the user had to found the wrong data in a lot of sensor database for the convenience of users, we set the "Alarm Sensor" feature.

If users need to see the real-time data on the scene of coal production, they can choose the real-time data, the 3G terminal deal with the sensor data by the Record Store category and then displayed this in the interface. The sensor data come from server side. HTTP and the server are used to exchange information in special terminal. First a HTTP Communication category must be designed, as the Controller part in MVC model, is provide all data of the 3G mobile phone to display. Start interface module, registration module, personal settings module, log in module and mine information display module needed to send or request data from the controller. The HTTP Communication concretely implements the common type of network infrastructure, as well as to provide the data function which the request module screen need. RMS modules access to function in the Record Store category, that mainly used in automatically log in, storage and processing the real-time data of production. The display thinking of real-time data is to divide the strings received from servers into single sensor information via mark partition symbol, hen saving every of them as a note. When display the user interface, it's need to remove partition identifier before and after the string.

5. Conclusions

The development of digitization mine quickens information construction of coal mine enterprise, but synthesized monitoring system is the core of digitization mine system. 3G techniques is adopted in the paper, designing remote monitoring scheme of coal mine based on TD-SCDMA, trussing ground and underground network structure on remote monitoring special network of coal mine receptively, analyzing interface standard between remote monitoring special network of coal mine based on TD-SCDMA and information network of coal mine enterprise, discussing multi-thread processing ways of J2EE server supporting wireless application, which provide technical basis for application of 3G in safety production of coal mine. Thus, it is convenient to monitor information and obtain monitored information fast for managers, which improves real-time and reliability of monitoring system.

According to the requirements of the 3G Mobile Communication System TD-SCDMA in the coal mine safety production, particularly realizes the software function of special 3G mobile in the coal safety monitoring by MVC mode.

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Notes

Note 1. The software are developed based on Chinese J2ME platform.

Table 1. Class and its function of special 3G terminal

CLASS	FUNCTIONS
CoalMain	Main program
StartUpUI	Realization the function of the start interface
SignOnUI	Realization the function of the login interface
EnrolUI	Realization the function of the register interface
AccountInfoUI	Realization the function of the person information set interface
CoalUI	Realization the function of the real-time data interface and data display
HTTPCommunicationUI	Realization the function of the network processing interface
GaugeUI	Realization the function of the wait interface
WrongUI	Realization the function of the hint error interface
OkUI	Realization the function of the hint success interface
SureExitUI	Realization the function of the confirm exit interface
Record_Store	Automatic login and real-time data storage and processing
Account	Storage the user's name and password
Preference	Storage whether the users are automatically login
MD5	Access to encryption of user's information
MessageConstants	Mobile terminals and server-side share information

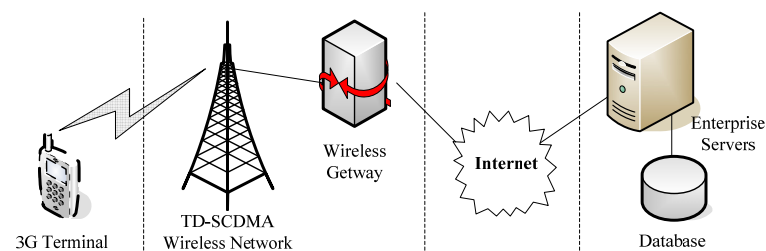


Figure 1. The application model based on TD-SCDMA in coal mine

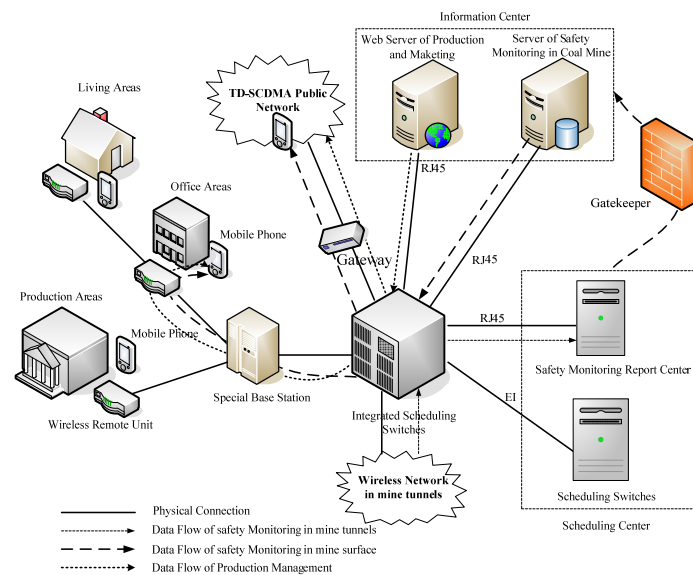


Figure 2. The ground solution scheme of coal mine special network

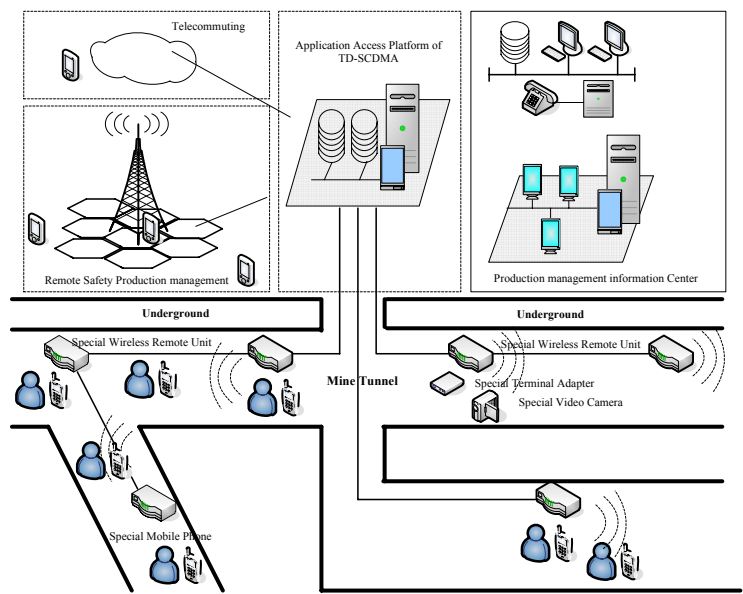


Figure 3. The underground solution scheme of coal mine special network

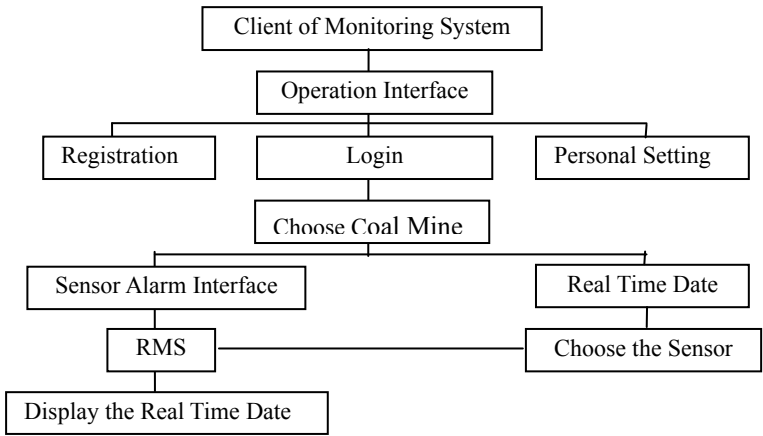


Figure 4. Module structure of special 3G terminal



Figure 5. Interface of starting and welcome