

Yangquan Coal Industry (Group) Co., Ltd

KT594 Mine Wireless Communication System

(5G + Intelligent miner lamp intercom)

Technical proposal

Huainan Wantai Electronic Co., Ltd

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1. Project introduction

1.1 Project background

Underground communication system is an essential facility for safety protection and production scheduling in coal mines. The application of wireless communication system technology in coal mine enterprises, improve the level of underground wireless communication, accelerate the pace of underground communication development, for the safety of coal mine production, improve production efficiency, improve the management level of enterprises to build an effective information platform, has become an important task in the development of coal mine wireless communication. Due to the poor underground environment, roadway distribution, interference signal source, the development of wireless obstacles are relatively large.

In the early stage, underground communication in China was mainly wired, while in recent years, it was mainly PHS and wifi communication. With the vigorous development of the scientific and technological revolution centered on information technology, the construction of the fourth generation coal mine represented by intelligent construction has been started. At the same time, it is also required that the mine communication system, one of the six major systems in the coal mine, can not only provide voice telephone and voice dispatching functions, but also bear the transmission of text, multimedia video, monitoring data and other information.

(1) PHS Personal handy-phone systems

Since 2000, the first set of wireless communication and mobile dispatching system based on PHS technology has been applied in underground coal mine. In 2011, the national radio management committee issued the original PHS frequency band 1900MHz to China's independent research and development of TD-SCDM 3G network. The manufacturers of PHS have stopped making PHS equipment.

(2) SCDMA

SCDMA technology is not in line with the standards of the international

telecommunication union and has not been applied on a large scale in the public telecommunication network and enterprise private network. Its maturity, reliability and practicability can be imagined.

(3) Wireless LAN technology

WIFI belongs to the short range wireless broadband data access standard stipulated by ITU, that is, IEEE802.11. From the formulation of the standard to the launch of the product, it just serves wireless data communication transmission. WIFI technology itself does not support mobile voice communication services. Due to the lack of the necessary air port protocol standards and strict product technical specifications for mobile communication, WIFI does not have the communication networking capability of large-scale multi-base stations and the corresponding communication theoretical basis.

(4) Public technology

Public as a global mobile communications to the standards set by the international telecommunication union ITU, hundred countries around the world telecommunication public network of commercial success, in more than 1.6 billion web users, its core technology and the future development direction to the world's most advanced mobile communication, the advancement, standard of their products, the maturity and reliability, practicability and continuity, of course, it goes without saying.

In a word, with the improvement of automation and informatization of coal mine production, traditional data and voice communication cannot meet the needs of coal mine safety production and wireless visual multimedia service. This requires the use of a new network structure and a new wireless transmission theory and technology, the construction of the mine broadband integrated communication system, to achieve a variety of underground wired and wireless monitoring, monitoring, voice information transmission. So as to build a safe and efficient modern mine, improve the level of automation and information in China's coal mine.

1.2 Description of project

This project is to organize the implementation of the project with the goal of 4G network coverage downhole in the first mine of Yangquan coal industry (group) co., LTD. The project consists of four parts:

- 1) ground core network construction
- 2) downhole wireless network system construction
- 3) downhole mobile terminal

4) ground server and system software. Through the construction of the above four parts, the first mine of Yangquan coal industry (group) co., ltd. is realized, and the underground 4G network is fully covered.

1.3 Introduction to cooperative enterprises

Wantai electric was established in 1998, the headquarters is located in Huainan, is a production of coal mine safety monitoring system, integrated automation and informatization, intelligent electrical complete sets of equipment for the integration of national high and new technology enterprise, China well-known trademark recognition, built in Anhui province enterprise technology center, mine electrical engineering technology research center in Anhui province, Anhui industrial design center. Ranked the first three in the same industry, Anhui province first. Zhang haijiang, a professor at the university of science and technology of China, is the chief expert on the project. Professor Zhang haijiang is one of the first batch of "thousand talents program for young people" in China. Born in 1973, he obtained his bachelor's and master's degrees in applied sciences in Changchun in 1994 and 1997 respectively. In December 2003, he obtained his doctoral degree in University of wisconsin-madison (uw-madison). He was an assistant and associate researcher at uw-madison from 2004 to 2007 and a Research Scientist at the Massachusetts institute of technology from 2007 to 2012.

Professor Zhang haijiang published a total of 100 papers and 87 papers were included in SCI. Among them, 40 papers were published as the first author or corresponding author, 12 papers were published in area I and 28 papers in area ii. He is

deputy editor of two international magazines. As the co-technical chairman of the conference, he held the 2017 SEG international symposium on microseismic technology and application, and made six guest presentations at major international conferences. Responsible for 2 general projects of national natural science foundation of China, 2 international (regional) cooperation and exchange projects, 1 key support project, 2 sub-projects of key research and development projects of Ministry of Science and Technology, 2 public welfare projects of ministry of land and resources, 2 regional research projects of China geological survey bureau. Five patents have been obtained, including five national invention patents, one as the first inventor, and one has been implemented. Won 5 municipal and above awards, was awarded the seventh batch of strategic emerging industry in Anhui province technical leading talent and other honorary titles.

A talent team composed of 40 fixed scientific researchers has 11 invention patents related to this major emerging industry. Was awarded "China well-known trademark", "national hi-tech enterprise", "national enterprise intellectual property pilot unit", "innovative enterprises in Anhui province", "green factory in Anhui province", "top 20 software enterprises in Anhui province", "industrialization and information fusion in Anhui province demonstration enterprise", "specialization, new small and medium-sized enterprises in Anhui province", "Anhui provincial government quality prize", "Anhui province labor and social security good faith demonstration unit", "Anhui provincial enterprise technology center", "Anhui province engineering technology research center", "Anhui industrial design center" "manufacturing and Internet integration development pilot enterprises in Anhui province", "AAA level standard Good behavior certificate of Anhui province, famous brand product of Anhui province, fine industrial product of Anhui province, high-tech product of Anhui province, new product of Anhui province, top 20 software enterprises of Anhui province, etc.

The project is undertaken by the r&d center of Wantai electronics co., LTD. The products and solutions of the r&d center cover the wired dispatching communication system and wireless dispatching communication system of coal mine. The wired system includes mine dispatching machine, mine underground explosion-proof automatic

telephone set and mine safety coupler. Wireless system includes central controller, base station for mining, mobile phone for mining. The seamless and perfect combination of wired and wireless dispatching communication network provides a strong guarantee for safe and efficient production of coal mine.

Products have been widely used in coal, metallurgy, petrochemical, transportation and other industries, the company passed the ISO9001 quality management system certification. The company is committed to providing innovative products, services and solutions that meet customers' needs to create long-term value and potential growth for customers.

1.4 Service advantages

The company attaches great importance to customer service work, our service purpose is: everything to meet customers. In the spirit of "rapid response, work patience, rigorous system, always for the sake of users, to provide 100 percent thoughtful, meticulous service" concept, wholeheartedly for customers to provide satisfactory service.

1.4.1 Service organizations

After-sales service department is responsible for customer service work, there are 42 professional after-sales service personnel, and each project team of technical personnel more than 70 as a backup force. The leaders of the company and each department are responsible for the customer service work, providing customer service 24 hours a day, 7 days a week.

1.4.2 Service system

During the project implementation and trial operation, the company establishes a special after-sales service department, which is responsible for providing relevant technical information to the end users, tracking the operation of each system, responding to the end users' technical support request and urgent maintenance request as soon as possible, and ensuring the normal and stable operation of the whole system. If

necessary, the customer shall be trained according to the contract; During the trial operation of the project, the company will provide the following technical support services:

Specially-assigned technical support: the customer service center will assign specially-assigned personnel to maintain a set of detailed support files to track the operation and failure of the system at any time. And at any time to the person in charge of a regular report, at the same time by a variety of ways to provide a full range of technical support to end users, so as to ensure the normal operation of the system.

Establish support files: after the initial inspection of the project, the customer service center will establish a complete set of support files for the system. It includes the technical implementation plan, user information, and records of system failures and interviews with end users at any time, so as to facilitate party b to provide targeted technical support.

Regular user interviews: the customer service center will conduct regular user interviews to inquire about the operation of the system and existing problems, so as to find and solve problems at any time. The interview will be conducted by telephone, fax, E-mail or on-site interview.

Regular user reports: the customer service center will regularly report the system operation status and comprehensive information of technical support to the end user to strengthen the communication between the two parties.

During the warranty period stipulated in the contract, provide the following services to the end user:

During the warranty period, if all equipment fails due to quality problems, the company will work with the software and hardware manufacturers to repair the defective equipment and replace all or part of the defective materials until the final acceptance indicators and performance requirements are met.

During the warranty period, the customer service department will continue to provide comprehensive technical support services. Provide special services during the

trial run, such as specially-assigned technical support, establishment of support files, customer interviews and regular customer reports. After delivery of the system, carry out maintenance according to the established maintenance plan, and regularly submit the maintenance report during maintenance; When the user requests or complains, the customer service specialist shall be responsible for answering, and when necessary, fill in the problem report form and submit it to the original research and development department for processing. If the original research and development department confirms that maintenance needs to be carried out, fill in the application form for technical support, indicating the improvement work content, progress, mode, acceptance standard, etc., and assign engineers to complete customer service tasks after the approval of the general manager of relevant departments.

1.4.3 The service response

The service response

The service mode adopts telephone, fax, E-mail and door-to-door service, etc., to solve the general problems on the spot, more complex problems within 24 hours at the latest to give a reply.

The customer service center will provide 24 hours a day, 7 days a week to receive and process end user failure reports. The customer service department will provide mobile, telephone, fax, E-mail, remote assistance and other online support. All incoming calls, emails, faxes, etc. will be recorded and tracked until they are completely resolved until the user confirms. Service response time: 24 hours

2. Introduction to wireless communication system

2.1 Execution standard

Coal mine safety regulations

Basic requirements for coal mine safety equipment

General technical conditions for electrical products for coal mine communication,

testing and control (MT 209)

Code for coal industry mine design GB 50215-2005

Domestic no.7 signaling technical specification integrated services digital network user part

Code for coal industry mine design GB 50215-2005 Relevant norms of telecommunication industry

GB4943-90 security of information technology equipment

GB5081-85 data collection guide for reliability, validity and maintainability of electronic products in field work

GB7611-87 pulse code modulation communication system network digital interface parameters

GB9254-88 information technology equipment - radio interference limits and measurement methods

GB/T 6879-95 2048kbit/s, technical requirements and test methods for 30-channel PCM multiplexing equipment

Environmental test method for digital communication equipment

MT401-1995 general technical conditions of coal mine production dispatching communication system

YD/T 1821-2008 requirements for environmental conditions of computer room of communication center

Safety requirements and test methods for mobile communications equipment

General technical specification for mobile communication antennas

Production safety standards

GB3836.1—2000 Electrical equipment for explosive gas environments - part 1: general requirements

GB3836.2—2000 Electrical equipment for explosive gas environment - part 2: flameproof type "d"

GB3836.3-2010 Electrical equipment for explosive gas environment - part 3: increased safety type "e"

GB3836.4—2000 Electrical equipment for explosive gas environment -

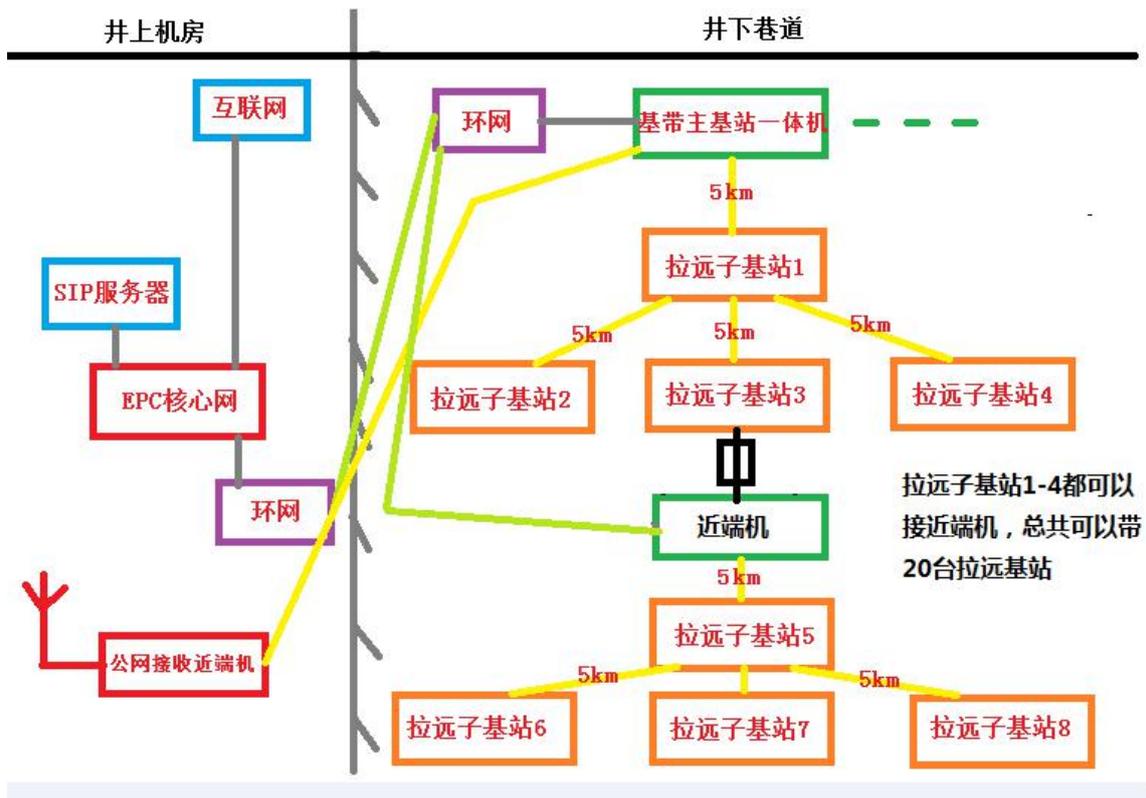
GB/T4208-93 part 4: intrinsically safe "I"GB/ t4208-93 low voltage electrical enclosure protection class

ZBD 98 001-90 Communication and control device for mining face of ZBD 98 001-90 coal mine

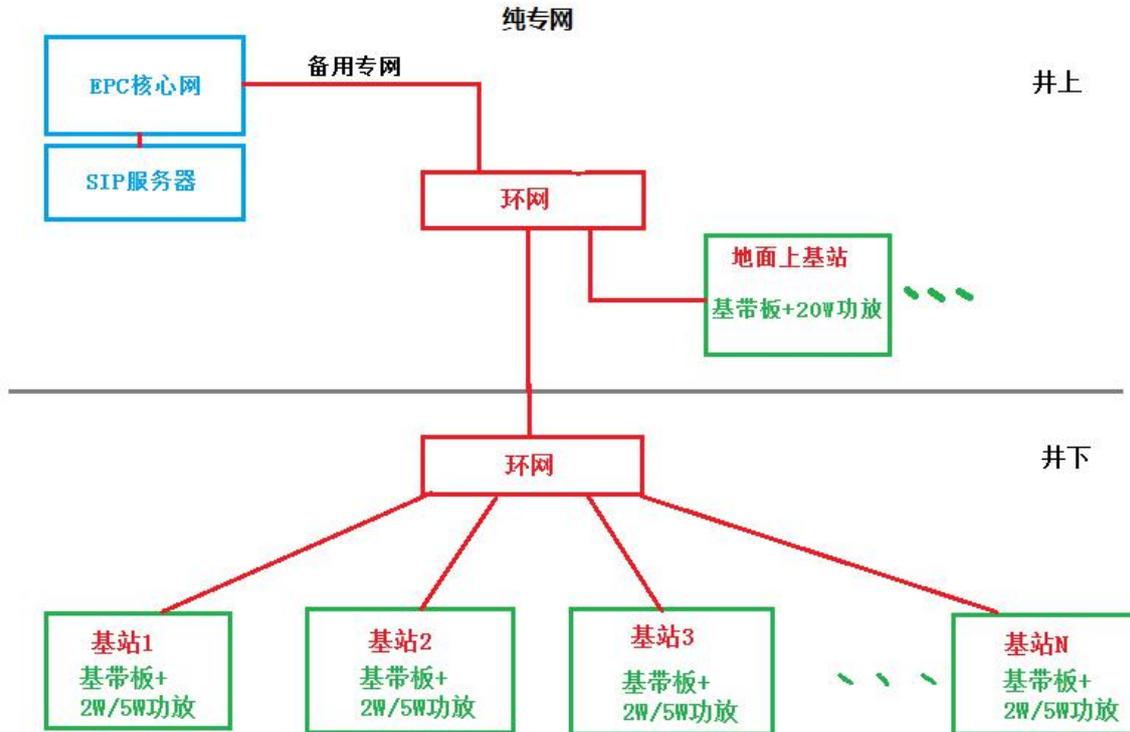
MT/ T1115-2011 general technical conditions for multi-base station mine mobile communication system

2.2 System architecture

2.2.1 4G Public network +4G private network + intelligent mining lamp intercom system architecture:



2.2.2 Pure 4G private network + intelligent mining lamp intercom architecture:



2.3 The system characteristics

2.3.1 the traditional 4G network covers only 4G network, without the functions of intelligent mining lamp intercom and accurate personnel positioning. If the application of intelligent mining lamp is to be realized, hardware and software of intercom and accurate personnel positioning system must be added.

2.3.2 public network and private network coexist. Any public network telephone on the ground can directly call any underground private network mobile phone user or intelligent mining lamp intercom user through the core network, but it must be allowed to access or exhale through the core network management, which can effectively ensure safety management.

In addition to the traditional 4G network coverage, the wireless communication system of Wantai can also realize accurate personnel positioning and intelligent intercom function of mining lamp.

2.3.4 distributed antenna feed system realizes single base station to effectively cover complex roadway environment without blind area.

2.3.5 comprehensive services: realize wireless coverage and interconnection of ground and downhole public network signals, and provide voice, data, video, short message and other functions.

2.3.6 flexible composition and wide coverage: the system can be composed of two base stations with a wide coverage range. The coverage distance of mobile phone signal in a single base station is $\geq 1000\text{m}$, the coverage distance of wifi signal is $\leq 500\text{m}$, and the maximum pull distance is 40km.

2.3.7 high reliability: support ring networking, and automatically complete link switching when the fiber link is damaged. Signal expansion adopts antenna feed system coverage, so as to achieve signal stability, long transmission distance and full coverage.

2.3.8 wireless relay: the downhole supports last-stage wireless relay connection, which is convenient for equipment disassembly and installation, especially suitable for wireless coverage of mining surface;

2.3.9 advanced technology: provide an integrated mine wireless mobile communication platform. The system allows mature 4G signals to be provided simultaneously on one device; The signal quality of the coverage area is the same as that of the ground public mobile network, which is much higher than that of all current mine wireless communication systems.

2.3.10 network flexibility: the system component link can be laid in the loop network (for the rectification or new mine), in one to N machine, in one to one (for the mine with free fiber link).

2.3.11 large system capacity: support 5000 registered users, support 126 channels above voice concurrency, and support stack expansion.

2.3.12 innovative technology: the mobile phone with identification card function can connect with the coal mine personnel positioning system independently developed by our company while making calls, and it is compatible with the existing coal mine personnel positioning system, so as to achieve the positioning function.

2.3.13 super compatibility: the downhole equipment of the system is only

responsible for the coverage of wireless signals, and all the switching equipment and information processing units are completed by the downhole equipment, so that the system has super compatibility and can be replaced or upgraded in a timely manner according to the needs of technological development.

2.4 Main functions of the system

2.4.1 Wireless system

1) The private network is required to operate independently and is not affected by the operator's network. Can use IMS technology and operators to achieve network docking. And the ground network can choose a different system from downhole private network (the operator needs to open the IMS interface, and the terminal needs to support both private network and public network communication system).

2) The base station of the system is required to be connected with full optical cable, which can be connected to the ring network nearby or can be self-assembled ring network (gigabit access, supporting VLAN division). The base station has a two-way coverage distance of 3000-4000 meters in the main alley, and the single base station is equipped with 4 antennas.

3) It is required to support the peak rate of 100Mbps downstream and 50Mbps upstream, and the wireless throughput rate is comparable to wired transmission, which can easily access a large number of wireless transmission devices including hd video;

4) The dispatcher is required to adopt a graphical operation interface, through which the dispatcher can conveniently monitor the status of all dispatching members, such as calling, ringing, calling, online, etc.

2.4.2 Intelligent scheduling system

1) Integrated scheduling communication platform that requires multi-platform integration; Sharing platform technology; Hierarchical networking and intelligent linkage; Graphical interface, mobile scheduling;

2) Request one-key evacuation; Plan management; Emergency call; Radio intercom; Mobile office; Audio video linkage; Video intercom; Unified dispatching;

2.4.3 Digital wired system

- 1) The voice scheduling module of the communication system of the wired dispatching machine is required to adopt a hot standby mechanism to realize the function of unified wireless command and scheduling. Support the platform access of broadcast and Shouting system; Dispatching direct calls to internal and external lines; Dispatch strong insertion, forced demolition, monitoring, one key in place; Dispatching group call and selection call; Non-blocking automatic switching between extensions; The extension number is displayed.
- 2) The wired dispatching communication system is equipped with an online recording module, which adopts an online embedded recording mode and requires the use of advanced DSP technology to process the voice signals, so as to realize all the functions required by the mine and monitor the whole process of the mine users at the same time without the limitation of the number of lines.
- 3) Network management function module is configured in the wired dispatching communication system, and the maintenance terminal adopts Chinese management interface, which can easily set and modify various user data, bureau data, dispatching station data and key data.
- 4) The system supports linkage alarm service. When an alarm is found at a terminal, the dispatcher can receive real-time scene images of the member in real time.
- 5) The system supports the function of mandatory remote monitoring, and the dispatcher can initiate monitoring instructions, so that video around members can be viewed remotely without terminal answering.
- 6) Upload photos and videos on site, and the dispatcher can store, check and retrieve them.
- 7) In addition to AD hoc network, the system can be seamlessly connected with the public network. The mobile phone card used on the ground can be installed on the mobile phone provided by our company.

2.5 Effects on production safety

- (1) When there is a disaster or safety hazard in the mine, the site situation can be timely and accurately transmitted to the management personnel and the management department in the first time.
- (2) Quick response mechanism. The mobile phone has the sound and light alarm function. When there is a disaster in the underground, the platform can be informed by the underground and underground workers.
- (3) Safety management information platform can be established to conduct safety management in aspects of safety production training, emergency notification, hidden danger detection, etc., anytime and anywhere.
- (4) An expert group policy platform can be established to gather professional talents to provide real-time guidance for mine safety production.
- (5) The mobile phone can take photos, record videos, talk on video and other functions according to customers' requirements, so as to facilitate production scheduling and safety management
- (6) Downhole workers can provide real-time production information to management personnel;
- (7) Unhindered management. Managers can conduct all-weather and all-directional tracking and command of underground personnel, equipment, production and other conditions.
- (8) Reflect the intimate and convenient humanistic care, no matter miners in the mine, the ground, home can communicate effectively.

3. Product introduction

3.1 KT594-S Mine intrinsically safe mobile phone

1. Technical parameters

- (1) Explosion-proof type: mine safety type
- (2) Display: 5-inch hd capacitive touch screen
1280*720 resolution;
- (3) Operating system: android 8.1; CPU: quad-core 1.3ghz;



(4) Network: all netcom (mobile 4G, unicom 4G, telecom 4G)

(mobile 3G, unicom 3G, telecom 3G) and the whole network 2G at the same time

Online, support VoLTE hd video calls;

(5) Camera: 5 million on the front and 16 million on the back; memory

Storage: 3G RAM + 32G ROM, TF card can support up to 32GB;

(6) WIFI:802.11b/g/n wireless network module and bluetooth 4.0; Built-in GPS chip;

Support FM. Battery: 5700mAh lithium battery; Grade :IP68 waterproof, dustproof, fall proof, explosion proof;

2. Main functions

1) low-power circuit is selected to meet the need of long standby and call;

2) two-way communication function with kt594-f mine flameproof and intrinsically secure communication base station;

3) with call selection function;

4) the authorized mobile phone has group call and full call functions;

5) emergency call function;

6) it has the prompt function beyond the service area and the busy prompt function of the current channel;

7) low voltage alarm function;

8) support functions of Android system;

9) it has the functions of taking photos, recording and recording, key operation and liquid crystal display;

10) support bluetooth, dual CARDS and dual standby;

11) support WiFi function;

12) anti-seismic, waterproof and anti-corrosion functions

3.2 KT594-S1 Mine intrinsically safe mobile phone

1. Technical parameters

(1) explosion-proof type: mine safety type;

(2) camera: 8 million front and 16 million rear

The camera; Memory storage :6G RAM +128GROM;

Double card double treat;



(3) network: all netcom (mobile 4G, unicom 4G,
(China mobile 3G, China unicom 3G, China telecom 3G)

It is online at the same time with 2G of the whole network and supports VoLTE hd video calls.

2. Main functions

- 1) low-power circuit is selected to meet the need of long standby and call;
- 2) two-way communication function with kt594-f mine flameproof and intrinsically secure communication base station;
- 3) with call selection function;
- 4) the authorized mobile phone has group call and full call functions;
- 5) emergency call function;
- 6) it has the prompt function beyond the service area and the busy prompt function of the current channel;
- 7) low voltage alarm function;
- 8) support functions of Android system;
- 9) it has the functions of taking photos, recording and recording, key operation and liquid crystal display;
- 10) support bluetooth BT4.0, dual CARDS, dual standby, LED flash, full netcom;
- 11) the phone has wifi function.
- 12) support office system (OA), APP, etc.

3.3 KJJ127 Mine Explosion-proof Gigabit Network

Switch

1. Gigabit optical port

Transmission mode: LC, single mode, double fiber;

Number of interfaces: 2 channels;

Light wavelength: 1310nm;

Transmission mode: SC, single mode, double fiber

Number of interfaces: 4 loop

Optical wavelength: 1310nm

Transmission power:-15dBm~0dBm



Maximum transmission distance: 50 km

(3) Ethernet electrical port

Transmission mode: RJ45

Number of interfaces: 3 loop

Transmission rate: 10/100Mbps (adaptive)

(4) Maximum transmission distance: 10m

Data transmission performance

Device throughput: ≥ 5400 Mbps

(5) back up power

Change-over time ≤ 500 ms

Continuous working time ≥ 4 h

(6) Power Supply Voltage

Rated working voltage: AC127V; rated working current ≤ 200 mA

(7) The switch conforms to IEEE802.3 protocol and has Ethernet optical port and Ethernet port, which supports full duplex / half duplex.

(8) It has the functions of initialization parameter setting and power down protection. Initialization parameters can be input and modified through the network.

(9) Has the function of vlan; has the function of self-diagnosis and fault indication.

(10) With power supply, working state, communication status indication function.

3.4 KT594-F Mine explosion-proof intrinsically safe communication base station

(1) Transmission interface: With 3 gigabit ports, 3 gigabit ports, 2 gigabit ports.

(2) Wireless communication with KT594-S mine own mobile phone, KT594-S1 mine own mobile phone

(3) Maximum capacity: more than 96 parallel calls of base station.

(4) Back up power

a) change-over time: ≤ 500 ms;

b) charging current: ≤ 1 A;

c) Maximum charge voltage: 31.5V;

- d) Charging cutoff voltage: 29.4V;
- e) final discharging voltage: 21.7V;
- f) operate time: ≥ 4 h;

(5) Power Supply Voltage

rated operational voltage: AC660V、127V

(6) The base station has the functions of initialization parameter setting and power down protection, and the initialization parameters can be input and modified through the network.

(7) The base station has the functions of working state, communication status indication, etc.

(8) In straight roadway or inclined roadway, the coverage radius of single base station is not less than 800 meters, one base station is equipped with 2 antennas, and multiple antennas are added at fork or slope point to realize full coverage of signals in all directions.

3.5 Scheduling host

(1) Main functions of core scheduling host

The core scheduling host is the core of the integrated scheduling platform, which has seamless docking with ip-pbx, including visual voice mail, virtual relay, lcr, teleconference, automatic operator, support No. 1 signaling and pri signaling. It can also connect other application servers with the help of open api interface to realize the cooperative operation of various integrated automation and information systems.

(2) Technical parameters of dispatching server

Specification list	
Index item	Main functions and index requirements
Network port	One 10/100M adaptive RJ45 Ethernet port
Voicemail	Accumulated 600 hours of voice mail
Line connection	Support SIP Phone (via Ethernet VoIP), support SIP soft phone or VOIP terminal, standard FXO interface to the Office (loop start,

	ground start), standard connection to analog phone (FXS interface), support did direct dial in; support IP relay, can directly connect to private IP voice core network or ITSP, IP phone service operator, T1 / E1 ISDN pri nisdn-2 / e-isdn interface, analog fax adapter (G.711 Fax) .
Voice function	Incoming call answer, call out number, call end; call hold, call transfer, call waiting; call transfer (user busy transfer, no answer transfer, unconditional transfer), music waiting; caller identity receiving and display; multiparty conference bridge: Supports simultaneous conferences with multiple participants, standard E.164 and IDDD PSTN outbound dialing, CDRs (call details) – AMA compatible – has several days of caching capability; multiple dial plans for different user groups, Maintenance and configuration – hierarchical user WEB management portal for end users, management users/different control levels, WEB configuration management interface for remote management, firewall/NAT traversal capability-transparent to users (no additional configuration required); enhanced voice quality /Business support capability, advanced jitter buffering function, can run in a hybrid VoIP/TDM network composed of different manufacturers' equipment, internal private dial plan (direct dialing number) automatic attendant.
Scheduling function	Management function, distributed networking; member status displa, call and call; monitoring function, scheduling operation, night service, linkage phone, voice time recording, recording; voice report, telephone inquiry missed call, temporary conference group, broadcast, multicast, broadcast, monitor, forbidden, forced demolitions, forced insertion, transfer (automatic/manual), pick-up, background music and emergency broadcast, emergency linkage.

3.6 Core network server



CPU frequency: 2.6GHz

CPU core: 16 cores

CPU threads: 32 threads

Memory type: DDR4

Memory capacity: 16GB

Solid state drive: 256GB

Hard disk interface type: SAS

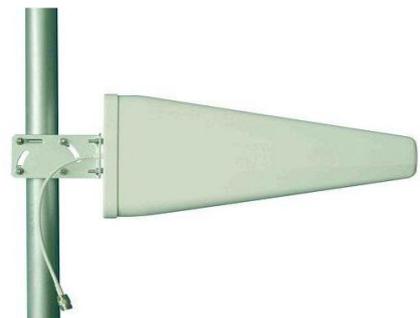
Hard disk capacity 1T*3

Maximum hard disk capacity: 16TB

3.7 Antenna feed system

The system adopts the antenna feed system (directional antenna + power divider + feeder distributed signal) coverage mode is the most effective, suitable for a variety of complex roadway environment, but also easy to maintain, the most economical engineering investment.

The realization method is to output the



high-power RF signal from the underground KT594-F mine explosion-proof and intrinsically safety base station, distribute the download power according to the width and curvature of the field tunnel through the special power divider, and cover an unshielded area through the directional antenna.

In case of the bending of the tunnel, the air door shield, fork road and chamber can be extended forward through the feeder line, with the maximum distance of 1.5km.

The segmented tunnel signal coverage system enables the end user to move at a speed of 60km in the tunnel, ensuring high-quality voice and no drop of line. To ensure the reliable use of the mobile terminal on the mine locomotive.

High-gain directional antenna is the key factor to improve radio frequency coverage in the complex environment of mine. The system adopts a high gain log directional antenna suitable for the wireless coverage of narrow mine tunnels. The antenna is suitable for the requirements of broadband, and the gain can reach 11dbm.

The practice proves that in the tunnel of the mine, the signal coverage is not limited to the narrow of the tunnel, mainly the large angle bending of the tunnel, plus the multi-port of the roadway, the blocking of the air door, the rock shielding chamber, the complex environment of the equipment area is covered by the straight line of the antenna, the distance is very limited, the system uses the feeder + power divider + antenna to realize the partial antenna project layout, which is the most valuable. Effective roadway coverage solution.



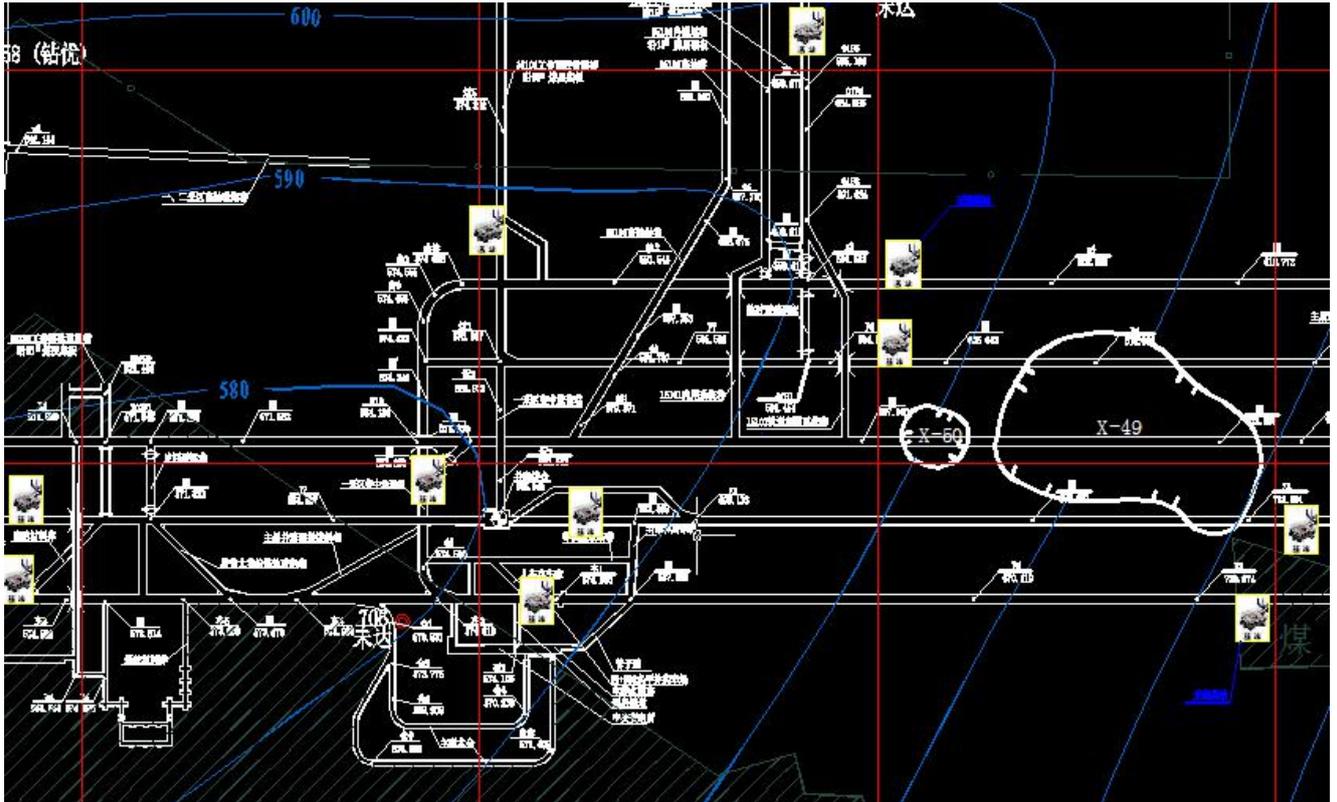
4. Coverage design

The ground is covered by a large base station of 500mW, and the coverage radius of the large base station is between 800m and 1200m. Three ground outdoor high-power base stations and eight indoor base stations are installed on the ground to cover the main office buildings and industrial sites on the ground.

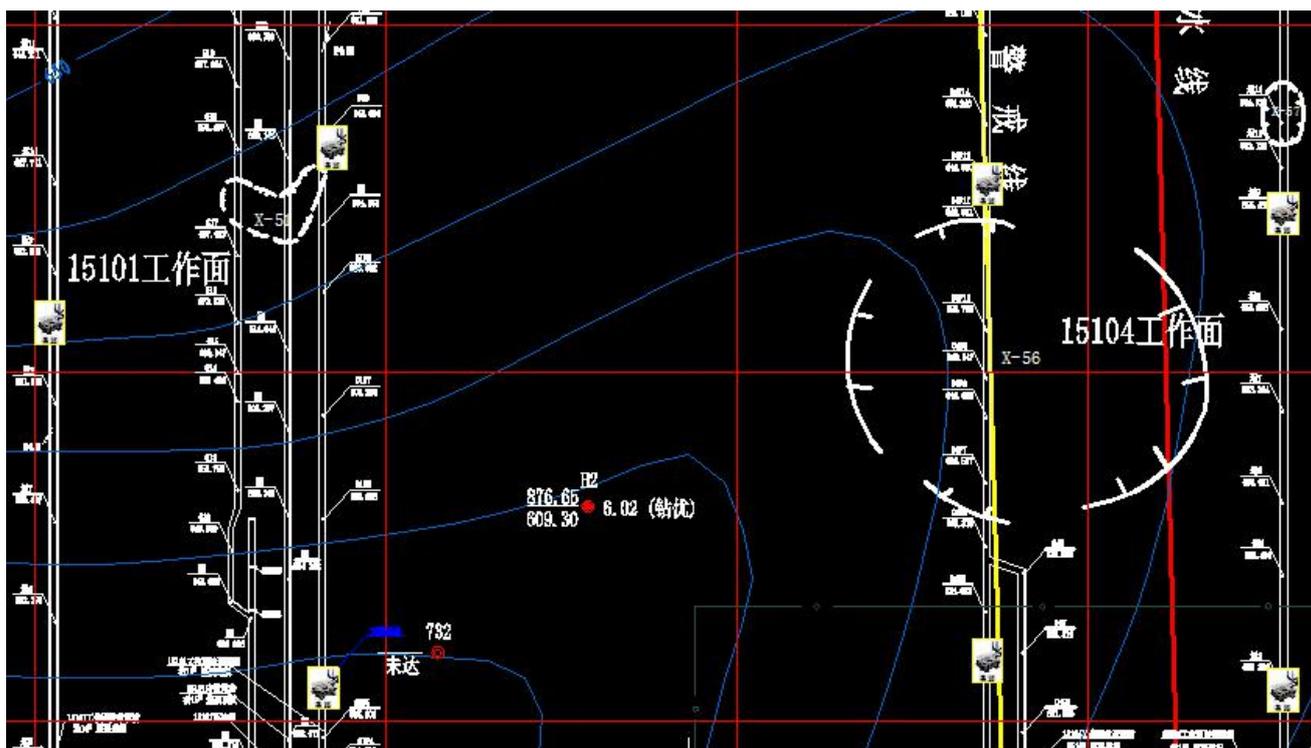
Because most of the underground channels are narrow and long, KT594-F mine base station and directional antenna are basically used for coverage. The underground

part of the project is designed to cover the main underground roadways, substations, transportation roadways, belt roadways and other areas. Considering the concentration of personnel and high traffic volume of each working face, and based on the 800 meter coverage of single KT594-F base station, a total of * * KT594-F base stations are planned underground.

Distribution diagram of underground base station 1:



Distribution diagram of underground base station 2:



5. Configuration list

The specific layout plan is configured according to the demand of the mine.