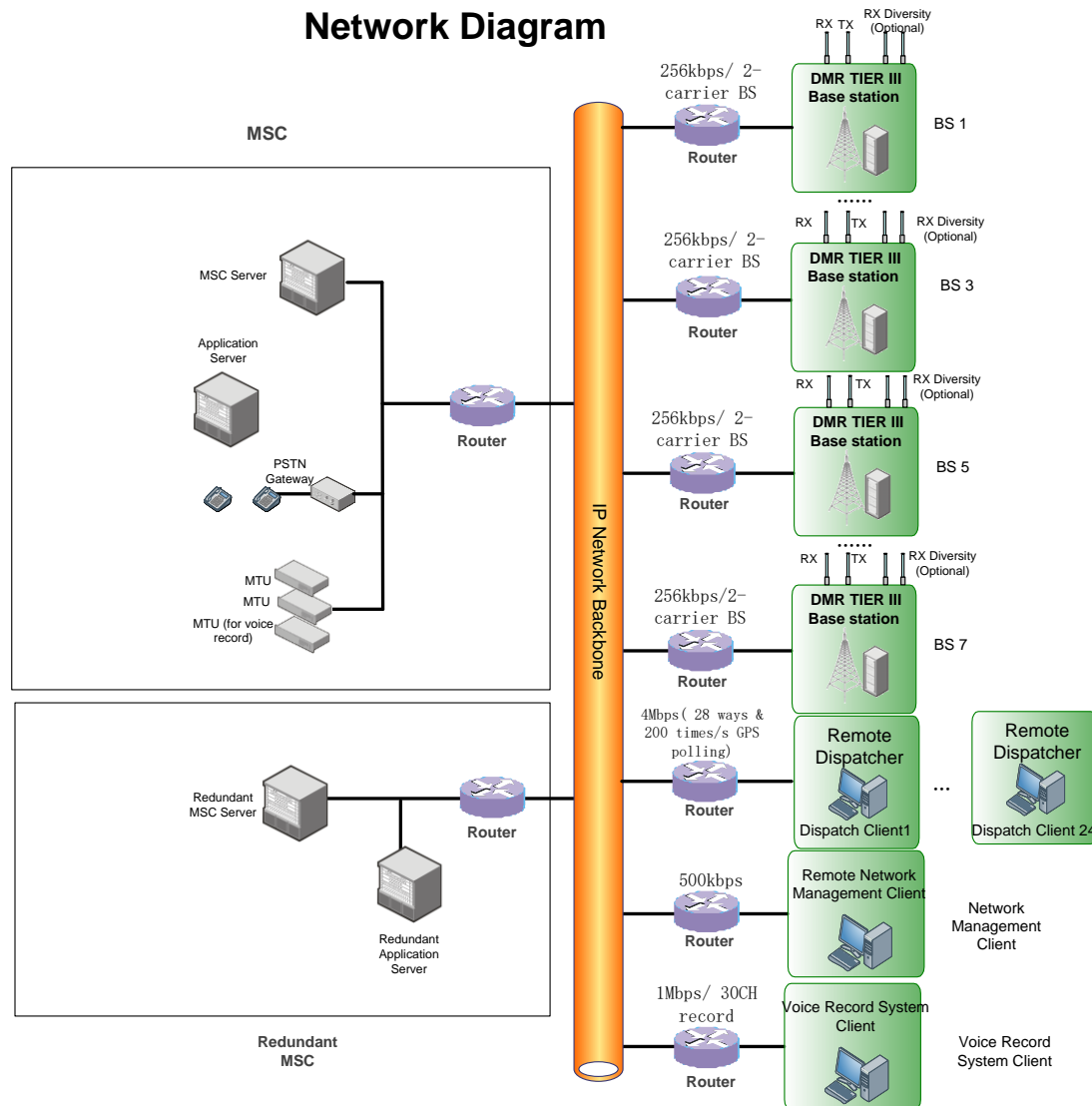


1. EXCERA DMR TIER 3 TRUNKING SYSTEM - NETWORK DIAGRAM AND IP REQUIREMENT



The core network refers to the MSC that adopts the soft switching technology. Its main functionality includes call control, signal exchange, resource management, and communication protocol processing. The MSC can connect to the analog MPT system, conventional system, PSTN and other existing systems to establish an integrated wireless dispatching network. The core network can be made up of multiple MSCs for expanding coverage and the access network is composed of several BSs. Each MSC can connect to 240 BSs at most. A zone center can contain a maximum of 200 MSCs and up to 48000 BSs.

2.1 IP Requirement

All the DMR tier III equipments are based on IP infrastructure. MSC equipments are at local, so it can provide 100M/1000M bandwidth.

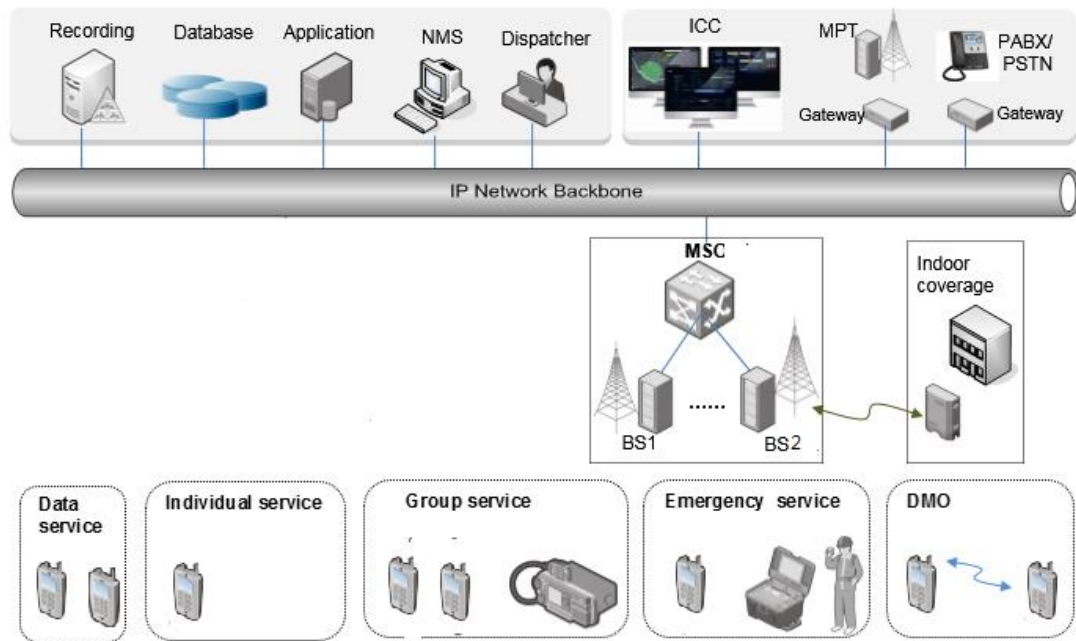
- a) For the remote equipment such as BS, remote dispatch and remote network management client, etc., the IP requirement is as below:
- b) BS: one 1-carrier BS bandwidth standard requirement is 128kbps, so one 2-carrier BS bandwidth maximum requirement is 256kbps, including voice and data transmit;
- c) Remote network management client: the maximum requirement is 500kbps;
- d) Remote dispatch: Dispatch system support up to 28 ways of voice transmission simultaneously. One way voice call needs 64kbps bandwidth. So the maximum voice call needs at least 2 Mbps.
- e) Dispatch system supports up to 1000 times pulling up in 1 minute, one way GPS data transmission needs 1kbps bandwidth, so the maximum GPS data transmission requirement is 1Mbps
- f) In total, the maximum requirement for dispatch system is 2M including 28 ways of voice and the maximum GPS data transmit.
- g) Voice record system client: One way voice recording supports up to 64kbps. So the maximum requirement is 2Mbps including 30 CH record simultaneous.

3.EXCERA DMR T3 TRUNKING SYSTEM ARCHITECTURE AND FUNCTION

3.1 System Architecture

The system logically consists of the Base Station(s), Mobile Station(s), Bearer Network, Mobile Switching Centre (MSC), Dispatcher, NMS and applications.

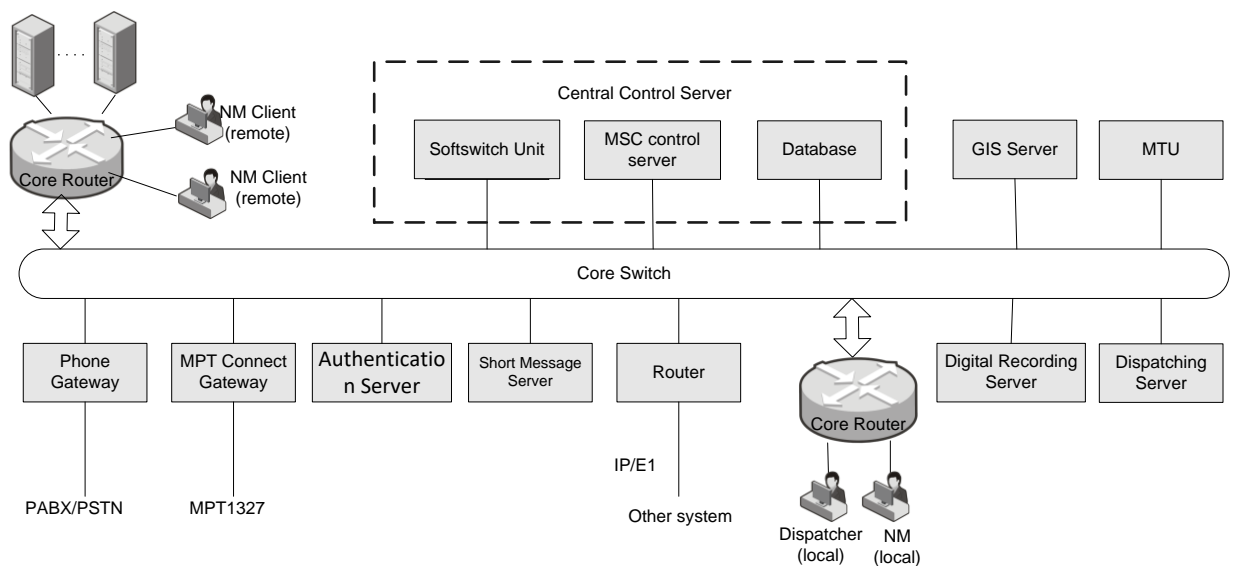
A typical multi-site network topology of EXCERA DMR trunking system is shown as below:



3.2 MSC Core Network Equipment

The MSC core network is in charge of interconnection and data switch between each base station, which can achieve the inter-site/system calls, user management, equipment monitoring and maintenance, and priority management.

The MSC core network logically includes the MSC control server, the switching server, network management unit, recording server, media translation unit, GIS server, message server, database unit, and authentication server. In addition, the standard interconnect interface and the secondary development interface are available for connecting to the analog system, digital conventional system, PSTN/PABX system, third-party DMR system, and the dispatching system at the command center. The DMR MSC contains the entities as follows:



Functions of each MSC logical component are described in the table below:

System Component	Description
Router	It routes IP data packet between the MSC devices, remote devices and remote base stations, and provides appropriate physical interfaces. It routes information between the system and user network, and allows intercommunication between different MSCs.
MSC control server	It implements functions such as signaling processing, call processing and resource management.
Central Database Server	It consists of short data router and packet data gateway, and provides data service.
Short Message Server	It routes and record short data message in the system.
Dispatching Server	It mainly implements communication and management, and monitors activity and status of the hidden subscriber.
Network Management Client	It provides the interface for monitoring, configuring and managing devices in the system, and implements configuration, management, operation and maintenance for the whole network via the network management server and central control server.
Recording Service	It can record the voice call across the whole network without any loss, and then retain them for future use such as post-incident analysis.
GIS server	It can transmit and storage all the user GPS position informations.
Authentication Server	The MS and the system can authenticate mutually relying on their keys and specific encryption algorithm.
MTU	It converts the voice data between different formats.

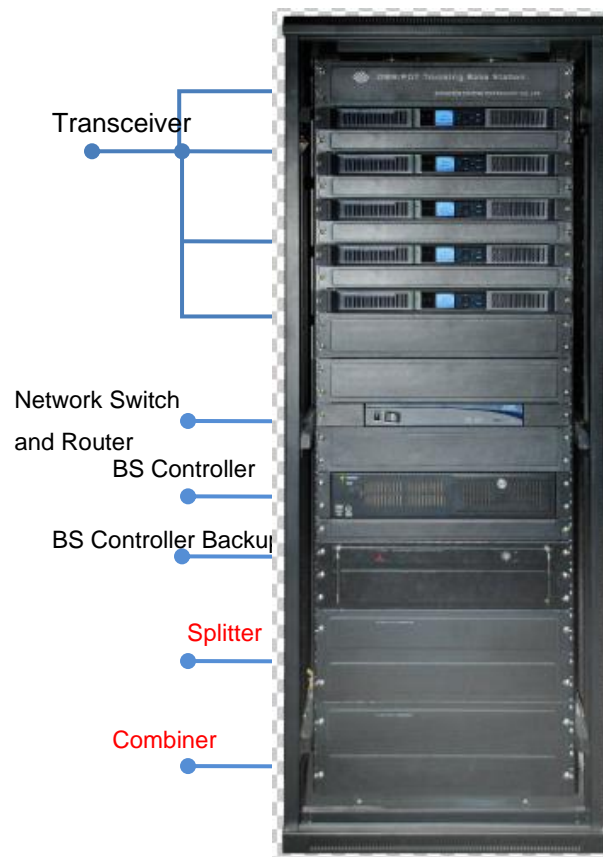
As the core equipment of the switching center, the MSC is to implement call control and switching, BS networking, user roaming management. A MSC in a prefecture –level city can connect to its counterpart in another prefecture-level city. The MSC adopts dual backup to enhance system reliability and stability. A single MSC can connect up to 240 BSs and a DMR core network can contain a maximum of 200 MSCs, satisfying province-wide dispatching requirements.

MSC includes dispatching, recording and GIS application systems. The dispatching system dispatches analog and digital trunking users, and it can connect to GIS system in the command center. In addition, the dispatching interface is available for connecting to the existing integrated dispatcher. The recording system records all calls in the system. Besides, it can retrieve and play back the calls on the webpage according to location and time of the calling and called parties. The GIS system displays the current location of the terminal with GPS functionality in real time. Users can make visual deployment on the map and makes calls to

terminals in a desired zone.

The IP-based switching center adopts carrier-grade routers and exchanges, and professional servers to make sure that the hardware platform of the switching center is stable and reliable. The Linux OS is available for the MSC server, ensuring high reliability and stability of the software platform.

The MSC physically consists of Authentication Server, MTU, IP-E1, Switch, Router, Gateway and Server, as shown below:



The Key components are shown as below:

a) Router

The core network router can provide the IP switching among the unit in the network, which can directly connect to the transmission system.

b) Center DB server

Center DB server main store below types of data:

Store user or group account information, and business property to contract

Call quantity statistics and billing database

Network database (Logs for system running, the network element software, configuration database)

- c) The authentication server, being the DMR AuC, is to store user authentication master key, make authentication algorithms, and generate the OTA encrypt key.
- d) Dispatcher

The dispatches can be flexibly in any location in networks as a logical entity, based on IP soft switch. Local dispatches in Switching MSC Control Center could directly access to the MSC central controller via IP soft switch in LAN. Remote dispatches are connected to the MSC central controller via IP soft switch in WAN.

- e) Network Management system

Network Management system is used to monitor the whole core network, to provide the daily management and maintenance remotely for base stations, show as below:

- ✓ ☐ Configuration Management
- ✓ ☐ User Management
- ✓ ☐ Secure Management
- ✓ ☐ Working Status Management
- ✓ ☐ Error Management

Network Management system provides the man-machine interface for system monitoring, configuration and management. With the support of the network management server, the Network Management system can achieve a integrated monitoring, management, maintenance and configuration for the equipment of the whole network. Through the IP switch, the network management system can achieve the remote control in WAN.

- f) MTU

This equipment could process different voice encoding format for the intercommunication.

3.3 DMR Trunking System Features and Functions

a) Mobility Management

It mainly includes power-up registration, authentication registration, power-off deregistration, handover and roaming, etc.

- **Power-up Registration:** The MS registers with the system to verify the identity and authority when it is switched on. Meanwhile, its status and location information can be determined via such registration.
- **Authentication Registration:** The system authenticates the registering MS and proves its validity.
- **Power-off Deregistration:** The registered MS deregisters from the network when it is switched off.
- **Roaming:** The MS updates its location information when it moves from one base station to another.
- **Handover:** The communication carries on seamlessly when the MS moves from one base station to another. The implementation of handover has following characteristics:
 - Handover-related information can be broadcast to the MS during idle period of the call.
 - During idle period of the call, the MS can switch to a base station not involved in the call.
 - During idle period of the call or when receiving, the MS can switch to a base station involved in the call.
- **Participant Group Attachment**

When the MS switches the current group to the participant group, it sends a signal to the system indicating that it is attached to the participant group. When a call is made to the participant group to which the MS is attached, the system determines whether to allocate traffic channel for the call according to information on the participant group.
- **Control Channel Reselection**

Includes automatic reselection or manual reselection.

 - Automatic reselection means that the MS automatically determines whether to re-register with control channel of the target base station based on a comprehensive comparison of signal strength, priority etc. between the current base station and the target base station, according to the MS's configurations and broadcast information from the system.
 - Manual reselection means that the user enters the control channel number of the target base station, so as to switch the MS to the corresponding control channel.

b) Security Services

The security services include authentication and end-to-end encryption.

- **Authentication:** The MS and the system can authenticate mutually relying on their keys and specific encryption algorithm. It can be accomplished through three approaches: a) the MS authenticates the system; b) the system authenticates the MS; and c) the MS and system authenticate each other (mutual authentication).

It includes: authentication made during the registration (power-up registration and registration due to location update), authentication initiated by the system (the NMS or LDS can authenticate a certain MS at any time), and authentication made during stunning, reviving or killing. The authentication made during the registration and the authentication initiated by the system enable the system to authenticate the MS, while the authentication made during stunning reviving or killing enables the MS to authenticate the base station.

The 128-bit authentication key can be generated by the tool developed by EXCERA or configured by the system administrator.

- **End-to-end encryption:** It allows the voice or data to be transferred in the encrypted form during communication. The data will not be decrypted until it arrives at the destination, so as to ensure data safety during transfer. By using the key preconfigured for the terminal, the transmitting party performs the encryption and the receiving party performs the decryption. The system devices are not involved in the key management and encryption and decryption.
 - Only MS and LDS can support the end-to-end encryption service.
 - The end-to-end encryption service can encrypt the voice and data.
 - The software-based end-to-end encryption is available.

c) Basic Voice Services

Basic voice services include individual call, group call, LDS call, telephone call, MPT call, all call and broadcast call, etc.

- **Individual Call**
 - **OACSU (Off Air Call Set Up):** The call can be put through automatically without operation to the called terminal.
 - **FOACSU (Full Off Air Call Set Up):** The call should be put through or terminated manually with operation to the called MS.
- **Group Call:** It is a half-duplex call initiated by one member in the group to the other members. The member can be either the MS or the LDS. During the group call, only one member can talk at a time, i.e. only one channel is allocated. The group

call can be terminated by the initiating member only.

- **LDS Call:** It is a call between the MS and the LDS.
- **Telephone Call:** It is a call between the MS and the PABX/PSTN terminal. It includes full-duplex telephone call and half-duplex telephone call.
- **MPT Call:** It is a call between the DMR MS and the MPT MS. However, only group call is supported between the DMR MS and the MPT MS.
- **All Call:** It is a call that involves system-wide users, allowing the initiating party to talk only.
- **Broadcast Call:** It is a call intended for one or multiple MSs, allowing the initiating party to talk only.

d) Basic Data Services

DMR system is capable of providing versatile data services, such as short message, GPS data polling, status message and emergency alarm, etc.

- **Short Message:** It is convenient to communicate via short message between MSs, or between the MS and the LDS.
- **GPS Data Polling:** The MS sends GPS information to the system upon request, for visible dispatching service.
- **Status Message:** The quick text such as “Patrolling” and “Refueling” can be predefined for both receiving and transmitting parties.
- **Emergency Alarm:** It is a status message that always accompanies the emergency call.

e) Supplementary Services

- **Emergency Call**

It is a call initiated by the subscriber to a fixed individual number, group number or dynamic individual number in case of emergencies.

- **Emergency Button:** You can press this button to make an emergency call, and with the Hot Mic function, you can directly speak into the microphone without holding down the **PTT**. At this moment, only the LDS can cut in.
- **Emergency Number:** You can also make an emergency call by dialing your desired emergency number. The emergency call can be sent to anyone to settle the urgencies.
- The emergency call enjoys the highest call priority, and does not need to queue in case of busy status. If all channel resources are occupied, a call with a lower priority will be terminated to release the channel resource for the emergency call.

When an emergency call is made, any called subscriber, regardless whether it is

involved in another call, will be brought into the emergency call.

- **Dynamic Base Station Assignment**

It is to dynamically assign a channel to the MS which really needs resources, enhancing the efficiency of channel utilization. Traditionally, the trunking system allocates the traffic channels of all base stations to a group call, no matter whether there is a group member in the coverage. So it brings about a waste of channel resource. With this function, the channel resources can be allocated according to the actual group member distribution, and thus provide high system capacity.

- **Call Priority**

It is used to set priorities of multiple levels for subscribers, enabling the most critical one to access the network quickly during busy period. When the system is busy, it will automatically terminate the less important call and allocate the resource to a call with a higher priority.

Pre-emptive priority is used to establish a high-priority call, even when there is no resource available. It allows you to terminate the call with a lower priority to release the resource.

Super group call is featured with the highest priority and pre-emptive priority. Only the most significant member is allowed to initiate this call.

Emergency call is next to super group call in priority and also has pre-emptive priority.

Normal call can be made only when the resource becomes available. The normal call has ascending priority levels from 0 to 3. The normal call with priority level 3 has pre-emptive priority.

- **Call Duration Limitation**

To make reasonable utilization of the system resource and prevent any subscriber from occupying the channel for a too long time, the system limits the call duration and speech item via appropriate timers. Once these timers expire, the system will end the call or interrupt the subscriber's talk automatically. It includes dynamic call duration limitation and talk group call duration limitation.

- **Dynamical Call Duration Limitation**

- The system dynamically adjusts the call duration according to traffic. In general, the call duration is set shorter for the busy period and longer for the idle period. Before the call is terminated due to expiration of the defined timer, the system will inform all involved MSs, which will alert the subscribers by audible or visible indication.

- **Talk group Call Duration Limitation**

The parameters of each talk group include customizable call-controlling timers, including:

- Total Call Duration
- PTT Item

- Idle Period
- Talk group/Background Group Hunt
 - Talk group Hunt: the MS can hunt the group numbers in the list, and jump into an in-progress call if any communication activity is detected in this group. There are two kinds of situations: an MS in an idle status can receive the call from other groups than the current one; and an MS during conversation can switch to a call with the higher priority if necessary.
 - Background Group Hunt: the background group has top priority, only allowing an authorized LDS or MS to initiate a group call. And this group is not displayed in the group list by default. The MS is allowed to receive a call only, because it cannot select the background group through a knob or menu. It will always keep hunting the background group and join in an in-progress call if detected.

- Dynamic Group Number Assignment

This feature enables the authorized LDS to dynamically create, modify or delete groups, which provides a powerful and flexible approach to enable you to manage your own communications in a way that is most suitable for you. Group members might be from different groups.

- Late Entry

This feature allows a group member that has missed the start of a transmission to join an in-progress group call later. It is applicable to the following situations:

- The MS is turned on after the group call is established.
- The MS goes to the coverage area after the group call is established.
- The MS is busy with other call services on a traffic channel when the group call is established on another traffic channel. After such other call services ends, the MS will join the group call.
- The MS moves from a place with weak signals to a place with strong signals after the group call is established.
- The MS is added to the group after the group call is established.

- Discreet Listening

It allows an authorized LDS to track and listen to voice and events experienced by a certain MS or group.

The listening service includes voice listening and event listening. Generally, the system forwards all voice from the listened party to the listening LDS. However, if the wireless voice and wired voice exist simultaneously in a call in which the PSTN/PABX terminal is involved, the system only forwards the wireless voice to

the listening LDS. The events that can be listened include registration event (registration/de-registration) and call event (call initiation success/failure, call establishment success/failure, call termination success/failure, voice listening success/failure and message transfer success/failure).

When an LDS makes a discreet listening attempt, the system first checks whether the LDS has the listening privilege. If yes, this listening task will be put into a listening task list. When the listened MS makes an individual call or a group call, or is called, the main control base station will send a listening message to the MSC, which in turn will report the corresponding listening event to the LDS. After the call is established successfully, the MSC allocates wired resources for the listening LDS, and forwards the call to it. However, if the listening LDS is a member of the group, the MSC does not need to allocate wired resources for the listening service.

- **Ambience Listening**

This feature allows an authorized LDS to listen ambient sound of an idle MS in order to learn its surrounding conditions. However, the listened MS will not be notified by any audible or visible indication that it is listened.

This feature is generally used for the subscribers' safety. This feature is generally used for the subscribers' safety (for example, a control center can acquire the current status of a subscriber in a hazardous circumstance). An authorized subscriber (e.g. a dispatcher) can establish a simplex call to the designated MS, only permitting the called party to transmit his or her surrounding sound to the control center. Voice must not be transmitted from the control center to the called MS. This call can only be initiated when the called MS is not involved in an active call.

Ambience listening includes normal listening and emergency listening. When the MS makes a call, the ongoing ambience listening will be terminated automatically. Just as emergency call, the emergency listening has top priority and cannot be interrupted. Only the MS (including the stunned one) can be listened.

- **Override/ Interrupt**

- **Interrupt:** This feature allows the authorized LDS to forcedly interrupt the active talk made by the MS and start talking.

- **Override:** This feature allows the authorized LDS to forcedly end the active call.

- **MS Stun/Revive**

Stun

If an MS is lost, the LDS can stun it. When this MS receives the stun command, all functions (including call and message services) will be disabled. However, its registration and GPS information are still available to help you get the MS back.

Revive

This feature allows the authorized LDS to activate a stunned MS for normal use.

- MS Kill

This feature allows the authorized LDS to kill an MS. The killed MS will be incapable of any operation permanently, before it is reprogrammed by a qualified dealer.

- Slave Group Call

If a call is initiated to a master group, this call can preempt subscribers of the master group in following three ways.

- It pre-empts subscribers involved in the active slave group call, from the coverage of BSs with which the subscribers are currently registered.
- It pre-empts subscribers involved in the active slave group call and subscribers involved in the active individual call, from the coverage of BSs with which the subscribers are currently registered.
- It pre-empts subscribers involved in any call, from the coverage of BSs with which the subscribers are currently registered.

- Short Message Storage and Forwarding

It allows storage and forwarding of the text message. When the called MS cannot receive short data because it is involved in an ongoing call or is not turned on, the short data will be stored in the short data message centre and sent to the MS when it is idle or online.

- Super Group Call

It is a group call with pre-emptive priority. Only the authorized MS is allowed to initiate this call to the specified group designated by the system. Once the super group call is established, all ongoing calls in the system will be terminated, to ensure all members of the super group to join this call immediately.

- Group Call Merging

This feature allows the system to merge the subscriber, which initiates a call to a group having a call, into this group as a called member.

- Emergency Alarm

This feature allows the subscriber to initiate an emergency alarm to an LDS or an MS or a fixed group by pressing the Emergency key or tilting the portable radio to a certain angle, and is enabled via MS programming.

The emergency alarm, which is sent via a predefined status message, includes non-horn/light alarm and horn/light alarm. If the MS is configured with the non-horn/light alarm, it will not give any indication after this alarm is generated. Otherwise, the MS will give horn/light indication after the horn/light alarm is generated, to indicate that the MS is in a hazardous circumstance.

- All Call

The All Call service provides a one-way voice call from any MS or LDS to all MSs within the whole network. It has the following features:

- Group Call: All Call is made in the same manner as the group call.
- Call Attribute (Broadcast/Non-broadcast): The calling party defines the all call as either a broadcast call or a non-broadcast call.
- Pre-empted/Non-pre-empted Subscriber and Priority: All call is classified into emergency all call, priority all call and normal all call by its priority. Emergency all call can interrupt all ongoing calls (including emergency individual call) within the target zone and then get the resource to initiate an all call. Priority all call and normal all call can pre-empt the subscribers. When the system is busy, priority all call is allowed to pre-empt the channel resources, while normal all call has to queue according to its priority.
- All call supports the following services: override, interrupt, monitoring and recording.

- Short Data Message

The text data including the text notification from the LDS and text message from the MS can be transmitted on the dedicated traffic channel. It has the following two features:

- Each MS applies for a data traffic channel after receiving the status notification from the system.
- Each MS transfers data on an independent traffic channel.

- OTAP

This feature allows you to remotely program the MS using the network management application over the air interface. The programming data such as GSI and group alias can be transferred to the MS over a narrow-band packet data

channel.

- Cut In

Normally, MS with high priority is unable to apply for talk right during the half-duplex call. When the subscriber presses the programming key, the MS will send the request by means of the status message to the system on the control channel. After the system grants talk right to the MS, it will go back to the traffic channel to speak.

- Queue

When all channels are in use, the system will send a message to notify MS that the call is queuing if a subscriber attempts to initiate a call. At this moment, the call begins to wait in the predefined period of validity.

- Call Display

After a call is initiated successfully with the PTT key, the call-related information will remain displayed on all participating MSs until the call ends. This service helps you learn the call status of the current MS.

- Call Alert

If a new call arrives when you are busy, the MS will display the call type and caller ID to prompt you. At this time, you can just answer or ignore it.

- Caller Line Identity Presentation

If this service, available for the called MS only, is enabled, the number of the calling party can be shown on the display of the called party. In this way, you can learn who is calling before answering the incoming call.

- Talking Party Identity

When an MS is authorized to talk after a group call is initiated, its number will be displayed on all the members' screen.

- Call Barring

The system can bar an incoming or outgoing call without the knowledge of the target terminal.

- Positioning

The dispatcher can request an MS to send its latest location information to the

system. After receiving such information, the LDS can spot it on the e-map for an intuitive view.

In the way, the movement track of an MS within a certain time period can be shown on the map clearly. The positioning information can be sent via a control channel or a dedicated data channel during the ongoing call or after the call.

- **Group Patch**

This feature enables the LDS to merge multiple talk groups into a temporary talk group, which is allocated with one traffic channel under each BS. When a call is made to any member of the patched group, the entire group will receive the call. The patched group can be disbanded by the LDS according to the actual needs. The LDS is allowed to perform various operations on the patched group, such as disbanding, querying, etc.

- **Channel Monitor**

It enables the user to view channel utilization of each BS via corresponding interface of the NMC or LDS. On the basis of the monitoring results, the LDS can interrupt, override or listen to the call on a certain channel.

- **Call End Pre-alert**

This is a countdown timer which, when triggered, enables the system to inform the MS that the ongoing call is to be ended. Then, the MS generates the pre-alert tone or activates the countdown timer to remind the subscriber that this ongoing call is to be ended within a specific period of time.

- **License Management**

Multi-level license mechanism is adopted, allowing the management of the application in the system. You can purchase appropriate licenses to access various services depending on your actual needs.

3.4 DMR Trunking System Specifications

3.4.1 Single MSC and DMR system Specifications

DMR System	
Items	Specifications
Signaling Standards	PDT&DMR and MPT-1327

Operating Mode	TMO/RMO
Channel Spacing	12.5kHz
Time Slot	2
Modulation	4FSK&FM
Group Call Set-up Duration(Single Base Station)	< 300mS
Group Call Set-up Duration(Multiple Base Station)	< 500mS
Maximum Channels at a Single Base Station	< 32 Carriers
Maximum Base Stations one MSC	< 240
Maximum Base Stations of Multiple MSC	< n*240
Maximum Users	16 million
Maximum Group Calls	16 million
Networked Interface	E1/IP
Wired Interface Standards	FX0 and signaling 1
Network Database	Mysql
Communication Port	10/Adaptive Ethernet Port

MSC

Items	Specifications
Supporting Trunking Standards	DMR&PDT, MPT-1327, digital conventional, analog conventional
Number of Equivalent MSC	64
Number of Base Stations at a Single MSC	240
Switching Server	2, hot backup
Maximum Users	16 million
Maximum Group Calls	16 million
Supported Signaling	Loop, E&M, DTMF
Data Service Interface	E1, IP

3.4.2 Base Station Specification

General	
Frequency Range	VHF1: 136-174 MHz

	UHF1: 136-174MHz UHF3: 350-136MHz
Channel Spacing	12.5 kHz/25 kHz
Dimension (H*W*D)	44*483*375mm
LCD	1.8"HD semi-transparent 128×160 color display
Operating Voltage	DC13.6V±15%,AC 100-240VA
Operating Current	<1A (standby), <11A (transmission)
Frequency Stability	0.5ppm
Duty Cycle	100%
Environment	
Operating Temperature	-30 to +60℃
Storage Temperature	-40 to +85℃
Shock and Vibration	MIL-STD-810 C/D/E/F/G
ESD	IEC 61000-4-2 (level 4) ±8kV (contact) ±15kV (air)
Lightning Stoke (EN 6100~4~5)	Differential mode: 6KV, Common mode: 6KV
Rx	
Digital Maximum Sensitivity	-120dBm/BER 5% / -116dBm/BER 1%
Digital Dynamic Sensitivity (100km/h Rayleigh , 8km/h Rayleigh fading, TU5 path)	-104dBm
Analog Maximum Sensitivity	-120dBm/12dB SINAD
Intermodulation	75dB (TIA603) /70dB(ETSI)
Block	95dB (TIA603 & ETSI)
Spurious Response Rejection	75dB (TIA603 & ETSI)
Selectivity	75dB@25 kHz(TIA603&ETSI) / 65dB@12.5kHz(TIA603&ETSI)
Conductive Spurious Tx	-57dBm
Rated Audio Power	1W
Rated Audio Distortion	3%
SNR	45dB@25 kHz /40dB@12.5 kHz
Audio Response	+1dB to -3dB
Vocoder	AMBE++/NVOC
Protocol	ETSI-TS102 361-1, -2,-3,-4
Tx	
Frequency Stability	0.5ppm
Output Power	High: 45-50W, Low: 25W
Digital Modulation	7K60FXD(data)/7K60FXW (data and voice)

Analog Modulation	16K ϕ F3E@25 kHz/11K ϕ F3E@12.5 kHz
4FSK Modulation Accuracy	5%
4FSK Tx Error Rate	0%
4FSK Error and Measured Error	5%/1%
Adjacent Power	70dB@25 kHz /60dB@12.5 kHz
Spurious Emission	-36dBm <1GHz /-30dBm >1GHz
Tx Frequency Deviation Limit	5 kHz@25 kHz /2.5kHz@12.5 kHz
Audio Distortion	3%
SNR	45dB@25 kHz /40dB@12.5 kHz
Audio Response	+1dB to -3dB

Base Station Controller

Items	Specifications
CPU Main Frequency	2GHz
OS (Software Platform)	Linux
Memory	1GB
Hard Disk	160GB
Network Speed	100M
User Authentication	Support
Remote Maintenance	Support
Communication Port	IP
Network Links	E1/IP/Satellite/Microwave/Public Network

3.4.3 Network Switcher

Product Type	Fast Ethernet Switch
Application Level	Three Layers
Transmission Rate	10/100Mbps
Switch Mode	Storage-Forwarding
Backplane Bandwidth	64Gbps
Packet Forwarding Rate	9.6Mpps
MAC Address List	16K
Port Parameter	
Port Structure	Non-Modular
Port Number	28

Port Description	24 10/100Base-TX ports, 2 1000Base-X SFP ports, 2 Gigabit Combo ports (10/100/1000Base-T or 100/1000Base-X)
Transmission Mode	Full Duplex/Half Duplex Adaptive
Features	
Network Standards	IEEE 802.3, IEEE 802.3u, IEEE 802.3ab, IEEE 802.3z, IEEE 802.3x, IEEE 802.1Q, IEEE 802.1d, IEEE 802.1X
VLAN Support	4K VLANs
	Supports Guest VLAN, Voice VLAN, and Super VLAN; Supports MAC, Protocol, or IP –based VLAN; Supports QinQ; Supports flexible QinQ; Supports 1:1 VLAN switching ; Supports N:1 VLAN switching.

3.4.4 Environment Specification

a) Storage environment

Climate	
Temperature	BS: -40℃~+85℃
	MSC: 0℃~45℃
Temperature Variation Rate	≤1℃/min
Relative Humidity	BS: 10%~95%
	MSC: 10%~90%
Altitude	≤2000m
Air Pressure	70kPa~106kPa
Solar Radiation	≤1120W/s ²
Thermal Radiation	≤600W/s ²
Wind Velocity	≤30m/s
Waterproof Requirements	
<p>The product must be kept as instructed below:</p> <p>Keep the product in doors.</p> <p>Keep the ground clean and dry. Make sure no water penetrates into the package case.</p> <p>Keep the package box from water sources, such as hydrant, air conditioner, etc.</p> <p>If the product has to be stored in the open air, the following requirements must be met:</p>	

The package case must be free from defects.			
Take necessary measures to prevent penetration by rain water.			
Keep the package case from accumulated water.			
Keep the package case from direct sunlight.			
Biotic Environment			
Avoid the growth of animalcules, such as fungi and mildew.			
Avoid entry of rodents, such as mice.			
Mechanical Stress			
Sine Vibration	Displacement	$\leq 7.0\text{mm}$	/
Acceleration	/	/	$\leq 20.0\text{m/s}^2$
Frequency Range	/	2~9Hz	9~200Hz
Unsteady Shock	Shock Response Spectrum II	$\leq 250\text{m/s}^2$	/
	Static Load	$\leq 5\text{kPa}$	/

b) Transportation environment

Climate				
Temperature		-30~+60℃		
Temperature Variation Rate		≤1℃/min		
Relative Humidity		10%~95%		
Altitude		≤2000m		
Air Pressure		70kPa~106kPa		
Solar Radiation		≤1120W/s2		
Thermal Radiation		≤600W/s2		
Wind Velocity		≤30m/s		
Mechanical Stress				
Sine Vibration	Displacement	≤7.5mm	/	/
Acceleration	/	/	≤20.0m/s2	≤40.0m/s2
Frequency Range	/	2~9Hz	9~200Hz	200~500Hz
Random Vibration	Acceleration Spectral Density	10m²/s³	3m²/s³	1m²/s³
	Frequency Range	2~9Hz	9~200Hz	200~500Hz
Unsteady Shock	Shock Response Spectrum II	≤300m/s2		

	Static Load	$\leq 10\text{kPa}$
Waterproof Requirements		
The package case must be free from defects.		
Take necessary measures to prevent penetration by rain water.		
Keep the transportation free from accumulated water.		

c) Operation environment

Base Station Operation Environment Specifications

Climate	
Temperature	BS: $-30^{\circ}\text{C} \sim +60^{\circ}\text{C}$
Temperature Variation Rate	$\leq 3^{\circ}\text{C}/\text{min}$
Relative Humidity	BS: $5\% \sim 95\%\text{RH}$
Altitude	$\leq 2000\text{m}$
Air Pressure	$70 \sim 106\text{kPa}$
Solar Radiation	$\leq 700\text{W}/\text{s}^2$
Thermal Radiation	$\leq 600\text{W}/\text{s}^2$
Wind Velocity	$\leq 5\text{m}/\text{s}$
Voltage	AC 110-240V
Current	6A

The base station supports a wide voltage and module of PDM lightning, automatic air switch protection base station without damaging overcurrent and overvoltage.

MSC Operation Environment Specifications (including NMS and Dispatch system)

Climate	
Temperature	$0 \sim 45^{\circ}\text{C}$
Temperature Variation Rate	$\leq 3^{\circ}\text{C}/\text{min}$
Relative Humidity	$10\% \sim 90\%\text{RH}$
Altitude	$\leq 2000\text{m}$
Air Pressure	$70\text{kPa} \sim 106\text{kPa}$
Solar Radiation	$\leq 700\text{W}/\text{s}^2$
Thermal Radiation	$\leq 600\text{W}/\text{s}^2$
Wind Velocity	BBU $\leq 1\text{m}/\text{s}$

4. SYSTEM RELIABILITY

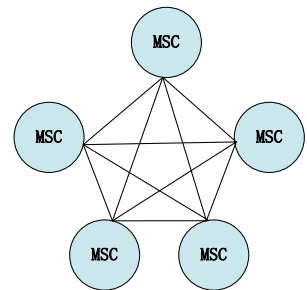
4.1 System Hardware Reliability

4.1.1 Flat Network-Fast Access

Despite hierarchical management of the MSCs in the DMR Trunking system, an MSC can connect to another MSC directly. The calling MSC can access the target MSC directly because signaling exchange is made between MSCs for quick calling.

4.1.2 All-IP Architecture-Simple Networking

The DMR Trunking system adopts the all-IP architecture base on soft switching technology. The controller and server in the MSC and the controller and the transceiver in the BS interconnect with each other uses the unified IP interface, making networking simple and facilitating user management and configuration, easy and simple for the system upgrade, scalability, and interconnect with third parties.

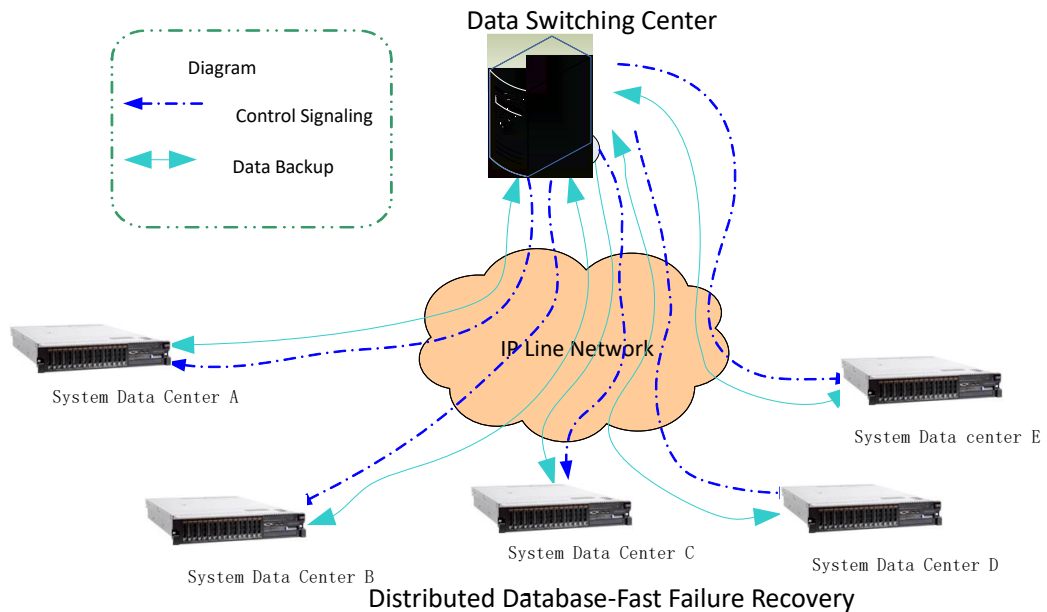


4.1.3 Redundant Hot Backup

The MSC control unit and BSC unit can adopt master-slave redundant hot backup. The slave units synchronize data with the master one at normal status. The slave unit takes over the control tasks of the master unit when the master one gets abnormal, making sure the system works properly.

4.1.4 Distributed Database-Fast Recovery

The Excera DMR Trunking system adopts the distributed database architecture. A same system and user file is stored on each MSC and BS that can be synchronized to realize remote backup and remote disaster recovery. A Data Exchange Center for a region can support about 10 to 20 thousand subscribers. When failure occurs in the local database, users can access the remote database, and the system will work properly without any interruption, data will be synchronized to the local database in a few minutes to achieve fast recovery.



4.2 System Software Reliability

4.2.1 Main control channel redundancy

The main control channel is used for transmit the signals and instruction. It will automatically distribute the channel resources for all kinds of call. It is the most important channel for the whole base station. EXCERA provide control channel redundancy. For the base station, running on multiple carriers, can switch to the standby control channel when the main control channel is faulty or the main carrier gets interrupted.

4.2.2 Multi-level fault-soft design

The Excera DMR Trunking system adopts the decentralized control method. When any error occurs to the link between MSCs or between the MSC and the trunking station controller (TSC), the base station still works in trunking mode and the basic trunking functions (for example, group call, priority call and emergency call, etc.) run as normal; no registration information may get lost, and new mobile station can still be registered (however, its identity and validity can't be verified due to link error). After troubleshooting, the base station can upload the new mobile station data.

When the BS loses linking to the MSC, BS can still work properly in single BS trunking mode, supporting local network management and authentication functionality.

In case of BSCU error, the CHC can still activate the Trunking function without user authentication, so that local trunking calls will be unaffected.

4.2.3 Other ways for software reliability

The system is reliable especially for its excellent fault-soft performance from the following aspects:

- Regular Inspection on Key Resources

The system performs regular inspection on the software resources. Once the resource gets faulty due to software error, this mechanism can release such resources and output the logs and alarms.

- Task Monitoring

The system can monitor all software errors and certain hardware faults when the software is running. This monitor process can check the task progress, clear the system errors and output the reports.

- Data Verification

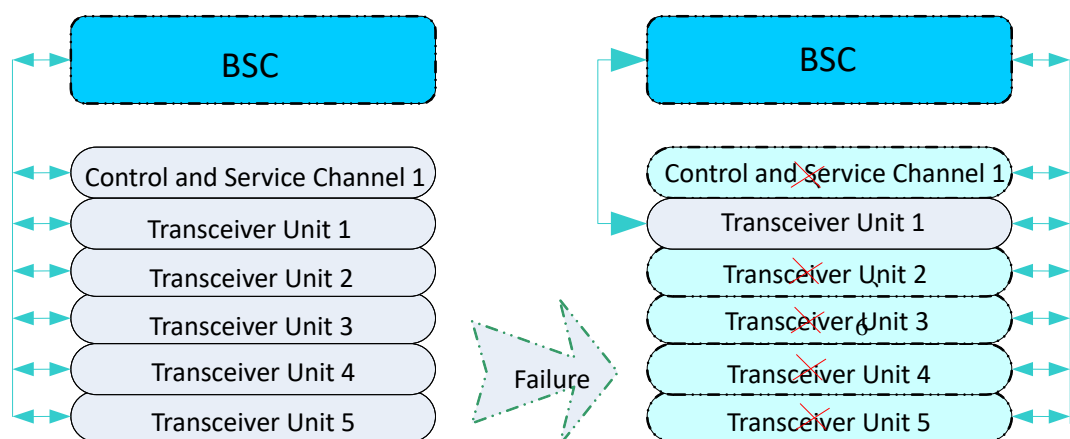
The system can verify the data on a regular or event-driven basis, restore the data optionally or preferentially, and output the logs and alarms.

- Work Log

The system can record the operation progress and store it in the work log, which helps locate the errors and restore the system to normal operation.

4.2.4 Single Carrier BS Operation Mode

A single BS is capable of minimizing effects of failure local. The system remains in trunking mode with fewer services if only one carrier works properly.



Fail Redundancy

5. SERCURITY

The link of DMR trunking system makes use of VPN technology, effectively enhance the network security. The VPN is encrypted and when VPN packet is transmitting on the Internet, users can only see on the public IP addresses, instead of the proprietary network addresses inside the data package. It distributes a proprietary way for DMR trunking system data transmission in the link.

For the network equipments, DMR trunking system can utilize hardware firewall to enhance network security.

Besides, the DMR trunking system provides many functions to ensure users' security requirements, described as below:

5.1 Authentication

The mobile station should be authenticated by an encryption algorithm before accessing certain services. This security service, comprising ESN verification and advanced authentication, can be accomplished through three approaches:

- a) The terminal authenticates the system;
- b) The system authenticates the terminal;
- c) The terminal and system authenticated each other. The serial number and key of the authentication center must be consistent with those of the security module for successful authentication.

5.2 ESN check

ESN (Electronic Serial Number) refers to the mobile station to check the registration process, the mobile station ESN legal information system for the mobile station ESN upload information stored in the system database for comparison, in order to determine the mobile station legitimate of course, only the mobile station ESN information system to store uploaded ESN information matches, the system only allows the mobile station to register.

ESN is a unique device identification DMR equipment factory when the cluster is assigned. ESN Number assigned by the manufacturer DMR unified alliance; equipment type number is used to distinguish the product model.

5.3 End-to-end Encryption

EXCERA provides Full Encrypt in trunking mode, which employ a key accessible to the involved call parties only. Advanced encryption provides two types of technologies: EXCERA encryption and DMRA encryption. EXCERA encryption is named for EXCERA's own encryption algorithm innovation, and DMRA encryption is DMR standard encryption which applies the technology/encryption

specified by DMR association.

Full Encrypt Description:

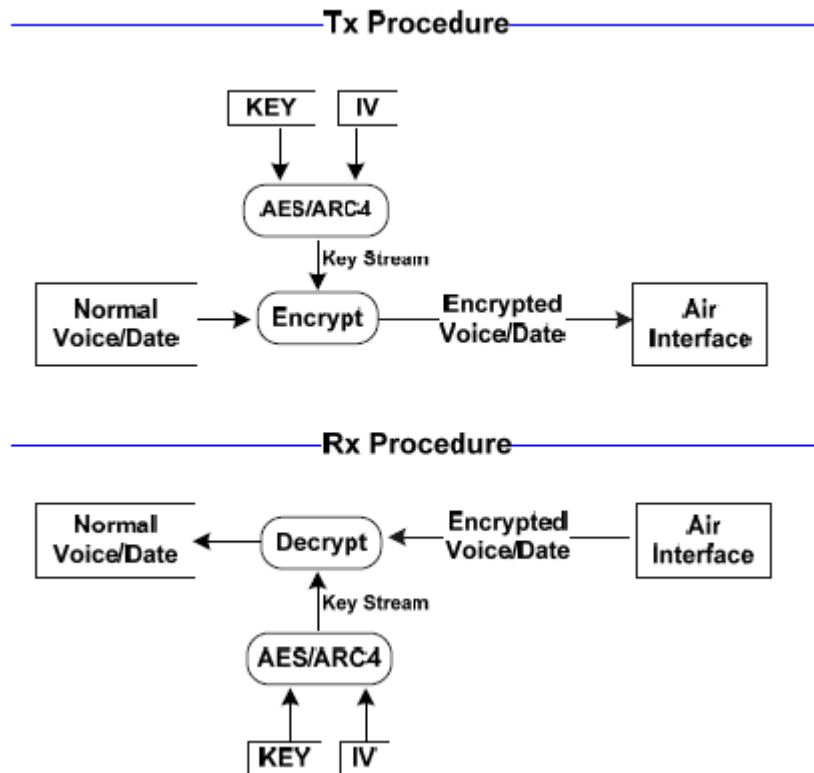
The Full Encrypt function can provide enhanced protection for your communication privacy by using a secure algorithm. This mechanism has features below:

- a) You can configure the key type (40 bits, 128 bits and 256 bits) and key value freely.
- b) The 40-bit key adopts ARC4 to generate a key stream to convert the voice or data, while the 128-bit or 256-bit key uses AES to convert the voice or data. Such keys provide different key streams for each voice super frame or data packet, making it impossible for the attackers to decrypt by capturing over-the-air voice or data packet.

During the encryption key generation through the algorithm, EXCERA will have extra processing, while DMRA encryption will directly generate the key, as even with the same value, these two technologies will generate different keys.

In this mechanism, an extra header is required for sending the encryption parameters, and it prolongs the system access time by approximately 60ms. Additionally, the system late entry time may also be prolonged due to encryption-related information embedded in the voice super frame.

EXCERA encryption defines its own way in embedding the encryption parameter into the voice super frame, which is different from the DMRA encryption.



5.4 Stun/Revive, Kill

If the terminal is lost through authorized remote network management may be faint, to achieve the lost terminal disabled. NM can also have

Remote terminal is the resurrection of the halo operation to return to normal working condition.

If a remote terminal has been a halo disabled, the cluster system provides only registration, authentication, resurrection business, GPS to the terminal

Pull-up business, businesses are not eligible for other systems and use.

If a terminal has been a stun, then the terminal will lose all functions within the system privileges.

Stage system only supports remote network management for authentication by the success of Halo terminal, resurrection, Stun operation, the safety of not carrying

Modules cannot be authenticated remote terminal without the halo, resurrection, Stun.

NMS specified remote terminal halo, resurrection, after the stun fails, the system does not consider retransmission away dizzy, resurrection, Stun instruction through

Failure message to the network through the feedback from the initiator to decide whether to initiate artificial halo away again, resurrection. Stun.

If been successfully stunned then you want to re-use terminal, the terminal needs to re-write the relevant institutions frequency settings.

a) Stun/ revive

This feature enables the LDS to temporarily disable a lost mobile station to avoid unauthorized use. When the mobile station receives the stun command, all functions (including call and message services) will be locked out. However, its registration and GPS information are still available to help you get the mobile station back. Revive allows the authorized user to activate a stunned mobile station for normal use.

b) Kill

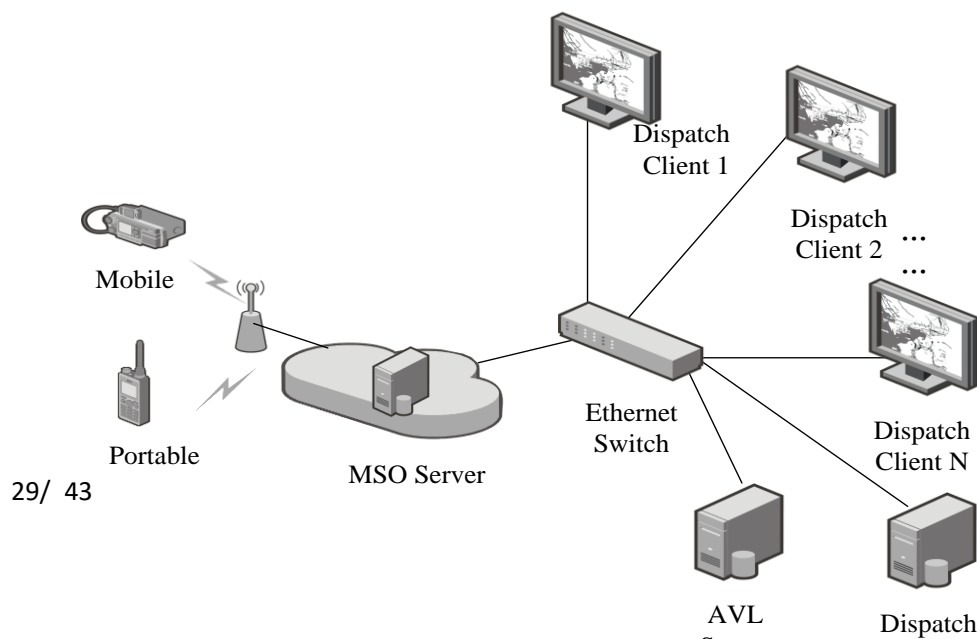
This feature allows the authorized LDS to disable a mobile station.
The killed mobile station will be deprived of all functions permanently.
The killed mobile station must be reprogrammed by a qualified dealer for reuse.

6. DISPATCHING SYSTEM

6.1 System Overview

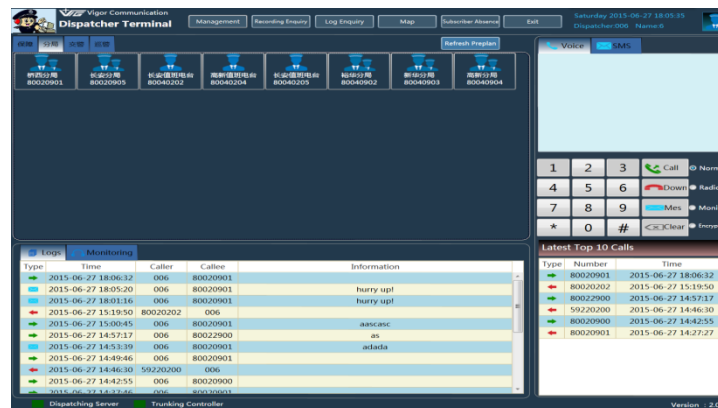
The dispatching system adopts IP-based architecture with plug-in design and provides remote dispatch and management capabilities. As a part of DMR trunking system, the dispatching system provides variety of voice service, data service and also AVL service to enable enhanced dispatching capability for professional users to improve the communication efficiency.

The dispatching system is composed of dispatch server, AVL server and dispatch client. Dispatching system connect with DMR trunking system through IP link. In one DMR trunking system, up to 128+ dispatch clients can be supported, these dispatch clients can be located in different place with IP connection with dispatch server and AVL server. The system architecture is shown as below:



The dispatching system provides a user friendly GUI working under Microsoft Window operating system.

The main window of dispatch client is illustrated as below.



6.2 System Features

6.2.1 Voice Service

The offered dispatching system support following voice functions:

Individual Call: This feature allows dispatcher to initiate or receive a half-duplex or full-duplex call to/from a radio subscriber. Calls can be terminated manually or automatically upon expiration of the relevant timer.

Group Call: This feature allows dispatcher to initiate a half-duplex call to a group. Multiple group calls can be initiated simultaneously. Calls can be terminated manually or automatically upon expiration of the relevant timer.

Broadcast Call: This feature allows dispatcher to initiate a special group call from the dispatcher to a group of subscribers. On a broadcast call, only the dispatcher can talk.

Emergency Call: This feature allows dispatcher to initiate an emergency call to a radio subscriber or a group in case of emergency. With the preemptive privilege, it can interrupt any ongoing normal call.

All call: This feature allows dispatcher to call all portable and mobile radio subscribers and dispatchers in the MSC.

Ambience listening: This feature allows dispatcher to listen to a radio remotely without the knowledge of the radio subscriber.

Call Display: During call, the call-related information including calling party ID,

called party ID, talking party ID, and call type is displayed on the dispatch client interface. This feature helps dispatcher learn the status and details of the current call.

6.2.2 Supplementary Service

Radio Monitor: This feature allows dispatcher to monitor all voice calls and messages from the designated radio, or calls from the designated group. During monitoring, dispatcher can break into the active call to speak or terminate the ongoing call.

DGNA: This feature allows dispatcher to temporarily establish a group whose members might be the online portable or mobile radios. The group information will be saved even if the dispatch client is shut down.

Group Patch: This feature allows dispatcher to temporarily bring multiple groups together for intercommunication in case of emergency. When any of the patched talk group is called, other groups will automatically join this call. Once the communication ends, the patched groups will disband.

Override/ Interrupt: This feature allows dispatcher to break into an active call and start speaking or forcibly terminate the ongoing half-duplex individual or group call.

Voice Record: This feature allows dispatcher to record the incoming all, outgoing call, and call monitored by the dispatch client. The recordings can be locally saved and replayed as required.

6.2.3 Security Service

Stun/Revive: This feature allows dispatcher to stun or revive a radio. When a radio is stunned, it will be capable of operations only including registration, revive, kill, authentication, ambience listening and GPS polling, so as to guarantee communication security in case the radio is lost. A Revive command from the dispatch client is required to re-activate the stunned radio. Supposing the radio is offline when dispatcher sends the Stun or Revive command, the system will save the command and execute it immediately when the relevant radio is online again.

Kill: This feature allows dispatcher to kill a radio. When the radio is killed, it will be incapable of any operations, and can be restored to normal operation via reprogramming only.

End-to-end Encryption: This feature allows voice or data to be transferred from the sending party to the reception party in the encrypted form. The voice or data will not be decrypted until they arrive at the reception party, so as to ensure data

safety during transfer. Both the sending party and reception party encrypt and decrypt the voice or data by means of respective internal encryption algorithm. All encryption keys are predefined in the radio or dispatch client.

6.2.4 Message Service

Text Message: This feature allows dispatcher to send the text message to radio(s) or group(s). Also dispatcher can receive such message from radios.

Status Message: The status message consists of the text and status code. Dispatcher can define the text and corresponding status code as per dispatcher's actual needs. For such message, only the status code will be transferred so as to reduce channel occupation duration.

Emergency Alarm: When the radio subscriber makes the emergency alarm by pressing the appropriate button in case of emergency, a predefined status message will be sent to the dispatch client.

6.2.5 AVL

The dispatching system supports to show terminals location info on the Google map or MapInfo.

GPS Positioning: This feature allows dispatcher to view the radio location and other information including alias, and GPS time on the map. Such information can be updated for one time, or periodically, depending on actual needs.

Real-time Track: This feature allows dispatcher to track the designated radio and view its route on the map in a real time way.

Real-time Call: The AVL dispatcher can directly make a half-duplex call to the subscriber on the map.

Toolbar: The toolbar at the top of the map consists of the shortcuts including Zoom In, Zoom Out, Distance, Area and Save View. It will make dispatcher's routine tasks easier and saves dispatcher's time.

Map-based DGNA: This feature allows dispatcher to draw a circle or polygon on the map and select all radio subscribers within this area at the same time. Then dispatcher can add these subscribers to a certain dynamic group and call them simultaneously.

History Track: This feature allows dispatcher to retrieve the radio subscriber's moving track and replay it in accordance with the radio ID and time period.

6.2.6 Management Service

Channel Monitor: This feature allows dispatcher to view the channel usage in

each base station. If a channel is busy, dispatcher can clear low-priority call and release the channel resource based on actual conditions. Accordingly, the channel utilization is enhanced.

Log Management

Log View: This feature allows dispatcher to view the log involving the call, message and emergency alarm.

7. DIGITAL VOICE RECORDING SYSTEM

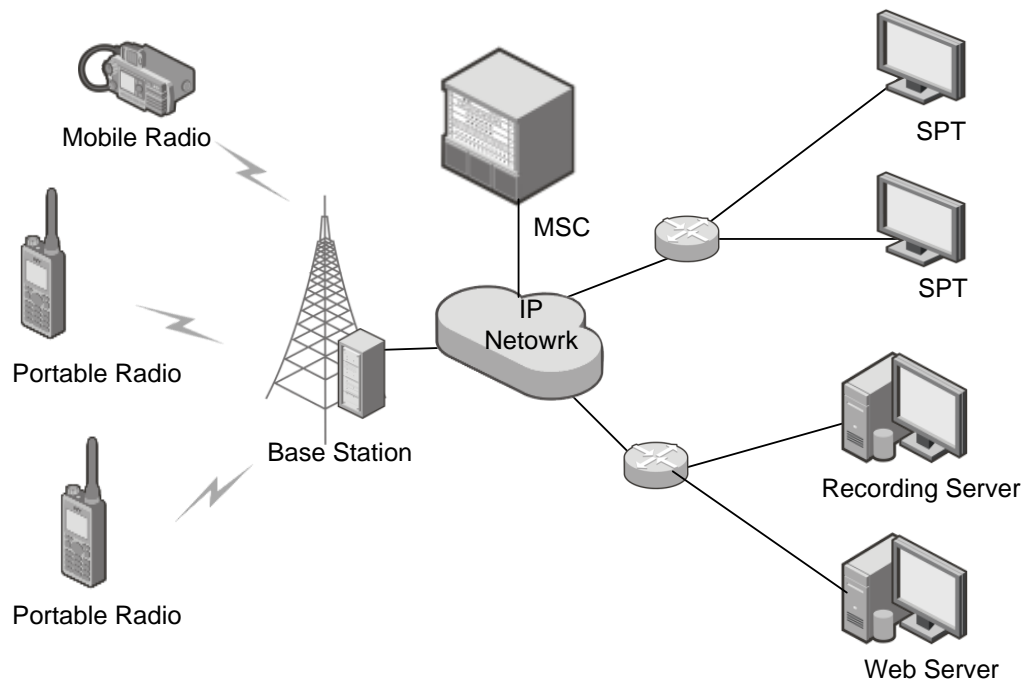
7.1 SystemOverview

Digital Voice Recording System (“DVRS”) is an IP based voice solution. It can record voice information in the whole network and retain them for further use such as post-incident analysis.

With the help of browser/server architecture, DVRS allows you to rapidly retrieve, download, and replay recordings on your local computer at any time using a Web browser. Its advanced functions such as recording statistics and system performance monitor would bring you flexible and pragmatic experiences.

The DVRS system comprises of the following components:

- A central voice recording server used to provide voice recording control and interconnection with DMR trunking system.
- A database platform where all voice data is stored.
- A client application SPT (Search and Play Terminal) for search, filter and replay of recorded data.



The DVRS can provide at least 100+ voice channels in parallel and can be expanded by simple license update. Multiple SPT can be used to search and replay the recording data simultaneously.

The DVRS also provide storage solution with high availability RAID 5 configuration. AMBE voice codec is used for DMR trunking system, each voice channel recording data is around 3.37M for hour.

Full redundancy solution is available for the DVRS to guarantee high reliability and availability of the system.

The DVRS can also connect directly with the DMR trunking Base Station and provide the recording service for the single Base Station.

7.2 DVRS Service

7.2.1 Voice recording service

The DVRS system can record all voice calls across the DMR Trunking network. Meanwhile it will capture the detailed information about the call to be recorded, namely, the caller ID, callee ID, date and time, duration, and call type, and then store them in the database for future query and use.

The interface is titled "Recording Enquiry". It features a media player at the top with a play button and a progress bar. Below the player are input fields for "Start Time" (2015/6/26 15), "End Time" (2015/6/27 15), "Caller Numbers", and "Callee Numbers". There is a "Call Type" dropdown menu set to "All" and an "Enquire" button. Below the search form is a table with the following columns: Number, Caller, Callee, Start Time, End Time, Call Duration(s), and Recording Playback. The table contains 20 rows of call data.

Number	Caller	Callee	Start Time	End Time	Call Duration(s)	Recording Playback
00620150627180632	006	80020901	2015-06-27 18:06:32	2015-06-27 18:07:05	33	
00620150627151950	80020202	006	2015-06-27 15:19:50	2015-06-27 15:20:09	19	
00620150627150045	006	80020901	2015-06-27 15:00:45	2015-06-27 15:00:50	5	
00620150627145717	006	80022900	2015-06-27 14:57:17	2015-06-27 14:57:22	5	
00620150627144946	006	80020901	2015-06-27 14:49:46	2015-06-27 14:49:51	5	
00620150627144630	59220200	006	2015-06-27 14:46:30	2015-06-27 14:46:41	11	
00620150627144255	006	80020900	2015-06-27 14:42:55	2015-06-27 14:43:31	36	
00620150627143746	006	80020901	2015-06-27 14:37:46	2015-06-27 14:37:49	3	
00620150627143741	006	80020901	2015-06-27 14:37:41	2015-06-27 14:37:44	3	
00620150627143725	006	80020901	2015-06-27 14:37:25	2015-06-27 14:37:33	8	
00620150627143642	006	80020901	2015-06-27 14:36:42	2015-06-27 14:36:55	13	
00620150627142727	80020901	006	2015-06-27 14:27:27	2015-06-27 14:27:48	21	
00620150627142443	006	80020901	2015-06-27 14:24:43	2015-06-27 14:24:47	4	
00620150627142219	006	80020901	2015-06-27 14:22:19	2015-06-27 14:22:27	8	
00620150626091427	006	80020901	2015-06-26 09:14:27	2015-06-26 09:14:31	4	

You can quickly search for a history recording by time, date, call duration, call type, group number and other search criteria. The search result may be accurate or fuzzy, depending on which search scheme you choose.

A recording file can be replayed in a SPT computer which is fitted with a sound card and speakers.

Voice recording file can also be downloaded and saved to local computer with WAV format.

7.3 Log Query

7.3.1 Message and registration service

The Log system can capture the detailed information of the text message and status message, namely, the sender ID, recipient ID, message type and etc, which can be stored in the database for future query and use.

Quickly search for a message by time, date, sender ID, recipient ID and other search criteria is also available.

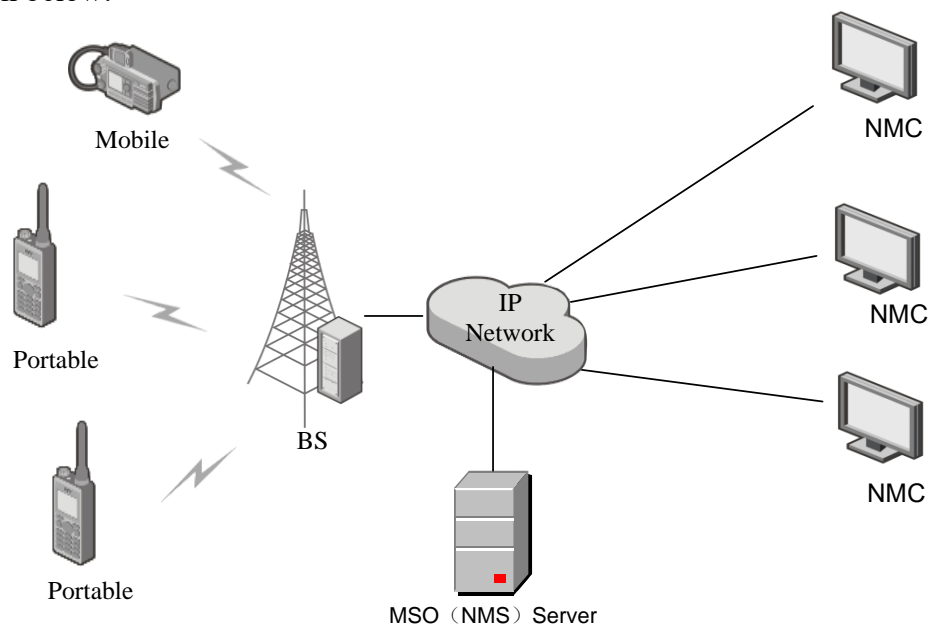
Message recording list can be exported to the ".csv" file, which can be opened with Excel.

The Log system can capture the detailed registration information, namely, the registration status (registered/deregistered), registration time and registered base station, which will be saved in the database for future query and use.

8 NETWORK MANAGEMENT SYSTEM

8.1 System Overview

The network management system is mainly composed of the Network Management Server and Network Management Client (NMC). It allows management, monitoring, operation and maintenance functions for the whole system, and configuration and monitoring for the software and hardware components. In addition, it can generate status report for easy fault diagnosis, and provide other functions such as subscriber management, performance management and security management. The architecture of the network management system is as shown below:



The NMS is based on SNMP over IP technology and adopt C/S structure, 32+ NMCs can be supported in one MSC.

The NMS server is accessible by NMCs that can be geographically distributed across the LAN/WAN infrastructure and remote monitoring.

The main menu in NMS is described as below:

Menu	Description
Configuration Manager	From this menu, you can configure system components and query appropriate parameters.

Menu	Description
Device Monitor	From this menu, you can monitor topology and system components.
Subscriber Manager	From this menu, you can manage subscribers, groups and group members
User Manager	From this menu, you can manage users.
Upgrade Manager	From this menu, you can upgrade the applications installed in the hardware components remotely.
Help	From this menu, you can view the version information and application introduction.

8.2 System Features

8.2.1 Configuration management

The configuration management provides the ability to configure the parameters of the network elements remotely.

The network element parameters can be configured and queried in the DMR trunking system including BS parameters, CHC parameters and MSC parameters.

The configuration management consists of the following capabilities:

- a) The configuration of system parameters, like call timer, queue timer, Tx base frequency, MS registration period, etc
- b) The configuration of BS parameters, like IP address, BS type, network ID, control channel backup, authentication, etc.
- c) Configuration of modules in BS, like channel unit etc.
- d) The configuration management support to backup and restore of the configuration information for the DMR trunking system.

8.2.2 Subscriber management

Subscriber management allows you to create, modify and delete subscribers and groups.

A subscriber management tool is integrated in NMS, being able to:

- a) Create, delete and modify a subscriber and its authorities
- b) Deactivate a subscriber temporarily or definitely
- c) Create, delete and modify a group and its rights
- d) Deactivate a group temporarily or definitely
- e) Flexible management of relationship between individual subscriber and group

Users can configure parameters for a subscriber such as handset ID, model, priority supported services, etc.

Users can configure parameters for a group such as group ID, priority, included subscribers, etc.

The NMS be capable of monitoring the status of the end user terminals (i.e power on/off, log on which site, etc) through subscriber management.

The NMS also be capable of disabling the user remotely to prevent the end terminals from monitoring, participating and initiating any voice communications on any channel or talk group in the system.

8.2.3 Fault management

Fault management is used to monitor alarm information in a real time to guarantee normal operation of the network. It includes monitoring the current alarm, monitoring the historical alarm, filter alarm, redefine alarm, etc.

The NMS can provide a graphical display of the network state, different color can be used to indicate the status of each network element.

Alarm actions and severity levels can be configured by users according to the real requirement.

All alarms will be stored in an alarm log file which can be exported to Excel. Each network element supports store and retain the following alarm information:

- a) A list of all active alarms (i.e. alarms not cleared)
- b) History alarm information.

8.2.4 Performance management

The Performance Management provides a set of reports about the operations and activities of the DMR trunking system. User can also query and analyse the voice and data service in the system.

The Performance Management system has the capabilities of:

- a) Providing network statistics (i.e. queue time, call duration, busy hour traffic , call count by call type, channel usage, etc.) per site and per system,
- b) Provides the traffic use by specified talk groups and subscriber radio units
- c) Provides the capabilities to allow the user to generate the required statistic on a specified date or period.
- d) Flexibility to display the selected required statistics data selected by the operator weekly (system peak) or hourly.
- e) Able to export statistic report to Excel format.

8.2.5 Security management

Security management provides management on user's login and exit, changing user password, managing user privilege, group privilege and the operation log.

NMS has the following method to ensure the information safety:

- Login authentication with the user name and password.
- User authentication for access and modification.
- Sytem Log, recording all the operation.

The NMS provides a unique user id and password management for each user to access the system

Different network elements can be configured to be managed by different users according to the real requirements.

Login

Administrator Login PDT Connexion Configuration MPT Connexion Configuration

PDT Management Terminal

EXCERA

User Name:

Password :

Login DEL

Login

Administrator Login PDT Connexion Configuration MPT Connexion Configuration

Database IP :

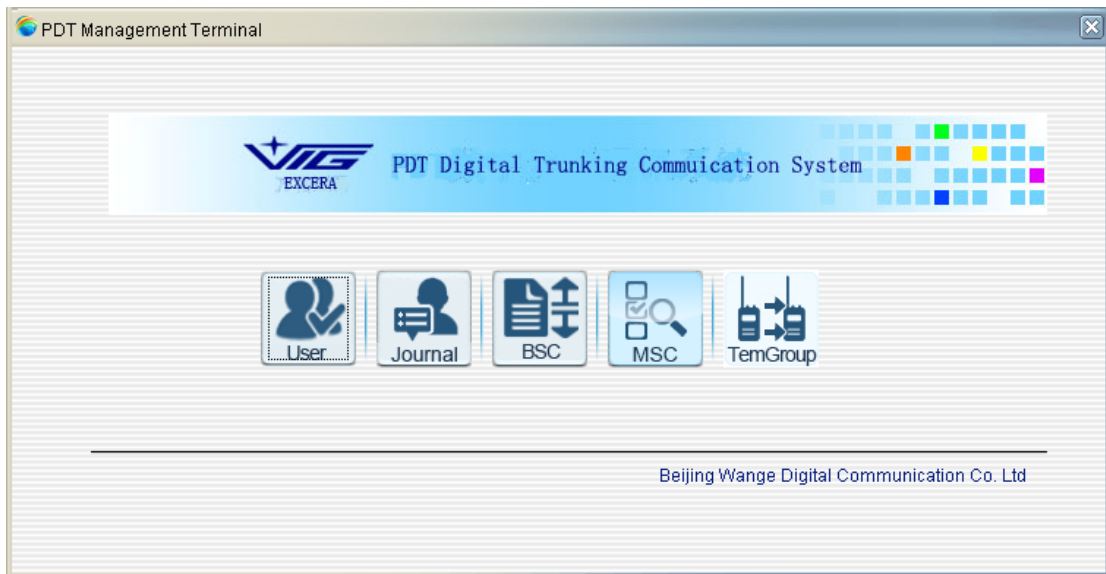
Database Name :

Database User Name :

Database Password :

Local IP : ▼

Login DEL



8.2.6 OTAP management

OTAP management allows you to read and write MS configuration over the air, to make the programming and updates more convenient.

In order to facilitate the management of terminals, NMS provide the OTAP service to allow network manager to read and write MS configuration over the air, to make the programming and updates more convenient.

OTAP operation includes modification of contactor list, subgroup list, frequency channel, timer, individual call contact list etc. The OTAP operation can be configured to implement based on a predefined specific time or by a periodic time.

8.2.7 Upgrade management

Network manager can realize remote upgrade for network element, to solve the problem that someone must go to the equipment site to upgrade, reduce the maintenance cost of equipments, it's also convenient to operate and manage. If the software upgrade unsuccessful, it is able to revert to the previous version.

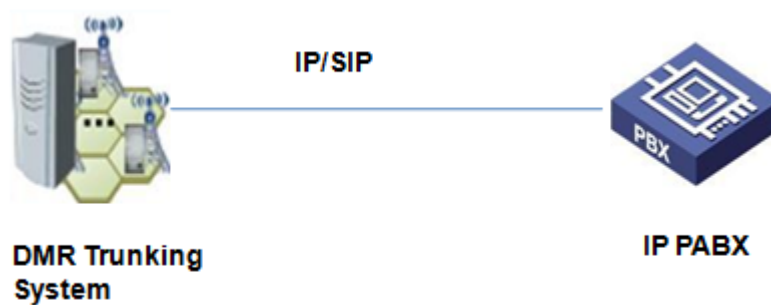
The NMS also support to query the software version of Base Station in the DMR trunking system.

9. GATEWAY SOLUTION

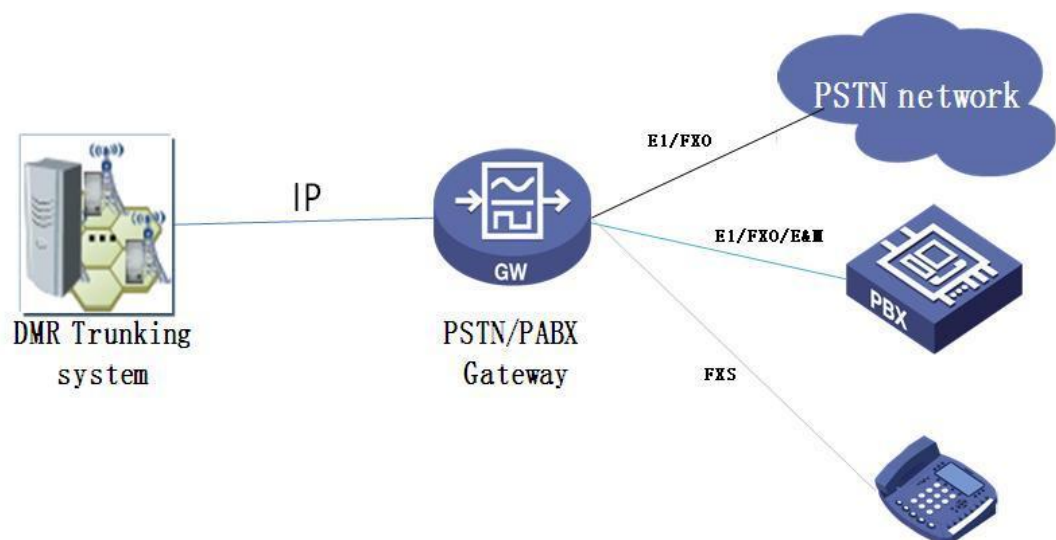
9.1 Gateway for DMR Trunking and PSTN

The DMR trunking system can support direct communications between radios and external telephones through the PSTN. It also supports communications between radios and private telephone extensions through PABX.

The DMR trunking system can interface directly to a SIP enabled PABX/PSTN via an IP connection.



If the PABX/PSTN not supports SIP, a PABX/PSTN gateway is required for the interconnection. The system architecture is shown as below:



The PABX/PSTN gateway communicates with the DMR trunking system through SIP proxy server based on the SIP protocol, and all units in the DMR trunking system

connect each other via the core switch.

The PSTN gateway can be connected with the PABX/PSTN terminal via E1 or FXO, to allow communication between the DMR trunking system and the PSTN terminal.

A MTU is required for each PABX/PSTN voice path for translating between the DMR AMBE+2 and PABX/PSTN G.711 voice streams.