ZXSDR R8860

CDMA Remote Radio Unit-8860

Technical Manual

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LEGAL INFORMATION

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Declaration of RoHS Compliance

To minimize the environmental impact and take more responsibility to the earth we live, this document shall serve as formal declaration that ZXSDR R8860 manufactured by ZTE CORPORATION are in compliance with the Directive 2002/95/EC of the European Parliament - RoHS (Restriction of Hazardous Substances) with respect to the following substances:

- Lead (Pb)
- Mercury (Hg)
- Cadmium (Cd)
- Hexavalent Chromium (Cr (VI))
- PolyBrominated Biphenyls (PBB's)
- PolyBrominated Diphenyl Ethers (PBDE's)

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The ZXSDR R8860 manufactured by ZTE CORPORATION meet the requirements of EU 2002/95/EC; however, some assemblies are customized to client specifications. Addition of specialized, customer-specified materials or processes which do not meet the requirements of EU 2002/95/EC may negate RoHS compliance of the assembly. To guarantee compliance of the assembly, the need for compliant product must be communicated to ZTE CORPORATION in written form. This declaration is issued based on our current level of knowledge. Since conditions of use are outside our control, ZTE CORPORATION makes no warranties, express or implied, and assumes no liability in connection with the use of this information.

FCC & IC STATEMENT

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference.
2. This device must accept any interference received, including interference that may cause undesired operation.

This Class[A] digital apparatus complies with Canadian ICES-003.

Note:

Working with the equipment while in operation, may expose the technician to RF electromagnetic fields that exceed FCC rules for human exposure. Visit the FCC website at www.fcc.gov/oet/rfsafety to learn more about the effects of exposure to RF electromagnetic fields.

Changes or modifications to this unit not expressly approved by the party responsible for compliance will void the user's authority to operate the equipment. Any change to the equipment will void FCC and IC grant.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to the FCC and IC Rules. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

RF Exposure Information for PMR

The product generates RF electromagnetic energy during transmit mode.

This radio is designed for and classified as “Occupational Use Only”, meaning it must be used only during the course of employment by individuals aware of the hazards, and the ways to minimize such hazards. This radio is NOT intended for use by the “General Population” in an uncontrolled environment.

This radio has been tested and complies with the FCC RF exposure limits for “Occupational Use Only”.

In addition, the product complies with the following Standards and Guidelines with regard to RF energy and electromagnetic energy levels and evaluation of such levels for exposure to humans:

1. FCC OET Bulletin 65 Edition 97-01 Supplement C, Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.
2. tAmerican National Standards Institute (C95.1-1992), IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.
3. American National Standards Institute (C95.3-1992), IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields– RF and Microwave.
4. The following accessories are authorized for use with this product. Use of accessories other than those (listed in the instruction) specified may result in RF exposure levels exceeding the FCC requirements for wireless RF exposure.

About This Manual

Purpose

ZXSDR R8860 is an outdoor remote RF unit. Composing an integrated BTS, ZXSDR R8860 and ZXSDR R8860 implement wireless transmission within coverage areas, control of wireless channel as well as communication with BSC.

This manual provides ZXSDR R8860 product overview, which will help the readers know the product's function, principle, specification, features, cabinet, modules, external interfaces and cables.

Intended Audience

This document is intended for engineers and technicians who perform operation activities ZXSDR R8860.

- Engineering technicians
- Equipment installation engineers
- Equipment commissioning engineers

Prerequisite Skill and Knowledge

To use this document effectively, users should have a general understanding of ZXSDR R8860 equipment and its components. Familiarity with the following is helpful:

- ZXSDR R8860 hardware structure
- Basic software knowledge

What is in This Manual

This manual contains the following chapters.

Chapter	Summary
Chapter 1 Product Overview	This chapter describes product's function, specification, features and technical specifications.
Chapter 2 Hardware Description	This chapter describes product's module function and work principle, cables's structure and main antenna system.
Chapter 3 Protocol Interface Description	This chapter describes product's protocol interfaces.

Conventions

ZTE documents employ the following typographical conventions.

Typeface	Meaning
Italics	References to other Manuals and documents.
“Quotes”	Links on screens.
Bold	Menus, menu options, function names, input fields, radio button names, check boxes, drop-down lists, dialog box names, window names.
CAPS	Keys on the keyboard and buttons on screens and company name.
	Note: Provides additional information about a certain topic.
	Checkpoint: Indicates that a particular step needs to be checked before proceeding further.
	Tip: Indicates a suggestion or hint to make things easier or more productive for the reader.

Mouse operation conventions are listed as follows:

Typeface	Meaning
Click	Refers to clicking the primary mouse button (usually the left mouse button) once.
Double-click	Refers to quickly clicking the primary mouse button (usually the left mouse button) twice.
Right-click	Refers to clicking the secondary mouse button (usually the right mouse button) once.

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Chapter 1
Product Overview

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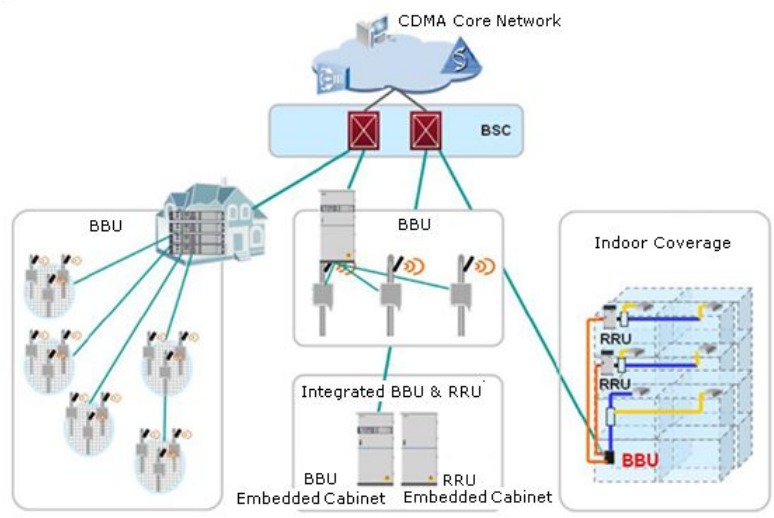
1.1 Distributed ZTE BTS Solution

In order to provide more competitive communication devices and solutions for customers, ZTE provides distributed ZTE CDMA2000 BBU +RRU solution to accomplish service functions of CDMA2000 BTSs.

Figure 1-1 shows the architecture of distributed ZTE BTS solution.

Figure 1-1 Distributed ZTE BTS Solution



The distributed BTS solution of ZTE CDMA2000 BBU+RRU has the following advantages:

- Low labor and engineering expenses.

  Its small size and lightness facilitates transportation and engineering installation.

- Low room rent and quick network establishment.

  It is applicable to various scenarios. It can be installed on a tower, a building top or a wall. The flexible adaptability facilitates quick network deployment and saves room rents and network operation expenses, taking advantage of Time-To-Market.

- Convenient upgrading and expansion.

  It supports multiple carrier sectors. The number of cabinets varies with the actual situation.

- Decrease in the total number of sites.

  The RRU can be installed as close to the antenna as possible, which saves feeder expenses, reduces feeder loss, improves RRU on-top output power and increases the coverage.

- Low power consumption.

  Compared with traditional BTSs, the distributed BBU+RRU BTS has lower power consumption, which reduces power investment, saves electrical expenses and network operation cost.

- Distributed networking mode.

  It supports star and chain networking between BBUs and RRUs, effectively making full use of network resources.

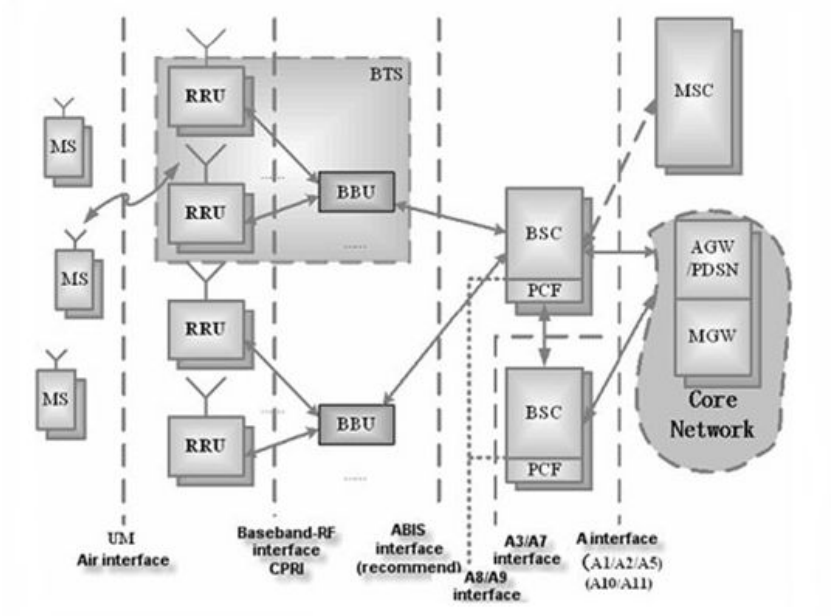
- Advanced universal BTS platform.

  The BBU uses a B3G and 4G oriented platform that implements various standards so that a single BTS can support multiple standards. This helps operators integrate multiple BTSs into a multi-mode BTS, simplifying the management of BTSs so that operators can flexibly choose network evolution directions and users can enjoy the transparence and smooth evolution of networks.

1.2 Position in the Network

ZXSDR R8860 is an outdoor remote Radio Frequency (RF) unit of ZTE CDMA2000 series. ZXSDR R8860, together with the BBU, constitutes an integrated Base Transceiver Station (BTS). ZXSDR R8860 implements wireless transmission in its coverage area. Figure 1-2 shows the position of ZXSDR R8860 (RRU) in the CDMA network.

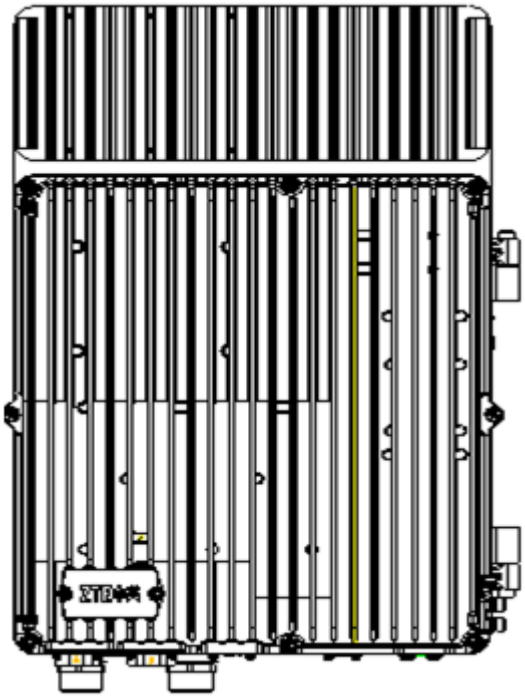
Figure 1-2 ZXSDR R8860 Position in the Network



1.3 Appearance

The ZXSDR R8860 cabinet is plated with materials that are applicable to outdoor environments. Figure 1-3 shows the ZXSDR R8860 cabinet appearance.

Figure 1-3 ZXSDR R8860 Cabinet Appearance



1.4 Functions

Table 1-1 describes ZXSDR R8860 functions.

Table 1-1 ZXSDR R8860 Functions

Function	Description
RF	Band: 800 MHz Band Class 0 1900MHz PCS 450MHz (Band Class 5) 850MHz (Band Class 10) 420MHz (Band Class 5) 2100MHz (Band Class 6) AWS Band Class 15
	RF modulation/demodulation
	RF transceiver duplexer
	Low noise amplification for received RF signal
	Amplification for transmitted RF signal
	RF transceiver
Interface	Baseband-RF interface: compliant with Common Public Radio Interface (CPRI) protocol
	Air interface: compliant with IS-2000 Release A and IS-856-A
	Local debugging and maintenance interface: Ethernet
Networking	Support for the remote application of the RRU; networking modes are involved into star and chain.
	Combined RF cabinets (diversity output/input)
	Support for the cascading networking mode of RRU, the highest up to 4 levels
Environment Monitoring	Input power undervoltage/overvoltage alarm
	Output power undervoltage/overvoltage alarm
	Power overcurrent alarm
	Environment temperature alarm
	External RS-485 monitoring interface
	External monitoring extension interface: 4 input dry contacts

Function	Description
Equipment maintenance and testing	Electronic label
	Power query: baseband power, RF power, and antenna output power
	Automatic calibration
	RSSI query
	Reverse spectrum query: querying the reverse received signal spectrum of each carrier
	monitoring alarm for antenna standing wave ratio
	Power amplification control and protection: over-power, over-temperature, and standing wave alarm.

1.5 Features

The features of the ZXSDR R8860 are as follows:

- Small Size

  The ZXSDR R8860 occupies a small area, saving room rent expenses.

  → Dimension of a single ZXSDR R8860 cabinet without handle (H x W x D): 500 mm × 320 mm × 172 mm. When installed indoors, it requires a small installation area.

  → ZXSDR R8860 can also be installed outdoors, supporting pole-mount, wall-mount, and Gantry mount installations. Except for the Gantry mount installation, which occupies minimum floor space, the other cases almost does not occupy any floor space.

- Light Weight

  A single ZXSDR R8860 cabinet weighs 22 kg so it is easy to transport and install, requiring low manpower and engineering costs.

- Optical fiber Support

  ZXSDR R8860 supports optical fiber installation on a tower. ZXSDR R8860 and the BBU can be connected via fibers. One pair of fibers can support a large number of sectors which greatly lowers antenna feeder cost and engineering expenses

- Low Power Consumption

  Lower power consumption imposes lower power supply requirements, saving power construction costs and daily power charges.

  → Power consumption: (<350W, -48 V DC)

  → Less RF power loss because the installation of ZXSDR R8860 on the tower close to antennas requires a shorter feeder cable.

→ Higher power amplification efficiency (>30%, -48 V DC).

- Natural Dissipation

  No heat exchanger is needed when the cabinet is installed outdoors.

- At most 8 carriers x 80 W RF power.

  supports various application scenarios including dense urban coverage and wide rural area coverage. It provides diversity reception function and supports transmission diversity and 4-antenna reception by means of cabinet combination.

- Complex Network Application

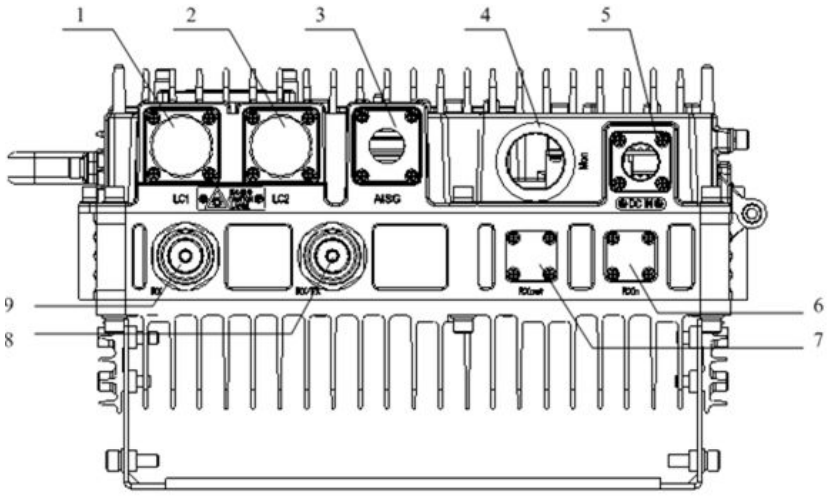
  supports baseband-RF star and chain networks, delivering flexible solutions to complicated network environments.

1.6 External Interfaces

The external interfaces supported by the ZXSDR R8860 are located at the bottom of the cabinet.

Figure 1-4 shows the external interfaces of ZXSDR R8860.

Figure 1-4 ZXSDR R8860 External Interfaces



1. LC1
2. LC2
3. AISG
4. Mon
5. DC IN
6. RXIn
7. RXout
8. RX/TX
9. RX

Interface Description

Table 1-2 lists the ZXSDR R8860 interfaces description.

Table 1-2 ZXSDR R8860 External Interfaces Description

Interface Name	Function	Interface Type/Connector
LC1	Interface between BBU and RRU/RRU cascading interface	LC optical interface

Interface Name	Function	Interface Type/Connector
LC2	Interface between BBU and RRU/RRU cascading interface	LC optical interface
AISG	AISG device interface	8-core aerial socket
Mon	External device interface	37-core aerial socket
DC IN	Power interface	DC interface connector: 4-pin straight round connector
RXIn	Frequency expansion interface	N connector
RXout	Frequency expansion interface	N connector
RX/TX	Receive/Transmit main set RF cable interface	50 Ω DIN connector
RX	Receive diversity RF cable interface	50 Ω DIN connector

1.7 Application Scenarios

ZXSDR R8860 supports gantry-mount, wall-mount, pole-mount and simplified—cabinet integrative installation modes.

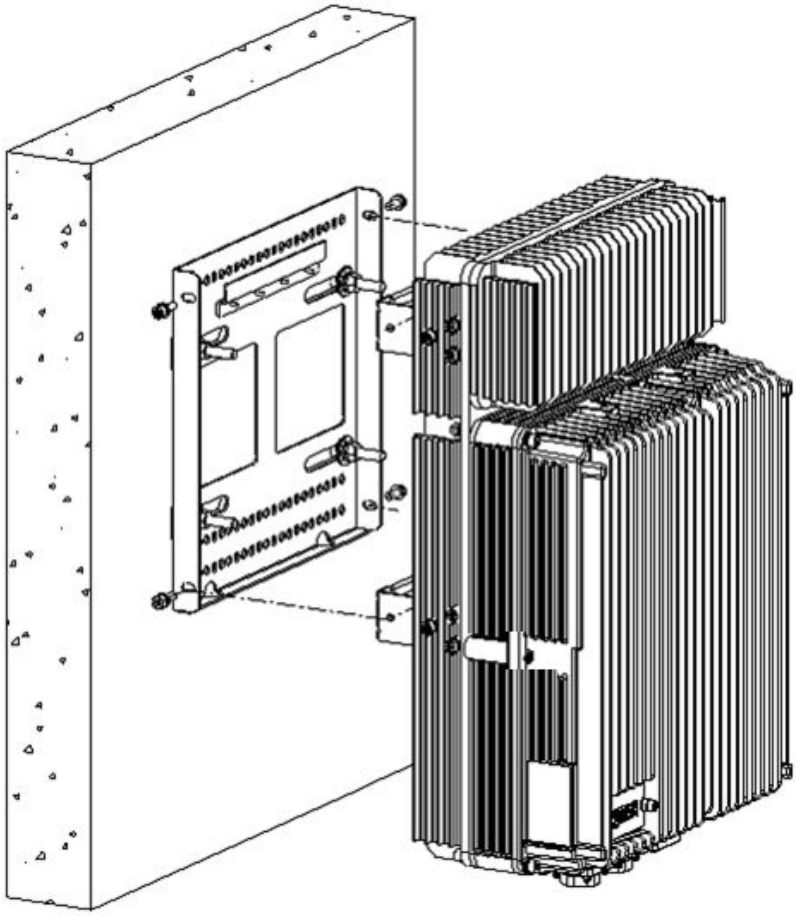
The application scenarios are classified into the following situations according to different installation conditions, power supply requirements and user demands:

- In the condition of ZXSDR R8860 indoor installation with the DC power cable 10 m outside the equipment room and without Level B and above lightning module configured in the indoor power output, the indoor DC lightning box is adopted for power supply and power distribution.
- When ZXSDR R8860 is installed outdoors, an external DC lightning box is adopted for power supply and power distribution.
- A wave trap module is needed in some countries or districts due to the special demand on the radio network or stations.

Wall-Mount Installation

Figure 1-5 illustrates the wall-mount installation

Figure 1-5 ZXSDR R8860 Wall-Mount Mode



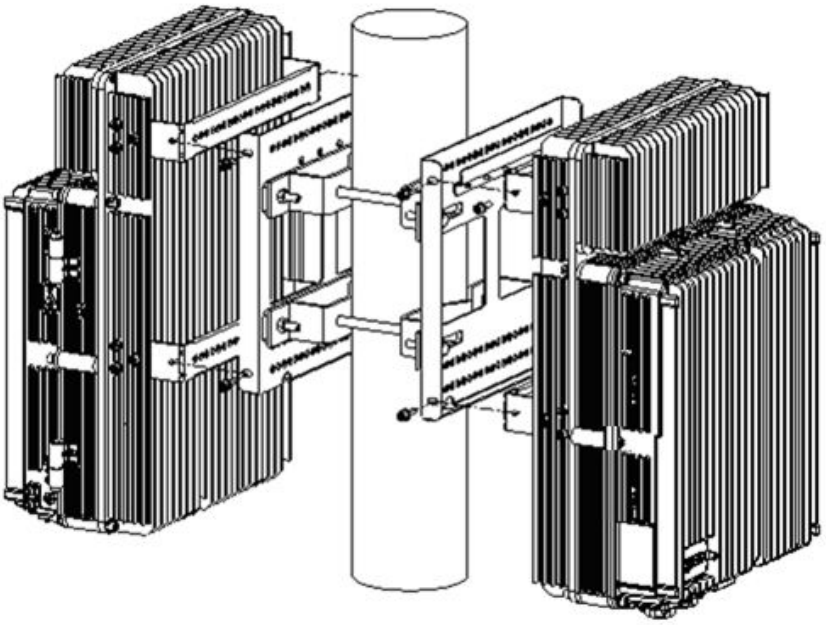
Pole-Mount Installation

This section illustrates the ZXSDR R8860 pole-mount installation in terms of double and three cabinets installation.

- Two ZXSDR R8860 cabinets

  Figure 1-6 illustrates two ZXSDR R8860 cabinets mounted on a pole.

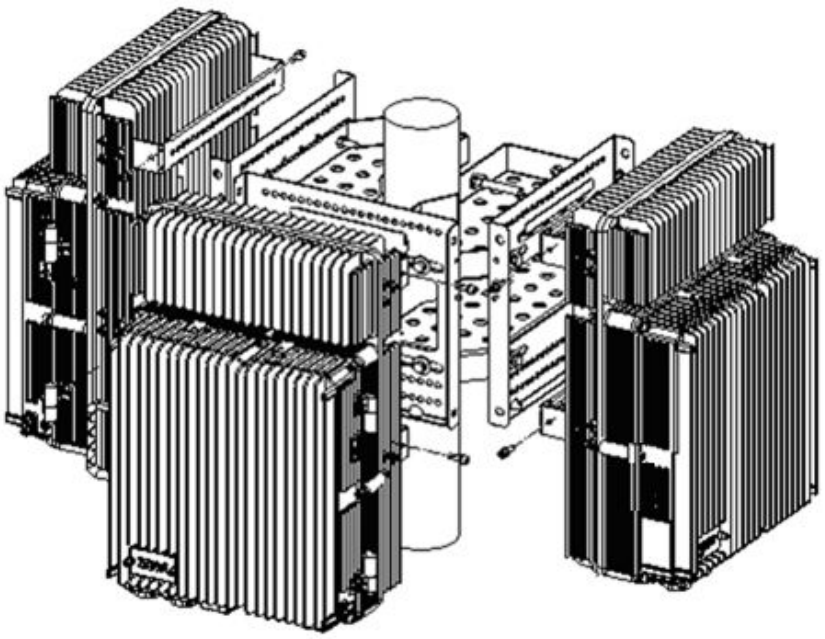
Figure 1-6 Two ZXSDR R8860 Cabinets Pole-Mount Mode



- Three ZXSDR R8860 cabinets

  Figure 1-7 illustrates three ZXSDR R8860 cabinets mounted on a pole.

Figure 1-7 Three ZXSDR R8860 Cabinets Pole-Mount Mode



1.8 Work Principle

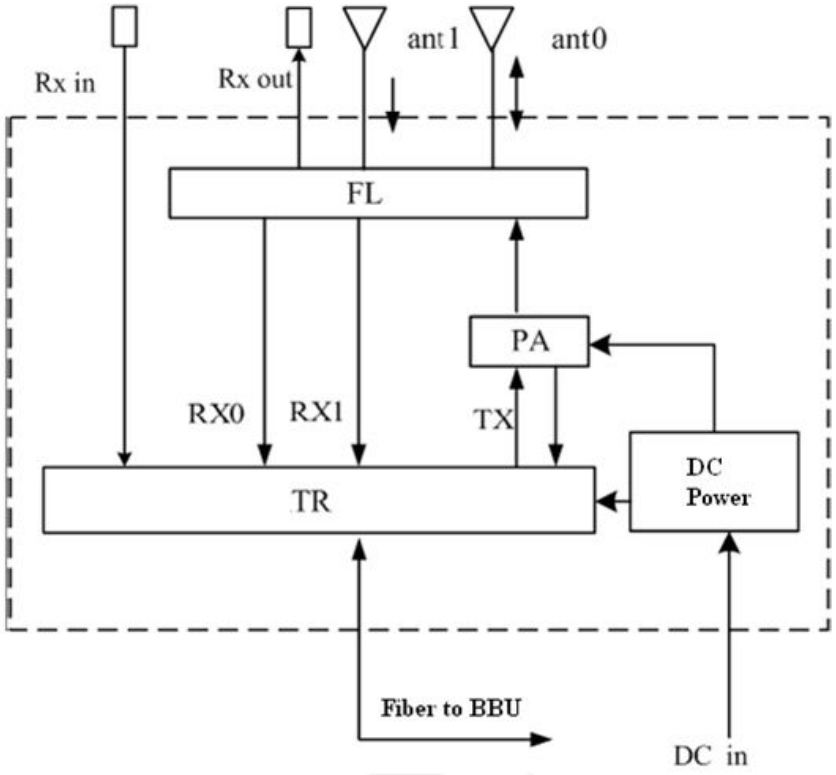
1.8.1 System Structure

The ZXSDR R8860 system structure includes a DC Power (Power source module), FL (Filter LNA module), TR (Transceiver module,) and PA (Power Amplifier module). It has following two reserved ports:

- The ZXSDR R8860 provides an external port (Rx out) to support the mutual main set/diversity combination mode. The FL main set reception Low Noise Amplifier (LNA) output port delivers the power division function.
- An electronic switch is set at the receive diversity channel and an external input port is reserved to deliver the compatibility with the long-distance frequency. The system can switch over to input signals through the FL of local Radio Unit (RU) or through another Remote Radio Unit (RRU).

Figure 1-8 shows the overall system structure.

Figure 1-8 ZXSDR R8860 System Structure



1.8.2 Signal Flow

The ZXSDR R8860 signal flow is described below.

Forward Flow

The forward signal flow consists of following.

1. After receiving the data modulated by the baseband unit through the Common Public Radio Interface (CPRI) interface, the up conversion is done by the TR and then the signal is sent to Power Amplifier (PA).
2. The PA amplifies the power of signals and then sends it to the (Duplex Filter) DFL.
3. The FL duplexes and filters the RF signals and then transmits it through the antenna.

Reverse Flow

The reverse signal flow consists of the following.

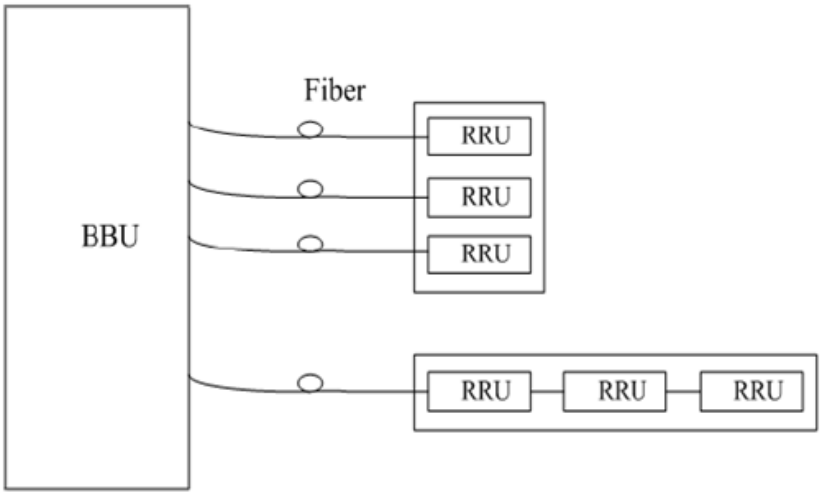
1. The FL filters the backward CDMA signals from the antenna, amplifies the power of these signals before sending them to the TR.
2. The TR performs down conversion and converts the signal into baseband digital signals and then transmits to the baseband unit through the CPRI interface.

1.9 Networking

1.9.1 Baseband-RF Interface Networking

The ZXSDR R8860 is connected to the Base Band Unit (BBU) by optical interfaces. It supports the Common Public Radio Interface (CPRI) protocol, and star and chain networking modes, as shown in Figure 1-9.

Figure 1-9 ZXSDR R8860 Baseband-RF Interface Networking



- **Star networking**: the networking mode adopts point-to-point connection, so the number of fibers led out of the baseband unit is the same as the total number of RF modules. Although many fibers are needed, the networking mode is more reliable than the chain networking.
- **Chain networking**: the networking mode requires fewer fibers but has lower reliability.

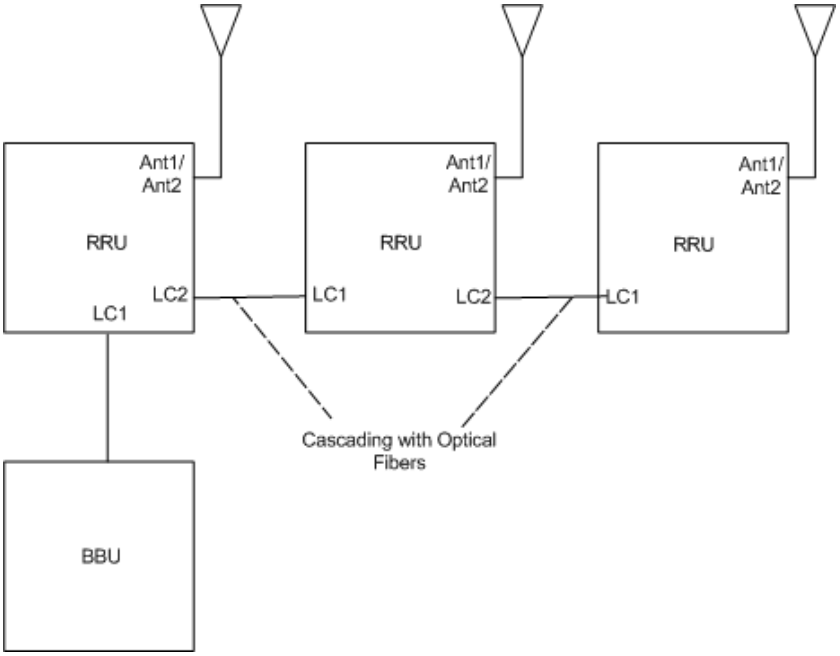
1.9.2 Cascade Networking

In the case where RRUs are close to each other but are far away from BBU, the cascade networking through CPRI interface is recommended to save optical fibers.

Alternatively, a cascade networking is also type of chain networking.

Figure 1-10 shows the cascade networking through CPRI interface.

Figure 1-10 ZXSDR R8860 Cascade Networking



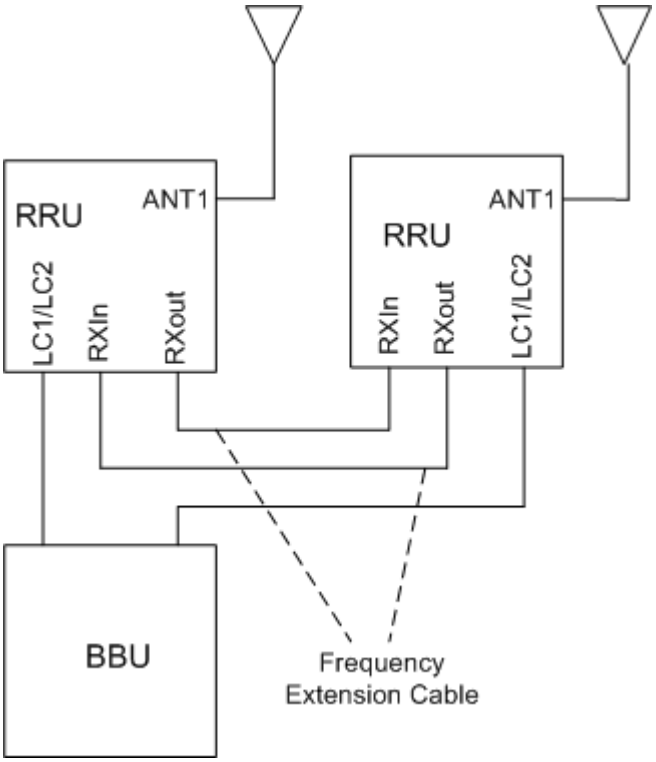
RRUs are connected by optical fiber. The RRU optical interface LC1 serves to connect BBU or the upper level RRU while LC2 serves to connect the lower level RRU.

1.9.3 Frequency Extension Networking

ZXSDR R8860 supports mutual receive diversity by means of cabinet combination so that it can support high-carrier or great-carrier-frequency-difference application.

Figure 1-11 shows the frequency extension networking mode supported by ZXSDR R8860.

Figure 1-11 ZXSDR R8860 Frequency Extension Networking

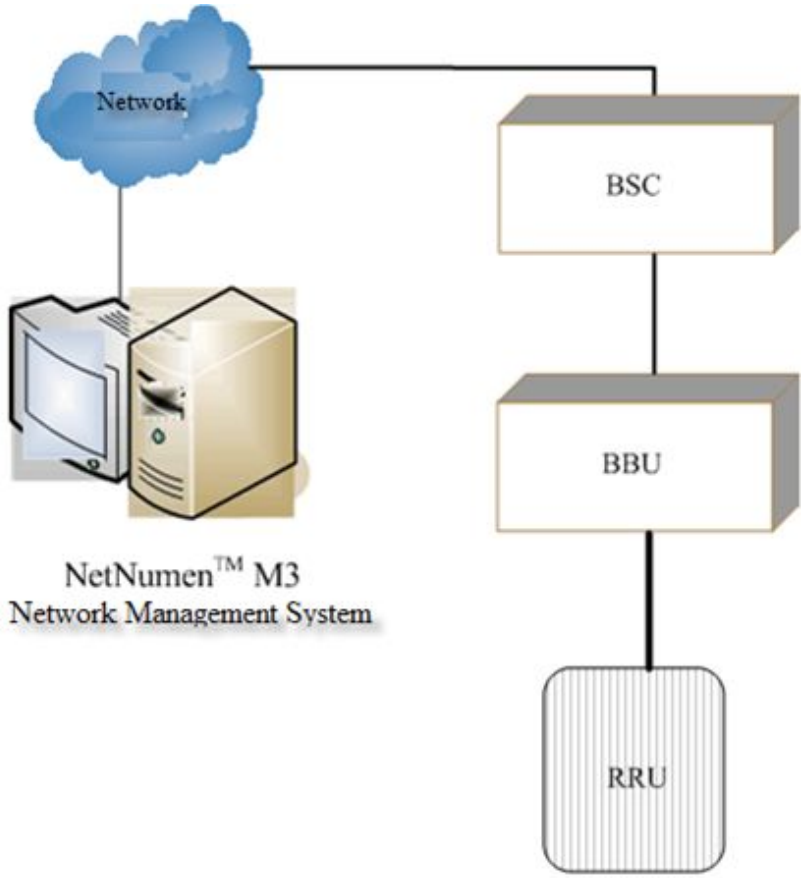


1.10 Equipment Management Modes

1.10.1 OMC Mode

The NetNumen™ M3 network management system (NMS) developed by ZTE can be used to operate and maintain the ZXSDR R8860, as shown in Figure 1-12

Figure 1-12 ZXSDR R8860 Operation and Maintenance –OMC Mode



The Network Element (NE) communicates with the NMS through the TCP/IP protocol.

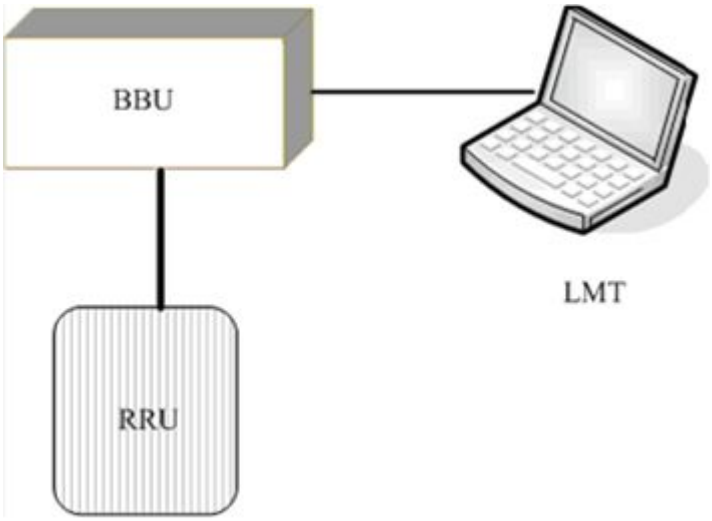
The NetNumen™ M3 provides the following functions:

- Configuration Management
- Performance Management
- Fault Management
- Security Management
- Report Management
- System Tools

1.10.2 LMT Mode

A Local Maintenance Terminal (LMT) can be used to operate and maintain the ZXSDR R8860, as shown in Figure 1-13.

Figure 1-13 ZXSDR R8860 Operation and Maintenance System (LMT Mode)



Implementation of power query, power increase/decrease or scaling of ZXSDR R8860 can be performed through the LMT.

1.11 Technical Indices

1.11.1 Engineering Indices

Table 1-3 describes the engineering indices of ZXSDR R8860.

Table 1-3 ZXSDR R8860 Engineering Indices

Item	Indices
Overall Dimension	Width x Height x Depth: 320mm x 500mm x 172mm
Upper Enclosure Dimension	Width x Height x Depth: 320mm x 370mm x 72mm
Lower Enclosure Dimension	Width x Height x Depth: 320mm x 500mm x 100mm
Weight	< 22 kg
Power	-48V DC; -40V~-57 V
Work Temperature	-40 ℃ to 55 ℃-40 ℉ to 131 ℉
Work Humidity	5% RH ~ 95% RH

Item	Indices
Power Consumption of Normal Work Under -48V DC Power Supply	● 1 Carrier → Output Power: 20W/C/S → Power Consumption: 160 W ● 2 Carrier → Output Power: 20W/C/S → Power Consumption: 200 W ● 3 Carrier → Output Power: 20W/C/S → Power Consumption: 250 W

The technical indices of the indoor DC lightning box, exemplified by JD40K085C20H2–K1Z, are listed in Table 1-4, which is subject to the actual field technical specifications for practical application.

Table 1-4 JD40K085C20H2–K1Z DC Lightning Box Technical Indices

Item	Index
Dimensions	Width x Height x Depth: 400 mm x 450 mm x 100 mm (The height of top cover box lock excluded)
Nominal Working Voltage	–48V
Installation Mode	Indoor wall-mount installation
Working Temperature	-5 ℃ to 70 ℃
Working Humidity	≤ 95% RH

1.11.2 Performance Indices

Table 1-5 lists the performance indices of the ZXSDR R8860.

Table 1-5 ZXSDR R8860 Performance Indices

Name		Index Value
Baseband — RF interface	Interface protocol	CPRI
	RRU level number supported by a single fiber	4
	Single link length supported by RRU	< 80 Km
Environment monitoring interface	Dry contact	4 Booleans: 4 inputs
	Serial port	One RS485
Capacity of a single cabinet		8C1S

Name	Index Value
Mean time between failures (MTBF)	> 100,000 hours

1.11.3 RF Indicies

RF indices of ZXSDR R8860 comply with 3GPP2 C.S0010-C, Recommended Minimum Performance Standards for cdma2000 Spread Spectrum Base Station and 3GPP2 C.S0032-A, Recommended Minimum Performance Standards for CDMA2000 High Rate Packet Data Access Network.

Table 1-6 lists the RF indices of the ZXSDR R8860.

Table 1-6 ZXSDR R8860 RF Indices

Name		Index Value
Operating Band Class		800 MHz (Band Class 0), compliant with 3GPP2 C.S0010-C Standards. 1900MHz PCS band with its uplink as 1850MHz ~ 1915 MHz and downlink as 1930MHz ~ 1995Mhz AWS band with its uplink as 1710 MHz ~ 1755MHz and downlink as 2110 MHz ~ 2155MHz 450MHz (Band Class 5) with its uplink as 450 MHz ~ 460MHz and downlink as 460 MHz ~ 470MHz 850MHz (Band Class 10) with its uplink as 806 MHz ~ 821MHz and downlink as 851 MHz ~ 866MHz 420MHz (Band Class 5) with its uplink as 410 MHz ~ 420MHz and downlink as 420 MHz ~ 430MHz 2100MHz (Band Class 6) with its uplink as 1920 MHz ~ 1979.95MHz and downlink as 2110 MHz ~ 2169.95MHz
Mode	**Index Name**	**Index Value**
Transmitter Indices	Transmitter output frequency tolerance	± 0.05ppm
	Occupied bandwidth of channel output spectrum	1.23MHz/carrier (800MHz) 1.25MHz/carrier (450MHz/1900MHz/AWS/850MHZ/2100 MHz)
	Transmit power at the antenna port	60W/80W
	Transmit power stability	The total transmit power is within +2dB and -4dB of the rated power.

Name		Index Value
	Transmitter intermodulation performance	The BTS transmits at the rated power but the output power of another BTS is 30 dB less than the rated power of the former BTS. When the powers of the two BTSs are combined at the antenna port, the generated intermodulation spurious emission meets the conducted spurious emission requirement. The intermediate frequency difference of transmit signals of the two BTSs is 1.25 MHz, which meets 3GPP2 C.S0010-C technical standard.
	Standing wave ratio of the RFE (transmitter)	< 1.50
Receiver Indices	Receiver sensitivity	<-128dBm(RC1)
	Receiver dynamic range	-128dBm ~ -65dBm
	Noise figure	< 3
	Conducted and radiated spurious emissions	● -80dBm measured within the BTS receive band; ● -60 dBm measured within the BTS transmit band; ● -47 dBm measured within other bands with RBW = 30 kHz, meeting 3GPP2 C.S0010-C standards.
	Standing wave ratio of the RFE (receiver)	< 1.50

1.12 Compliance Standards

ZXSDR R8860 follows the following compliance standards.

- ANSI J-STD-008, Personal Station-Base Station Compatibility Requirement for 1.8 to 2.0 GHz Code Division Multiple Access (CDMA) Personal Communications System, 1996.
- 3GPP2 C.S0001-A version 5.0: Introduction to CDMA2000 Standards for Spread Spectrum Systems - Release A.
- 3GPP2 C.S0002-A version 6.0 (TIA/EIA IS-2000.2-A-2): Physical Layer Standard for CDMA2000 Spread Spectrum Systems - Release A.
- 3GPP2 C.S0003-A version 6.0 (TIA/EIA IS-2000.3-A-2): Medium Access Control (MAC) Standard for CDMA2000 Spread Spectrum Systems - Release A, Addendum 2.
- 3GPP2 C.S0004-A version 6.0 (TIA/EIA IS-2000.4-A-2): Signaling Link Access Control (LAC) Specification for CDMA2000 Spread Spectrum Systems - Release A.
- 3GPP2 C.S0005-A version 6.0 (TIA/EIA IS-2000.5-A-2): Upper Layer (Layer 3) Signaling Standard for CDMA2000 Spread Spectrum Systems - Release A, Addendum 2.
- TIA/EIA/TSB-58, Administration Parameter Value Assignments for TIA/EIA Wideband Spread Spectrum Standards, 1995.

- TIA/EIA/TSB-74, Support for 14.4 Kbps Data Rate and PCS Interaction for Wideband Spread Spectrum Cellular System, 1995.
- TIA/EIA/IS-95-A, Mobile Station-Base Station Compatibility Standard for Dual-Mode Wideband Spread Spectrum Cellular Systems.
- TIA/EIA/IS-95, Mobile Station-Base Station Compatibility Standard for Dual-Mode Wideband Spread Spectrum Cellular Systems.
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Chapter 2
Hardware Descriptions

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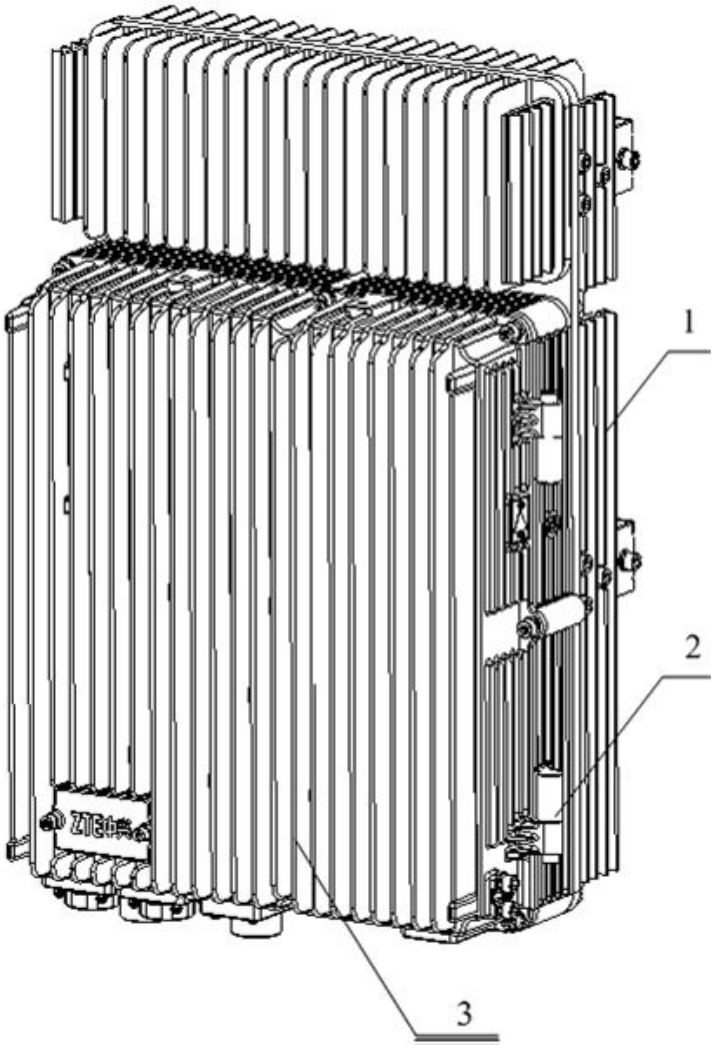
2.1 Cabinet

2.1.1 External Structure

The ZXSDR R8860 cabinet is fully sealed. The top and bottom enclosures are united by an anti-theft screw with two hinges as stop blocks. The top enclosure is equipped with a handle to facilitate conveyance and installation. A reserved engineering installation position on the bottom enclosure makes it easy to install the cabinet under various working environments by using installation accessories.

Figure 2-1 shows the ZXSDR R8860 cabinet external structure.

Figure 2-1 Cabinet Outer Structure



1. Bottom Enclosure 2. Hinge 3. Top Enclosure

Enclosure Dimension Description

Table 2-1 lists the dimensions of top and bottom enclosures.

Table 2-1 ZXSDR R8860 Cabinet Enclosure Dimensions

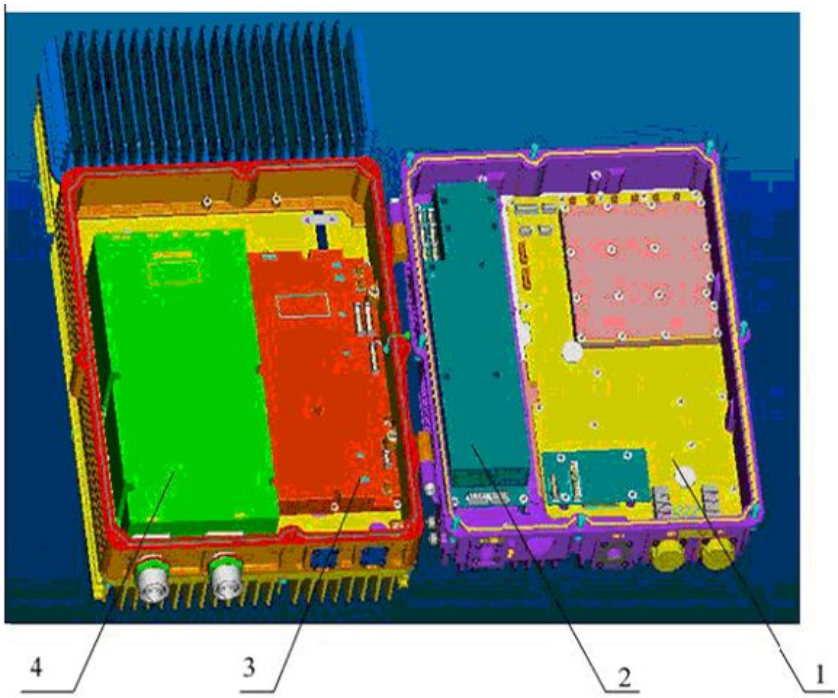
Enclosure	Dimension (W x H x D)
Top	320mm × 370mm × 72mm
Bottom	320mm × 500mm × 100mm

2.1.2 Indoor Structure

TheZXSDR R8860 cabinet consists of four modules such as FL module, PA module, DC Power module, and TR module.

Figure 2-2 shows the ZXSDR R8860 cabinet internal structure.

Figure 2-2 ZXSDR R8860 Cabinet Internal Structure



1. TR Module
2. DC Power Module
3. PA Module
4. FL Module

2.1.3 Ventilation and Heat-dissipation Principles

The ZXSDR R8860 cabinet is naturally cooled through air cooled fins on the top and bottom enclosures. Natural heat dissipation replaces heat exchanger requirement for outdoor application. In addition, a heat sink is equipped at the bottom of the cabinet to enhance heat dissipation.

2.2 Modules

2.2.1 Modules List

The ZXSDR R8860 cabinet consists of four modules such as:

- FL module
- PA module
- DC Power module
- TR module

2.2.2 Filter LNA (FL)

The functions of the Filter LNA (FL) module are as follows.

- Performs filtering and low noise amplification of the reverse CDMA signal from the antenna.

- Filters the forward RF signal to be sent.
- Reports LNA alarms to the TR.
- In the case of main/diversity combined cabinets, the main receive LNA output end of the FL has the power splitter function and reserves an external port (RXout).

2.2.3 Transceiver (TR)

The Transceiver (TR) is the main control module of ZXSDR R8860. It performs communication, control, alarm, and version management for ZXSDR R8860.

Following are the functions of the TR module.

- Forward link processing
  - → Conversion from baseband signal to RF signal
  - → Conversion of output IQ data format
  - → Power calibration and detection processing
  - → Peak clipping/digital pre-distortion processing
  - → Digital IF processing
  - → Gain adjustment (calibration)
- Reverse link processing
  - → Conversion from RF signal to baseband signal
  - → Digital IF processing
  - → RSSI and RAB report
  - → In-band anti-interference function
  - → Spectrum report
  - → Automatic gain control (AGC)
  - → Output IQ data format conversion
  - → Supports switching between different receive channel signals in the case of main/diversity combined cabinets
- Clock processing

  Performs clock recovery for data on the CPRI between the ZXSDR R8860 and the BBU generating a reference clock source and performs phase lock for the reference clock by utilizing a local high-stability clock. The working clocks generated include the master clock, frame- frequency clock, digital processing clock, and RF baseband clock.
- Monitoring
  - → PA forward power detection function: when the temperature threshold is exceeded, the TR reports the relevant alarm and controls the PA through the PA output enable/disable signal.

- → PA reversed power (standing wave ratio) detection function: when the temperature threshold standing of the wave radio is exceeded, the TR reports the relevant alarm and controls the PA through the PA output enable/disable signal.
- → PA temperature detection function: When the temperature threshold is exceeded, the TR reports the relevant alarm and controls the PA through the PA output enable/disable signal.
- → PA output enable/disable
- → TR transmit output power detection
- → FL two-channel LNA alarm detection and report
- → DC Power input undervoltage/overvoltage alarm detection and report
- → DC Power output undervoltage/overvoltage alarm detection and report
- → DC Power output overcurrent alarm detection and report
- → System environment monitoring
- → CPRI self-test alarm
- → Key chip self-test alarm

2.2.4 Power Amplifier (PA)

The Power Amplifier (PA) module performs the following functions:

- Amplifies downlink RF signal input via the TR and then sends the signal to the FL.
- Provides digital pre-distortion feedback signals for the TR.
- Provides a PA output enable/disable interface.

2.2.5 Power

The DC Power module converts -48V DC input power supply to DC power supply required by the PA, TR, or FL modules.

2.3 External Cables

2.3.1 DC Power Cable

The 4-core cable is used as DC power cable in ZXSDR R8860 . It is made according to the on-site survey requirement.

One end of the cable is soldered with a straight round connector while the other end is bare, with a label indicating signal definition.

Figure 2-3 shows the structure of the DC power cable.

Figure 2-3 DC Power Cable Structure

Table 2-2 describes the correspondence between core colors of the DC power cable and signals.

Table 2-2 Colors Correspondence between DC Power Cable and Signals

Core color	Signal
Blue	-48 V
Black	-48 V GND

NOTE **Note:**

- For the 4-core cable, make the two blue cores in parallel with each other and the two black cores in parallel with each other. The blue cores represent -48V and the black ones indicate -48V GND.

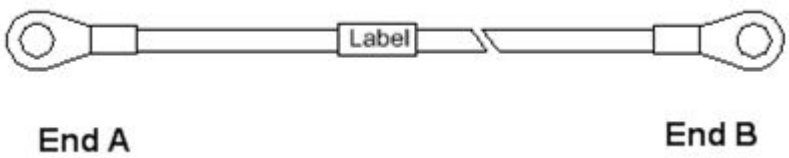
2.3.2 Grounding Cable

The grounding cable connects devices with the grounding bar in the equipment room. It provides system ground to prevent devices from static damage, and making sure devices run reliably.

The ZXSDR R8860 grounding cable is a standard fire-resistant cable adopting (yellow–and-green) core conductor, with 10mm^2 cross-sectional area. Both ends of the cable are the circular bare copper lug connectors.

Figure 2-4 shows the structure of the grounding cable.

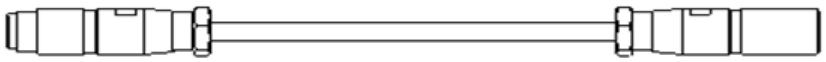
Figure 2-4 Grounding Cable Structure



2.3.3 AISG Control Cable

The AISG control cable connects the AISG device to the AISG port on the ZXSDR R8860 cabinet. The both ends of the cable are 8-core aerial connectors that meet the IEC 60130-9-ED standard. Figure 2-5shows the outline of the cable.

Figure 2-5 Outline of the AISG control cable

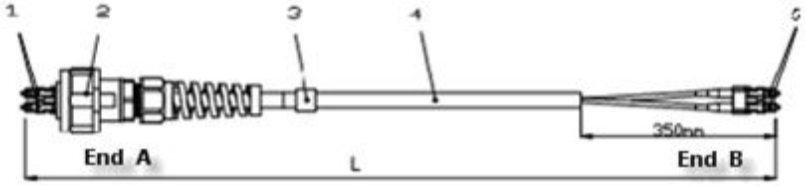


2.3.4 Optical Fiber Cable

There are two types of optical fibers used, one is used to connect with BBU while other is used to connect cascaded cabinets. The ZXSDR R8860 adopts single mode 2-core fiber tail and multi mode fiber. The tail length depends on the actual situation.

Figure 2-6 shows the structure of the fiber tail used to connect BBU.

Figure 2-6 Fiber Cable Used to Connect BBU.



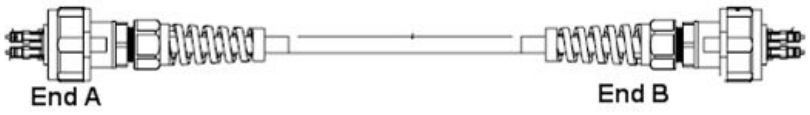
1. DLC optical connector
2. Outdoor fiber sealing nut component
3. Label
4. Single mode 2-core fiber tail
5. LC optical connector

NOTE **Note:**

The fiber is used in outdoor environments. The fiber sheath should be waterproof and anti-ultraviolet. The working temperature should be in the range of -40℃~+80℃. The sheath is of black color.

Figure 2-7 shows the optical fiber cable used for cascaded cabinets.

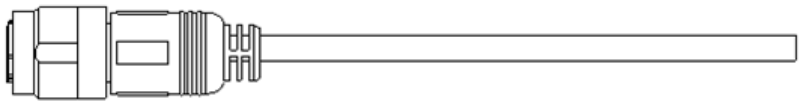
Figure 2-7 Fiber Used for Cascaded Cabinets



2.3.5 Environment Monitoring Cable

The environment monitoring cable serves as input/output dry contacts and is used to transmit RS485 monitoring signals. Figure 2-8 shows the outline of the cable.

Figure 2-8 Environment Monitoring Cable



One end of the environment monitoring cable that joins the ZXSDR R8860 is 37-core aerial connector, which meets the GJB599 III standard. Figure 2-9shows the outline of the connector.

Figure 2-9 Outline of Connector

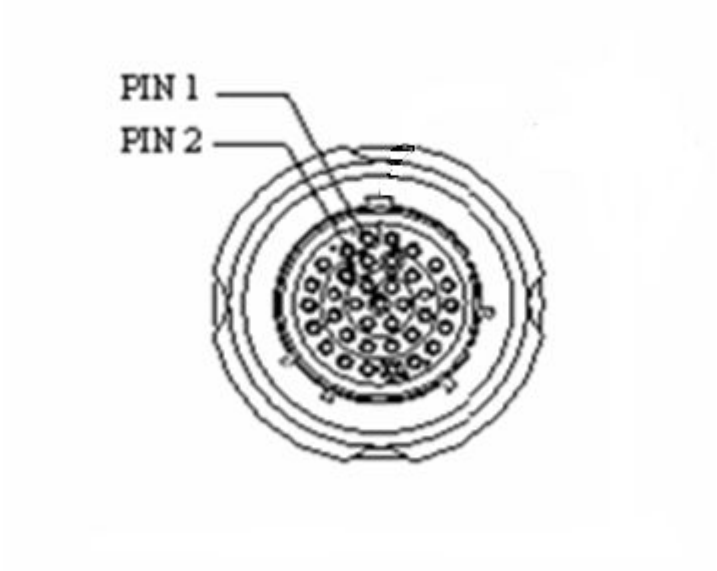


Table 2-3 describes the connector pins and connecting cores.

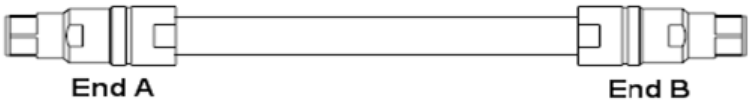
Table 2-3 Environment Monitoring Cable Pins and Connecting Cores Description

Pin	Core color	Signal description
15/16	White and blue/blue	Dry contact 4 -/+
17/18	White and orange/orange	Dry contact 3 -/+
19/20	White and green/green	Dry contact 2 -/+
21/22	White and brown/brown	Dry contact 1 -/+
23/24	Red and blue/blue	RS485 received
25/26	Red and orange/orange	RS485 transmission

2.3.6 Carrier Sector Extension Cable

The carrier sector extension cable is used to connect two ZXSDR R8860 cabinets to increase the number of carrier sectors. Figure 2-10 shows the structure of the carrier sector extension cable. End A and End B are N type male connectors.

Figure 2-10 Carrier Sector Extension Cable



2.3.7 RF Jumper Cable

RF jumper cable is used to transfer signals between ZXSDR R8860cabinet and antenna, between ZXSDR R8860cabinet and main feeder cable, and between main feeder cable and antenna.

When the distance between antenna and ZXSDR R8860cabinet is less and the adopted feeder cable is of 1/2 in. then, the jumper cable is not used, rather ZXSDR R8860cabinet is directly connected with the feeder cable and feeder cable is connected to the antenna. If the adopted feeder cable is of 7/8 in. or 5/4 in. then jumper is used.Figure 2-11 shows the RF jumper cable.

Figure 2-11 RF Jumper Cable

NOTE **Note:**

The length of the RF jumper cable is determined according to the actual situation.

2.4 Main Antenna Feeder System

2.4.1 Main Antenna Feeder System Structure

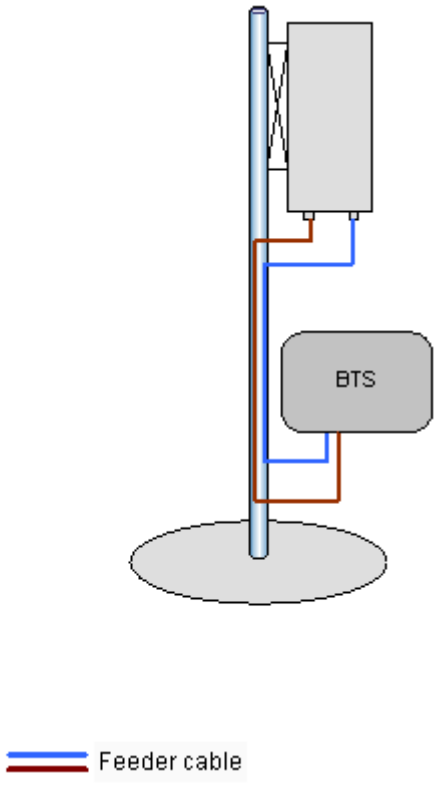
The typical configurations of ZXSDR R8860 main antenna feeder system described below includes:

- ZXSDR R8860 configured with common antenna
- ZXSDR R8860 configured with common antenna and AISG dual tower amplifier
- ZXSDR R8860 configured with electrically tuned antenna (1)
- ZXSDR R8860 configured with electrically tuned antenna (2)
- ZXSDR R8860 configured with electrically tuned antenna, AISG dual tower amplifier

ZXSDR R8860 configured with common antenna

In this configuration, generally ZXSDR R8860 installation position is near antenna and they are all installed on the building top. ZXSDR R8860 is connected to the antenna by 1/2″feeder directly, occasionally 5/4″or 7/8″feeder is adopted, as shown in Figure 2-12.

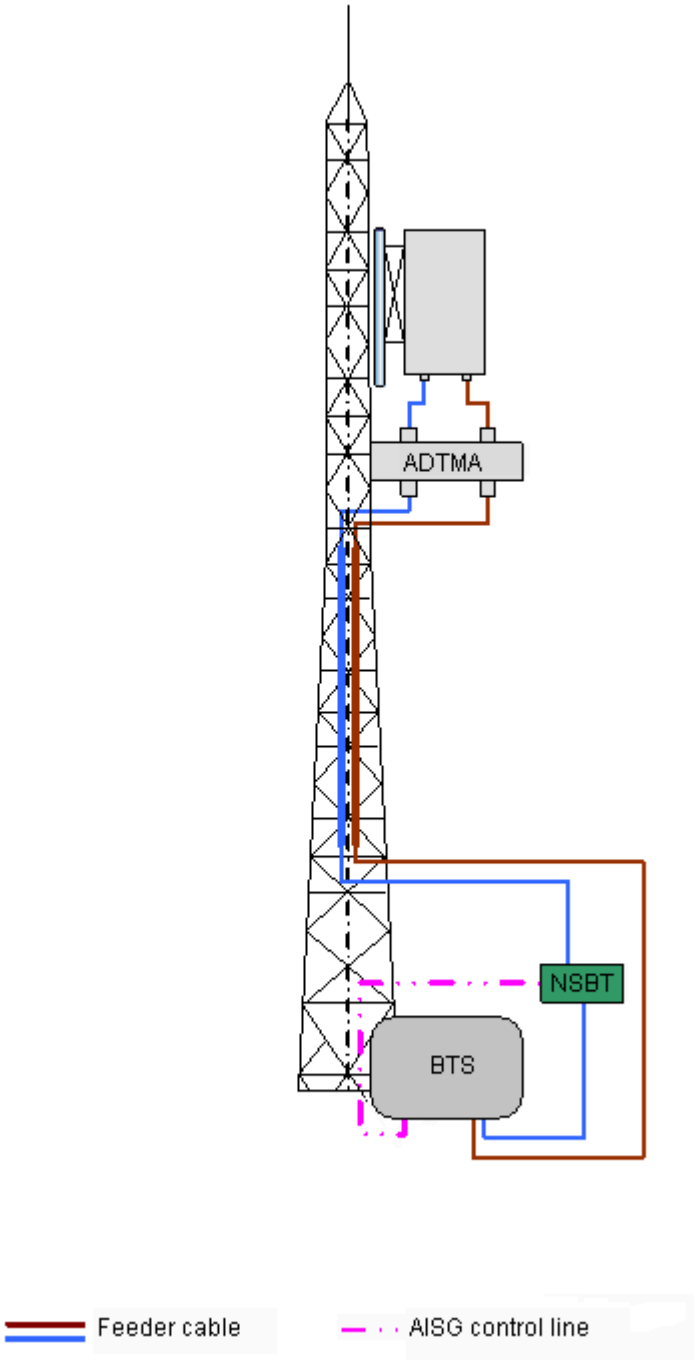
Figure 2-12 ZXSDR R8860 Configured with Common Antenna



ZXSDR R8860 configured with common antenna and AISG dual tower amplifier

In this configuration, generally ZXSDR R8860 is installed on the tower. ZXSDR R8860 is connected to the antenna by 5/4″or 7/8″feeder, as shown in Figure 2-13.

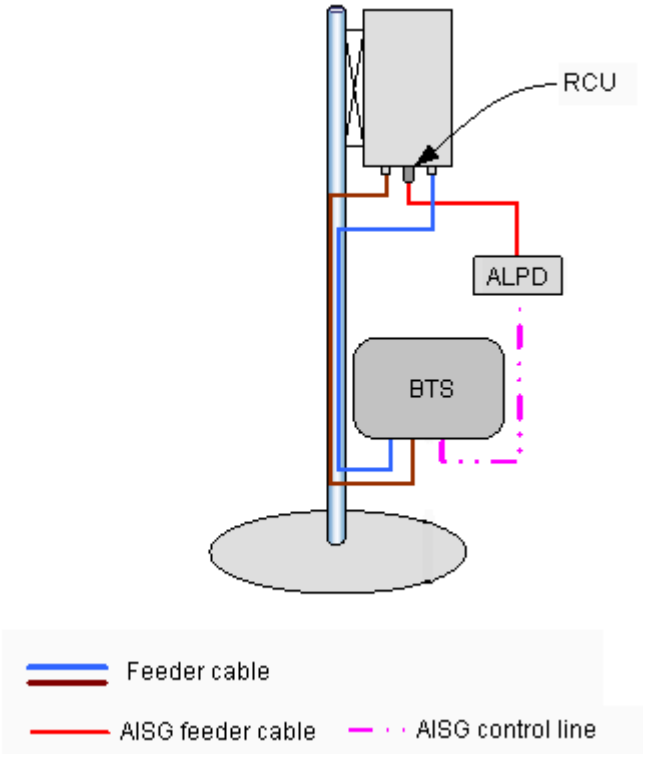
Figure 2-13 ZXSDR R8860 Configured with Common Antenna, AISG Dual Tower Amplifier



ZXSDR R8860 configured with electrically tuned antenna (1)

In this configuration, generally ZXSDR R8860 installed near the antenna on the building top. ZXSDR R8860 is connected to the antenna by 1/2″feeder directly, occasionally 5/4″or 7/8″feeder is adopted, as shown in Figure 2-14.

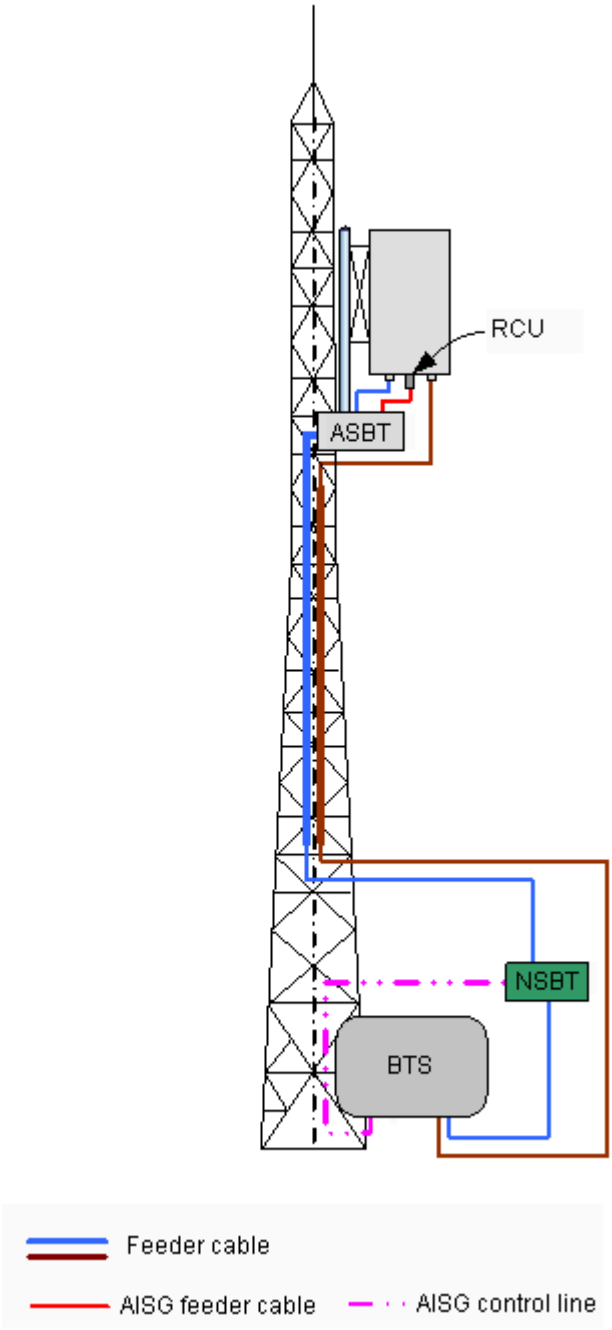
Figure 2-14 ZXSDR R8860 Configured with Electrically Tuned Antenna (1)



ZXSDR R8860 configured with electrically tuned antenna (2)

In this configuration, generally ZXSDR R8860is installed near the top of the tower. ZXSDR R8860 is connected to the antenna by 5/4″or 7/8″feeder is adopted, as shown in Figure 2-15.

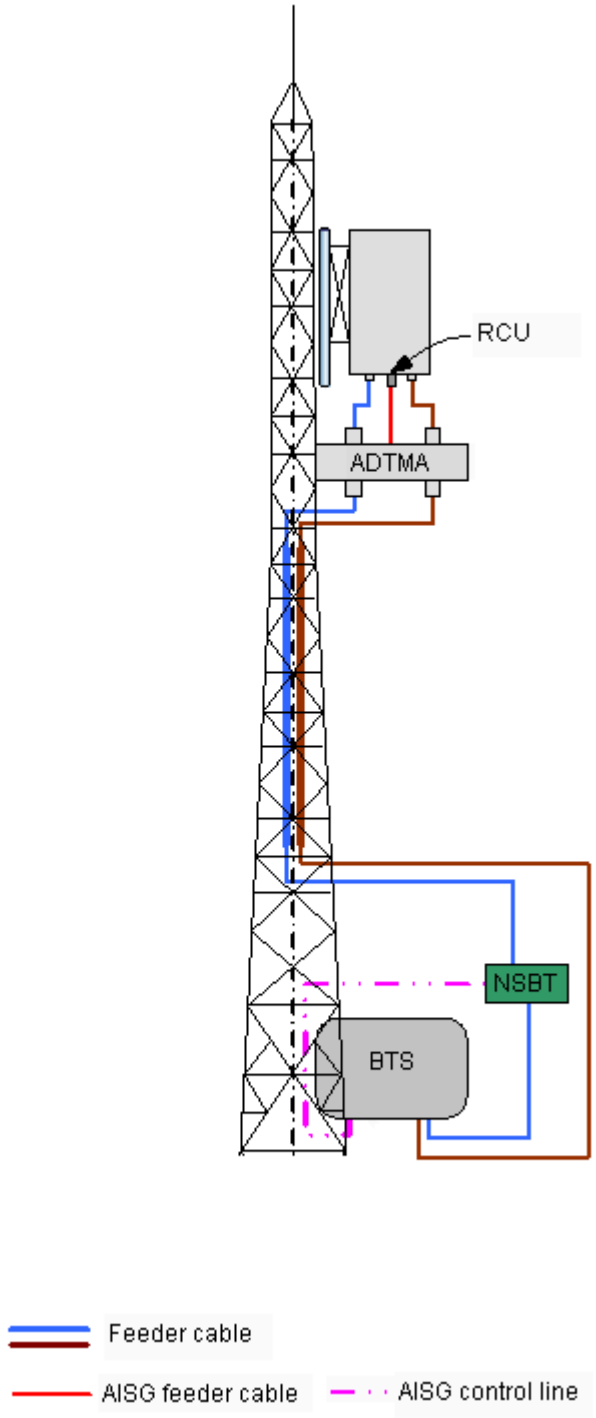
Figure 2-15 ZXSDR R8860 Configured with Electrically Tuned Antenna (2)



ZXSDR R8860 configured with electrically tuned antenna, AISG dual tower amplifier

In this configuration, generally ZXSDR R8860is installed near the top of the tower. ZXSDR R8860 is connected to the antenna by 5/4″or 7/8″feeder is adopted, as shown in Figure 2-16.

Figure 2-16 ZXSDR R8860 Configured with Electrically Tuned Antenna and AISG Dual Tower Amplifier



2.4.2 Antenna

The ZXSDR R8860 antenna feeder system adopts common antenna or electrical antenna. For the electrical antenna, you can adjust the lever to control the embedded adjuster and thus to tune the downtilt angle of the antenna. The tilt reflects the direction from which the

antenna receives the strongest signals. The tilt of the uni-directional antenna can be tuned mechanically, and electrical tilt is used to tune the omni-directional antenna.

The principle of the electrical tilt is as follows:

The adjustment of the phase of the antenna array vibrator changes the maximum vertical and horizontal components and alters synthesized field strength, thus making the vertical pattern of the antenna declining. Because the antenna field strength increases or decreases simultaneously in all directions, which ensures that the antenna pattern hardly varies with the tilt. This diminishes the coverage of the main lobe and ensures that no interference occurs when the coverage of the whole pattern decreases in its service area.

2.4.3 Feeder Structure

The feeder is used to receive and transmit radio RF signals between the antenna and the ZXSDR R8860. There are many types of feeder cables such as 1/2 inch and 7/8 inch feeder cable.

When the distance between the ZXSDR R8860 cabinet and antenna is less, then 1/2 inch feeder cable is used. In this case, the ZXSDR R8860 cabinet is directly connected to the 1/2 inch feeder and 1/2 inch feeder cable is connected to antenna.

When the distance between the ZXSDR R8860 cabinet and antenna is more, then 7/8 inch feeder cable is used. In this case, ZXSDR R8860 cabinet is first connected to the jumper, then jumper is connected to 7/8 inch feeder cable, and 7/8 inch feeder cable is again connected to jumper and lastly jumper is connected to antenna.

The antenna may have N type or DIN type interface. The feeder is adapted to female and male N connectors. Usually both ends of the delivered feeder are male N connector to facilitate on-site installation.

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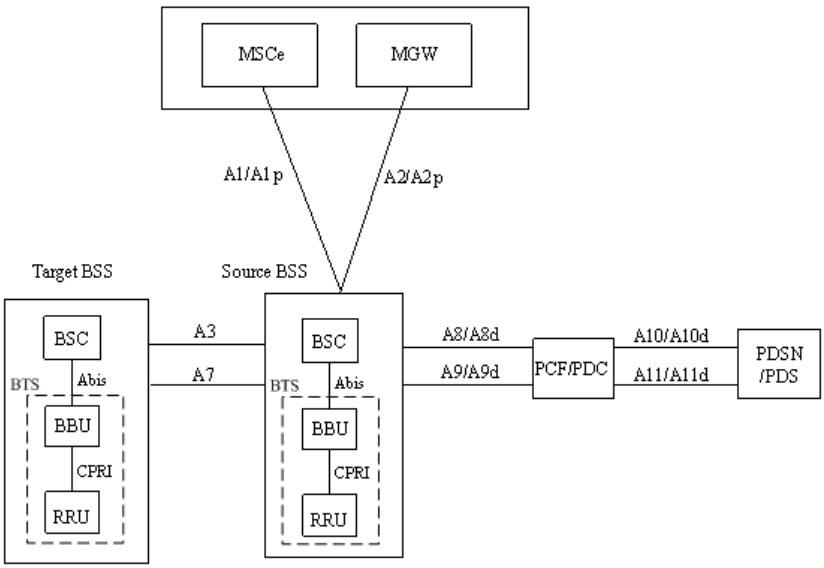
Chapter 3
Protocol Interface Description

Table of Contents

3.1 Network Reference Model

Figure 3-1 shows the network reference model of the CDMA2000 1x network.

Figure 3-1 CDMA2000 1x Network Reference Model



The description of the interfaces in Figure 3-1 are described in Table 3-1.

Table 3-1 Interface Description

Interface	Description
Abis	Interface between BSC and BTS
CPRI	Interface between BBU and RRU of the distributed base station
A1/A1p	Signaling interface between MSCe/MGW and BSC
A2/A2p	Service interface between MSCe/MGW and BSC

Interface	Description
A3	Implements soft handoff between different BSCs (focusing on the media plane).
A7	Implements soft handoff between different BSCs (focusing on the control plane).
A8/A8d	Implements data transmission between BSS and PCF/PDC.
A9/A9d	Implements signaling transmission between BSS and PCF/PDC
A10/A10d	Implements data transmission between PCF and PDSN, and between PDC and PDS.
A11/A11d	Implements signaling transmission between PCF and PDSN, and between PDC and PDS.

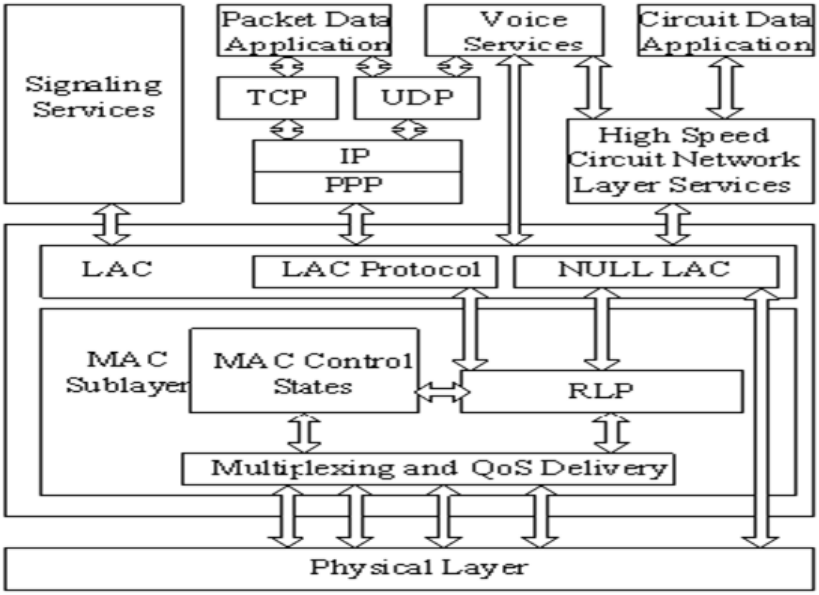
3.2 Um Interface

The Um interface is the air interface between Mobile Station (MS) and Base Transceiver Station (BTS), complying with the IS-2000 ReleaseA standards and the IS-856-A standard.

CDMA2000 1x Um Interface

The CDMA2000 1x Um interface is composed of physical layer, data link layer and uppermost layer. Figure 3-2 shows the protocol reference model.

Figure 3-2 CDMA2000 1x Um Interface Protocol Reference Model



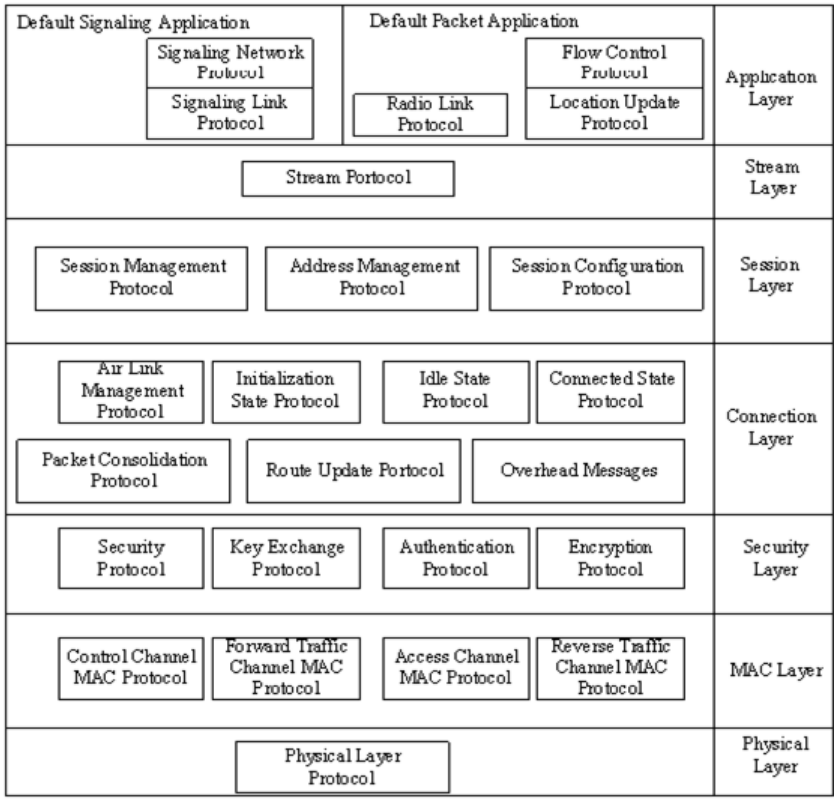
- The physical layer is a bottom layer, covering various physical channels. It provides basic radio channels to transmit information of upper layers.

- The data link layer comprises of Medium Access Control (MAC) sublayer and Link Access Control (LAC) sublayer. The MAC sublayer implements the mapping between logical channels and physical channels and delivers the Radio Link Protocol (RLP) function. The LAC sublayer performs authentication, automatic request retransmission, addressing, segment and reassembly.
- The uppermost layer provides signaling service, voice service, packet data application and circuit data application, and implements radio resource, mobility and connection management of the air interface through signaling service.

CDMA2000 1x EV-DO Um interface

The CDMA2000 1x EV-DO Um interface is divided into application layer, stream layer, session layer, connection layer, security layer and physical layer. The Um interface meets the IS-856 protocol standard. Every layer defines one or more protocols to realize its function. Figure 3-3 illustrates the overall protocol reference model.

Figure 3-3 1xEV-DO Um Interface Protocol Reference Model



- Application layer

  The application layer provides multiple applications, such as Default Signaling Application for transmitting air interface messages and Default Packet Application for transmitting data. The Default Signaling Application defines two protocols, Signaling Network Protocol (SNP) and Signaling Link Protocol (SLP). The protocols on all layers exchange messages through SNP . SLP implements message segment and assembly, Best-effort transmission, reliable transmission and duplicate packet detection.

The Default Packet Application provides a byte stream to transmit packet data between the terminal and the network. It includes three protocols.

→ Flow Control Protocol provides the flow control function for data stream.

→ Radio Link Protocol implements byte stream retransmission and duplicate packet detection, and provides a reliable data link for upper applications.

→ Location Update Protocol provides location update program and corresponding messages for mobility management of packet application.

- Stream layer

  The stream layer delivers the following functions:

  → It provides the architecture of data packets over the connection application layer by means of data stream authentication.

  → It distinguishes priorities signals and user services according to the data encapsulation protocol of the connection layer.

  → It connects users to signal service.

  → It allocates independent data stream to applications of different QoSs.

- Session layer

  The session layer contains a series of protocols used for session negotiation between the terminal and the network. In the 1xEV-DO system, a session indicates a state jointly maintained between Access Terminal (AT) and Access Network (AN). It includes address UATI distributed to the terminal, protocol set determined by the terminal and the network for air interface communication, protocol configurations in the protocol set and current terminal location. The session layer defines three protocols:

  → Session Management Protocol activates other protocols on the layer, ensures session validity and closes sessions.

  → Address Management Protocol manages terminal address (UATI) distribution.

  → Session Configuration Protocol (SCP) performs session flow negotiation. In the 1xEV-DO system, SCP negotiates the protocol used for communication between the terminal and the network, and how to set protocol parameters.

- Connection layer

  The connection layer controls the air link state. In the 1xEV-DO system, an enabled link between AT and AN means the AT is allocated with RPC, RTC and FTC (FTC is the time division channel shared by all the subscribers with open connections in the sector).

- Security layer

  The security layer delivers the following functions:

  → Key exchange. It provides a procedure for the terminal and the network to exchange keys that are used for authentication and encryption.

→ Authentication. It provides a procedure for the terminal and the network to authenticate over-the-air services.

→ Encryption. It provides a procedure for the terminal and the network to encrypt over-the-air services.

The security layer covers four protocols, among which Key Exchange Protocol, Authentication Protocol and Encryption Protocol define the three functions mentioned above respectively while Security Protocol provides public variables for Authentication Protocol and Encryption Protocol.

- MAC layer

  The MAC layer defines the rules for managing control channel, access channel, forward traffic channel and reverse traffic channel. It contains four protocols, as described below:

  → Control Channel MAC Protocol constructs Control channel MAC layer packet from one or more Security layer packets, controls packet scheduling and transmission rule of channels and regulates how the terminal captures the control channel and receives control channel packets.

  → Access Channel MAC Protocol defines that the terminal sends timing messages and power features over the access channel.

  → Forward Traffic Channel (FTC) Protocol regulates how to control the rate of the FTC through the DRC and how to support the fixed rate mode and variable rate mode of the FTC.

  → Reverse Traffic Channel (RTC) Protocol regulates how the terminal assists the network to capture the RTC and how the terminal and the network choose RFC rate.

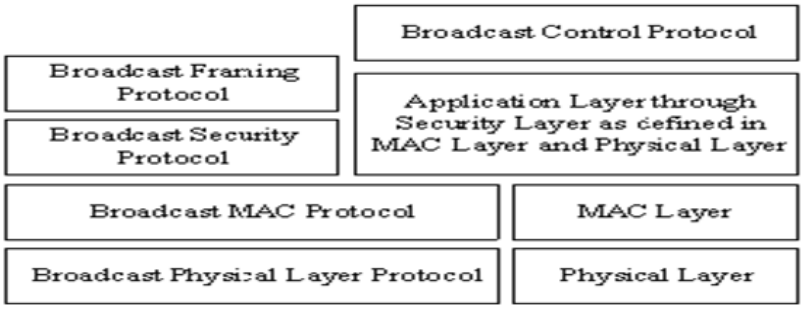
- Physical layer

  The physical layer defines structure, frequency, power output, modulation/demodulation and coding/decoding of the forward/reverse channel.

BCMCS Um Interface

The Broadcast and Multicast Service (BCMCS) Um interface implements broadcast and multicast services. Figure 3-4 shows the structure of the BCMCS Um interface protocol stack.

Figure 3-4 Structure of the BCMCS Um Interface Protocol Stack



- Broadcast Control Protocol processes BCMCS stream registration. The AT sends the stream registration request to the AN so that the AN can broadcasting the stream continuously.
- Broadcast Framing Protocol encapsulates, segments and delimits upper layer packets.
- Broadcast Security Protocol provides packet encryption mechanism.
- Broadcast MAC Protocol adds forward error correcting codes to form Error Control Block (ECB) and relays MAC frames to the physical layer. The layer is responsible of logical channel mapping, constructing and sending broadcast overhead messages.
- Broadcast Physical Protocol provides a logical channel structure.

3.3 Baseband—RF Interface

The baseband-RF interface of ZXSDR R8860 complies with the common public radio interface (CPRI) specification. The CPRI specification was instituted by the CPRI Union, which is an industry cooperation organization devoting itself to institution of internal radio interface specifications of radio base stations.

The CPRI specification describes the transmission, control and synchronization mechanisms of user data and control signaling, defining the essential factors such as transmission, connection and control.

From a view of the specification system, the CPRI specification contains the contents of physical layer and data link layer. It describes characteristics of electrical and optical interfaces and multiplexing mechanisms among various data flows in the matter of the physical layer, and media access control (MAC), flow control and information flow protection in the matter of the data link layer.

Figures

Tables

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Glossary

AISG
- Antenna Interface Standards Group

AN
- Access Network

BBU
- BaseBand Unit

BCMCS
- Broadcastand Multicast Service

BSC
- Base Station Controller

BSS
- Base Station System

BTS
- Base Transceiver Station

CDMA
- Code Division Multiple Access

CPRI
- Common Public Radio Interface

DRC
- Data Rate Control

FL
- Forward Link

FL
- Filter LNA

LNA
- Low Noise Amplifier

MAC
- Medium Access Control

MSCe
- Mobile Switching Center emulator

PA
- Power Amplifier

PCF
- Packet Control Function

PCF is a board which is responsible for the data selection between multiple reverse traffic channels and data distribution from a forward traffic channel to multiple cells/sectors during soft handoff.

PDSN

- Packet Data Service Node

RAB

- Radio Access Bearer

RF

- Radio Frequency

RLP

- Radio Link Protocol

RRU

- Remote Radio Unit

RSSI

- Received Signal Strength Indicator

TR

- Transceiver