ZXMBW R9100
Remote Radio Unit(2×4)
Technical Manual

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Revision History

Revision No.	Revision Date	Revision Reason
R1.0	02/04/2008	First Edition
R1.1	04/01/2008	Support 3.5GHz

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Content

Preface

Purpose

This manual provides ZXMBW R9100 Remote Radio Unit(2x4) 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 ZXMBW R9100.

Prerequisite Skill and Knowledge

To use this document effectively, users should have a general understanding of WiMAX system. Familiarity with the following is helpful:

- WiMAX technology
- IEEE802.16e - Standard
- ZXMBW R9100 and its various components

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.

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Chapter 1

Product Overview

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R9100 Position in the Network

The position ZXMBW R9100 in Base Station (BS) is as shown in Figure 1.

FIGURE 1 ZXMBW R9100 POSITION IN BS

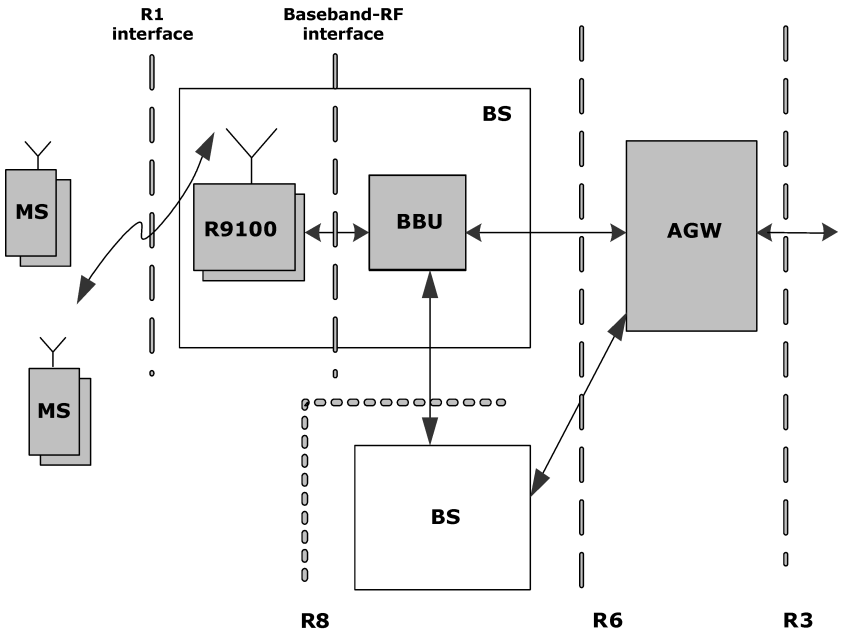


Table 1 shows meanings of the network elements.

TABLE 1 NETWORK ELEMENTS

Name	Meaning
AGW	Access Service Network GateWay
BBU	Base station Baseband Unit
BS	Base Station
MS	Mobile Station
R9100	Enhanced Radio Unit (2 carriers)

Interfaces of ZXMBW R9100:

- **Baseband-RF interface:** an interface between R9100 and BBU, abides by Open Base Station Architecture Initiative (OBSAI) RP3 standard.
- **R1 interface:** an interface between BS and MS, abides by IEEE 802.16e-2005 protocol.

R9100 Appearance

ZXMBW R9100 radio unit is made of cast aluminum metal. It is very small and exquisite.

Figure 2 shows the appearance of ZXMBW R9100. The cabinet surface is coated by silver gray paint that is suitable for outdoor climate.

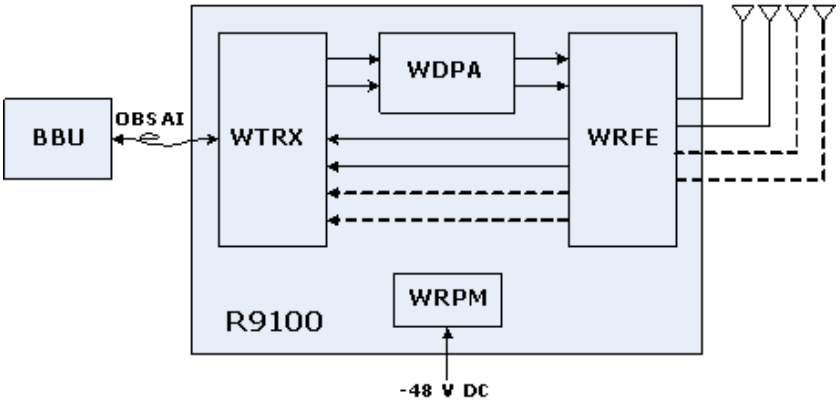
FIGURE 2 ZXMBW R9100 APPEARANCE

R9100 System Structure

ZXMBW R9100 is a remote Radio Frequency (RF) unit that accomplishes the conversion between the RF signal and baseband signal. An Optical fiber is used to accomplish the baseband data interface and baseband I/Q interface. RF cable is used to accomplish the antenna interface.

Figure 3 shows ZXMBW R9100 system structure.

FIGURE 3 ZXMBW R9100 SYSTEM STRUCTURE



Note:

- The real line indicates 2T×2R Multiple-Input Multiple Output (MIMO) and the dotted line indicates optional and supports 2T×4R MIMO.
- FCC RF exposure standards require that this equipment should be installed in such a way as to maintain a separation distance of 300 cm between the antenna used with this device and all the persons.

- Forward link: WTRX receives forward signal sent by BBU via an optical interface, performs digital intermediate frequency processing and up-conversion. WDPA performs signal amplification, then WRFE performs forward filtering, and finally sends RF signal to air via an antenna.
- Reverse link: WRFE receives signal from an antenna, then sends to WTRX to perform down-conversion and digital intermediate frequency processing and finally sends to BBU via an optical interface.

R9100 Functions

As a remote RF unit, ZXMBW R9100 performs the following functions.

1. Forward Link Functions
   - ZXMBW R9100 receives In-phase and Quadrature phase (I/Q) signals from Base station Baseband Unit (BBU) via optical interface for up-conversion. ZXMBW R9100 Performs RF power amplification and transmission filtering on the received signals, and then transmits the signals via antenna.
   - Provides standing wave detection of antenna feeder interface.
   - Provides power detection of baseband signals and antenna feeder interface.
   - Provides automatic and manual calibration.
2. Reverse Link Functions
   - ZXMBW R9100 sends the received air-interface signals to BBU via an optical fiber after band pass filtering. ZXMBW R9100 performs low noise amplification, RF mixing and digital down-conversion to baseband.
   - Provides Received Signal Strength Indicator (RSSI) function.
   - Provides Automatic Gain Control (AGC).
3. Other Functions
   - Monitors and manages power amplifiers and power supplies.
   - Regenerates Time Division Duplex (TDD) time sequence.
   - Provides version query and update.
   - Supports measurements of transmission delay.
   - Restores and regenerates clocks at the fiber interface.
   - Supports AISG electrical tunable antenna and trunk nodes monitoring.

R9100 Features

ZXMBW R9100 is designed for outdoor use. It is also applicable in basements and city squares.

Following are the features of ZXMBW R9100:

- ZXMBW R9100 and Baseband unit (BBU) together accomplish Base Station (BS) functions.
- Supports single carrier such as 5 MHz, 7MHz or 10 MHz.
- Supports 2Tx2R or 2Tx4R Multiple-Input Multiple-Output (MIMO) technology (optional).
- Supports Worldwide Interoperability for Microwave Access (WiMAX) band class 2300 MHz ~ 2400 MHz and band class 2490MHz2580MHz and 2600 MHz ~ 2690 MHz and band class 3400 MHz ~ 3500 MHz and band class 3500 MHz ~ 3600 MHz.

- For band class 2.3 GHz, output power is up to 2 x 10 W. For band class 2.5 GHz, output power is up to 2 x 10 W. For band class 3.5 GHz, output power is up to 2 x 4 W.
- Working temperature range is from - 40 °C ~ + 55 °C and supports IP65 shell protection level.
- Lightning protection level is 15 kA.
- Supports remote external monitoring such as one half-duplex RS232, one half-duplex RS485 and seven trunk nodes monitoring (optional).
- The Baseband-RF interface complies with an Open Base Station Architecture Initiative (OBSAI) standard. Supports flexible networking such as star and chain networking.
- The Baseband-RF interface supports optical fiber backup, thus the reliability is increased.
- Due to small size and light weight provides easy installation and maintenance. It can be installed on poles, walls and racks.
- Many ZXMBW R9100s can share the Global Positioning System (GPS) of baseband pool to save money.
- External antenna is used. Directional antenna and omni-directional antenna are available.
- Software remote download is available.
- Remote control board reset is available.
- Supports -48 V DC power supply.
- Complies with the FCC, CE and Underwriter Laboratories Inc. (UL) certified standards.
- Complies with Part 15 of the FCC Rules. Operation is subject to the condition that this device does not cause harmful interference.

Caution:

The user is cautioned that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Technical Specifications

R9100 Engineering Specifications

Physical Specifications

Physical specifications of ZXMBW R9100 are listed in Table 2.

TABLE 2 PHYSICAL SPECIFICATIONS

Name	Index
Dimensions	320 mm x 370 mm x 160 mm (width x height x depth), i.e., 12 10/16 in x 14 9/16 in x 6 5/16 in (width x height x depth)
Volume	19 L
Weight	16.3 kg (35 15/16 lb)
Shell protection level	IP65
ZXMBW R9100's Modules' Dimensions	
WRFE (RFE filter) module	200 mm x 230 mm x 25 mm (width x height x depth), i.e., 7 14/16 in x 9 1/16 in x 16/16 in (width x height x depth)
WRPM (Power supply) module	80 mm x 250 mm x 40 mm (width x height x depth), i.e., 3 2/16 in x 9 13/16 in x 1 9/16 in (width x height x depth)
WDPA (Power amplifier) module	210 mm x 270 mm x 20 mm (width x height x depth), i.e., 8 4/16 in x 10 10/16 in x 13/16 in (width x height x depth)
WTRX (Transceiver) module	210 mm x 330 mm x 25 mm (width x height x depth), i.e., 8 4/16 in x 12 16/16 in x 16/16 in (width x height x depth)

Temperature and Humidity Specifications

Temperature and humidity specifications of ZXMBW R9100 are listed in Table 3.

TABLE 3 TEMPERATURE AND HUMIDITY SPECIFICATIONS

Name	Index
Temperature requirement	Working temperature: -45° C ~ +55° C Storage temperature: -45° C ~ +85° C
Humidity requirement	Working humidity: 5% RH ~ 95% RH Storage humidity: 5% RH ~ 98% RH

R9100 Power Supply Specifications

Table 4 shows DC power supply specifications for ZXMBW R9100 to run normally.

TABLE 4 POWER SUPPLY SPECIFICATIONS

Category	Nominal Value	Power Supply Range
DC	-48 V DC	-60 V DC ~ -36 V DC

R9100 Power Consumption Specifications

Table 5 shows the power consumption specifications of ZXMBW R9100.

TABLE 5 POWER CONSUMPTION SPECIFICATIONS

Name	Index
Power consumption	≤ 200 W

R9100 RF Power Specifications

Table 6 shows Radio Frequency (RF) power specifications of ZXMBW R9100.

TABLE 6 RF POWER SPECIFICATIONS

Name	Carrier	Output Power	Power Step	Dynamic Range
Output power for 2.3 GHz	Single	10 W	0.5 dB	±15 dB
	Double	2 x 10 W		
Output power for 2.5 GHz	Single	10 W		
	Double	2 x 10 W		
Output power for 3.5 GHz	Single	4 W		
	Double	2 x 4 W		

Applied Standards

International Standards

The ZXMBW R9100 complies with the following international standards:

1. Institute of Electrical and Electronics Engineers (IEEE) Standard 802.16-2004, IEEE Standard for Local and Metropolitan Area Networks - Part 16: Air Interface for Fixed Wireless Access Systems.
2. Institute of Electrical and Electronics Engineers (IEEE) Standard 802.16-2005, Part 16: Air Interface for Fixed and Mobile Broadband Wireless Access Systems.
3. Worldwide Interoperability for Microwave Access (WiMax) Forum™ Mobile Radio Conformance Tests (MRCT).
4. Worldwide Interoperability for Microwave Access (WiMAX) Forum™ Mobile Protocol Implementation Conformance Statement (PICS) Proforma.
5. Worldwide Interoperability for Microwave Access (WiMAX) Forum™ Mobile System Profile.
6. Open Base Station Architecture Initiative (OBSAI) Reference Point 3 Specification Version 3.0.

Lightning Proof Standards

The ZXMBW R9100 complies with the following lightning proof standards:

1. International Electrotechnical Commission (IEC) 61312-1 (1995) Protection against Lightning Electromagnetic Impulse Part I: General Principles.
2. International Electrotechnical Commission (IEC) 61643-1 (1998) Surge Protective devices connected to low-voltage power distribution systems.
3. International Telecommunications Union (ITU) -T K.11 (1993) Principles of Protection against Overvoltage and Overcurrent.
4. International Telecommunications Union (ITU) -T K.27 (1996) Bonding Configurations and Earthing Inside a Telecommunication Building.
5. European Telecommunication Standard (ETS) 300 253 (2004) Equipment Engineering; Earthing and bonding of telecommunication equipment in telecommunication centres.

Safety Standards

The ZXMBW R9100 complies with the following safety standards:

1. International Electrotechnical Commission (IEC) 60950 Safety of information technology equipment including Electrical Business Equipment.
2. International Electrotechnical Commission (IEC) 60215 Safety requirement for radio transmitting equipment.
3. Canadian Standards Association (CAN/CSA) - C22.2 No 1-M94 Audio, Video and similar Electronic Equipment.
4. Canadian Standards Association (CAN/CSA) - C22.2 No 950-95 Safety of Information Technology Equipment including Electrical Business Equipment.
5. University of Limerick (UL) 1419 Standard for Professional Video and Audio Equipment.
6. 73/23/ Electrical and Eletronics Commission (EEC) Low Voltage Directive.
7. University of Limerick (UL) 1950 Safety of information technology equipment including Electrical Business Equipment.
8. International Electrotechnical Commission (IEC) 60529 Classification of degrees of protection provided by enclosure (IP Code).
9. GOST 30631-99. General Requirements to machines, instruments and other industrial articles on stability to external mechanical impacts while operating.
10. GOST 12.2.007.0-75. Electro-technical devices. The general safety requirements.

EMC Standards

The ZXMBW R9100 complies with the following EMC standards:

1. IEC Special International Committee on Radio Interference (CISPR) 22 (1997): Limits and methods of measurement of radio disturbance characteristics of information technology equipment.
2. EN 301 489-1 Part 1: Common technical requirements.
3. International Electrotechnical Commission (IEC) 61000-6-1: 1997: Electromagnetic Compatibility (EMC) - Part 6: Generic standards - Section 1: Immunity for residential, commercial and light-industrial environments.
4. International Electrotechnical Commission (IEC) 61000-6-3: 1996: Electromagnetic Compatibility (EMC) - Part 6: Generic standards - Section 3: mission standard for residential, commercial and light industrial environments.
5. International Electrotechnical Commission (IEC) 61000-4-2 (1995): Electromagnetic Compatibility (EMC) - Part 4: Test-

ing and measurement techniques - Section 2: Electrostatic discharge immunity test.

6. International Electrotechnical Commission (IEC) 61000-4-3 (1995): Electromagnetic Compatibility (EMC) - Part 4: Testing and measurement techniques - Section 3: Radiated, radio-frequency electromagnetic field immunity test.
7. International Electrotechnical Commission (IEC) 61000-4-4 (1995): Electromagnetic Compatibility (EMC) - Part 4: Testing and measurement techniques - Section 4: Electrical fast transient/burst immunity test.
8. International Electrotechnical Commission (IEC) 61000-4-5 (1995): Electro- Magnetic Compatibility (EMC) - Part 4: Testing and measurement techniques - Section 5: Surge immunity test.
9. International Electrotechnical Commission (IEC) 61000-4-6 (1996): Electro- Magnetic Compatibility (EMC) - Part 4: Testing and measurement techniques - Section 6: Immunity to contacted disturbances, induced by radio frequency fields.
10. International Telecommunications Union (ITU) -T Recommendation K.20: Resistibility of Telecommunication Switching Equipment to Overvoltages and Overcurrents.
11. GOST R 51318.22-99: Electromagnetic compatibility of technical equipment. Man-made noise from informational equipment. Limits and test methods.
12. GOST 30429-96: Electromagnetic compatibility of technical equipment. Man-made noise from equipment and apparatus used together with service receiver systems of civil application. Limits and test methods.

Environment Standards

The ZXMBW R9100 complies with the following environment standards:

1. International Electrotechnical Commission (IEC) 60529 "Degrees of protection provided by enclosure (IP code)".
2. International Electrotechnical Commission (IEC) 60721-3-1: Classification of environmental conditions- Part3: Classification of groups of environmental parameters and their severities-Section 1: Storage
3. International Electrotechnical Commission (IEC) 60721-3-2: Classification of environmental conditions- Part3: Classification of groups of environmental parameters and their severities-Section 2: Transportation.
4. International Electrotechnical Commission (IEC) 60721-3-3 (1994): Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Section 3: Stationary use at weather protected locations.
5. European Telecommunication Standard (ETS) 300 019-2-1: Equipment Engineering (EE); Environmental conditions and

environmental tests for telecommunications equipment; Part 2-1, Specification of environmental tests Storage.

6. European Telecommunication Standard (ETS) 300 019-2-2: Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 2-2, Specification of environmental tests Transportation.
7. European Telecommunication Standard (ETS) 300 019-2-3: Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 2-3, Specification of environmental tests Transportation Stationary use at weather-protected locations.
8. International Electrotechnical Commission (IEC) 60068-2-1 (1990): Environmental testing - Part 2: Tests. Tests A: Cold.
9. International Electrotechnical Commission (IEC) 60068-2-2 (1974): Environmental testing - Part 2: Tests. Tests B: Dry heat.
10. International Electrotechnical Commission (IEC) 60068-2-6 (1995): Environmental testing - Part 2: Tests - Test Fc: Vibration (sinusoidal).
11. GOST 15150-69: Machines, instruments and other industrial articles. Applications for different climatic regions. Categories, operating, storage and transportation conditions in compliance with the environmental factors.
12. GOST 23088-80: Electronic equipment. Requirements to packing and transportation and test methods.

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Chapter 2

Hardware Description

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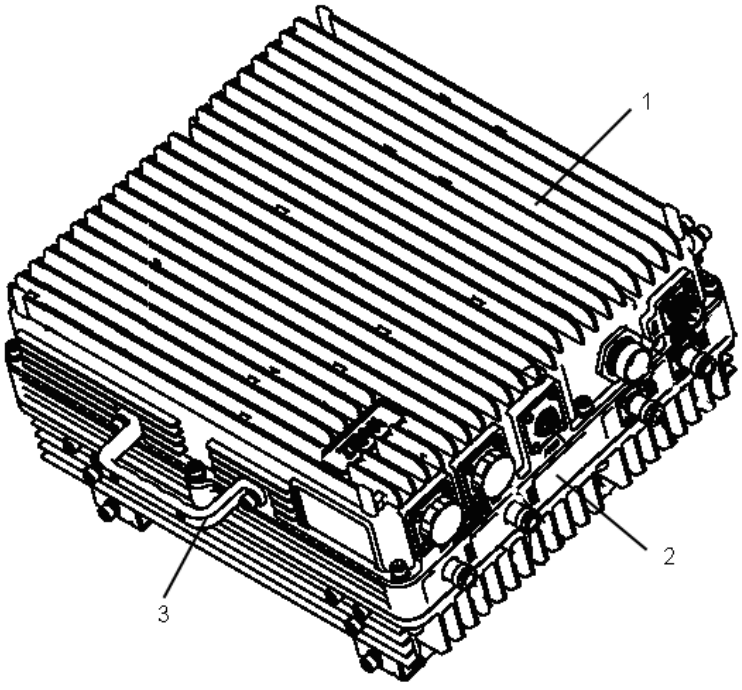
Cabinet

R9100 Cabinet Structure

Figure 4 shows the cabinet structure of ZXMBW R9100 .

FIGURE 4 ZXMBW R9100 CABINET STRUCTURE



1. Cabinet
2. Bottom Panel
3. Handle

R9100 Interface Description

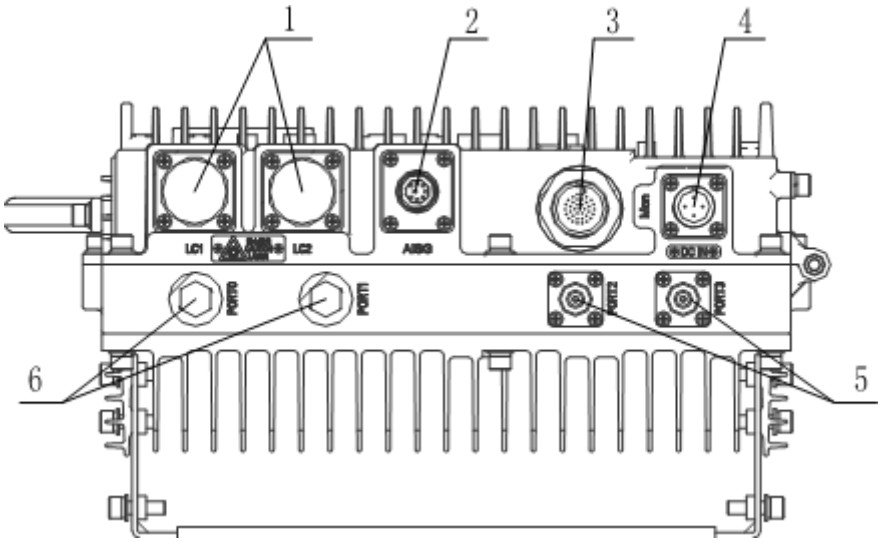
Short Description

The ZXMBW R9100 is highly integrated. Only four modules are used and many external interfaces are available on the panel. The power interface connects with the WRPM module, RF antenna interface connects with the WRFE module and BDS-RFS Optical Fiber interfaces connect with the WTRX module.

ZXMBW R9100 External Interfaces

External interfaces are located on the ZXMBW R9100 bottom plate. Figure 5 shows the position of the interfaces on the ZXMBW R9100 panel.

FIGURE 5 ZXMBW R9100 EXTERNAL INTERFACES



1. BDS-RFS Optical Fiber (LC1/2)
2. Antenna Interface Standard Group (AISG)
3. Monitoring Interface (MON)
4. Power Interface (DC IN)
5. RF Antenna Interface (Port2/3)
6. RF Antenna Interface (Port0/1)

Interface Description

Table 7 Lists the description of the external interfaces of ZXMBW R9100 cabinet.

TABLE 7 ZXMBW R9100 EXTERNAL INTERFACE DESCRIPTION

Interface	Description
BDS-RFS Fiber Optical (LC1/2)	This interface connects the ODF.
Antenna Interface Standard Group (AISG)	This is the test interface. The Indoor AISG control cable connects the WTRX board. The outdoor AISG control cable connects the antenna for adjusting the azimuth of the antenna.
Monitoring Interface (MON)	The monitoring cable connects between the MON interface on the cabinet with the various monitoring devices.
Power Interface (DC IN)	-48VDC power cable connects between DC IN and the power source.

Interface	Description
RF Antenna Interface (Port2/3)	The RF cable connects the Antenna with the port 2/3 of the cabinet.
RF Antenna Interface (Port0/1)	The RF cable connects the Antenna with the port 0/1 of the cabinet.

Modules

Modules Constituents

The ZXMBW R9100 is composed of WRFE, WRPM, WDPA, and WTRX modules. The physical description of these modules are given below.

- WiMAX RF Front End Filter (WRFE)

  The dimension of WRFE module is 200mm X 230mm X 25mm (width X height X depth), excluding connector.

- WiMAX RRU Power Module (WRPM)

  The dimension of WRPM module is 80mm X 250mm X 40mm (width X height X depth), excluding connector.

- WiMAX Digital Power Amplifier (WDPA)

  The dimension of WDPA module is 210mm X 270mm X 20mm (width X height X depth), excluding connector.

- WiMAX Transmitter & Receiver (WTRX)

  The dimension of WTRX module is 210mm X 330mm X 25mm (width X height X depth), excluding connector.

WRFE

WRFE Functions

Short Description

The WRFE module is the WiMAX RF Front End Filter module of ZXMBW R9100 .

The WRFE module performs the following functions.

- Transfers RF signal to antenna.
- Filters RF signals.
- Provides lightning proof for RF unit.
- Isolates uplink and downlink as the receiving and transmitting power is different.

WRFE Performance Specifications

Short Description

The following describes the performance specifications of the WRFE module.

WRFE Performance Specifications

Table 8 lists the performance specifications of WRFE module.

TABLE 8 WRFE PERFORMANCE SPECIFICATIONS

Index	Range
Frequency range	2300 MHz ~ 2400 MHz 2490 MHz ~ 2580 MHz 2600 MHz ~ 2690 MHz 3400 MHz ~ 3500 MHz 3500 MHz ~ 3600 MHz

WRPM

WRPM Functions

Short Description

In ZXMBW R9100 , the WiMAX RRU Power Module (WRPM) is responsible for power supply conversion. The WRPM module is optional in system configuration.

The WRPM module performs the following functions.

- Power supply conversion
- Lightning proof
- EMI filtering
- Power supply management and alarm.

WRPM Work Principle

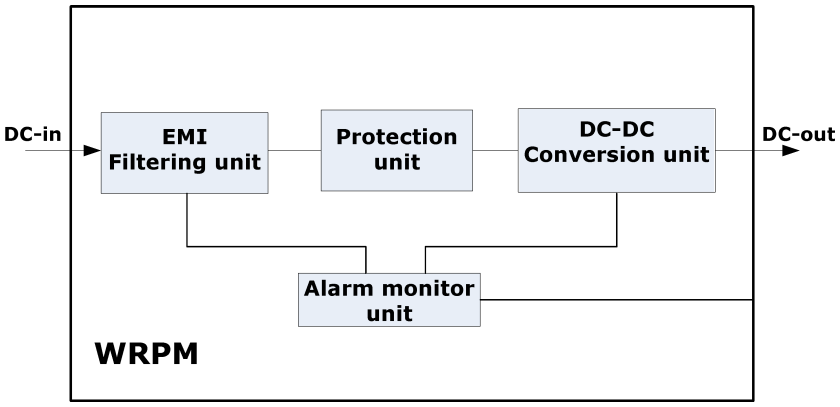
Short Description

The following describes the work principle of WRPM module.

WRPM Work Principle

Figure 6 shows the work principle block diagram of WRPM module.

FIGURE 6 WRPM WORK PRINCIPLE



Description

The WRPM module consists of an EMI filtering unit, protection unit, DC-DC conversion unit and alarm monitoring unit. The function of each component is introduced below.

- **EMI filtering unit** provides filtering function.
- **Protection unit** provides over-voltage or under-voltage protection.
- **DC-DC conversion unit** provides power supply conversion.
- **Alarm monitoring unit** reports the under-voltage, over-voltage and over-current alarms.

WDPA

WDPA Functions

Short Description

In ZXMBW R9100, the WiMAX Digital Power Amplifier (WDPA) module amplifies the RF power.

The WDPA module performs the following functions:

- RF amplification
- VSWR measurement
- Alarm reporting

WDPA Work Principle

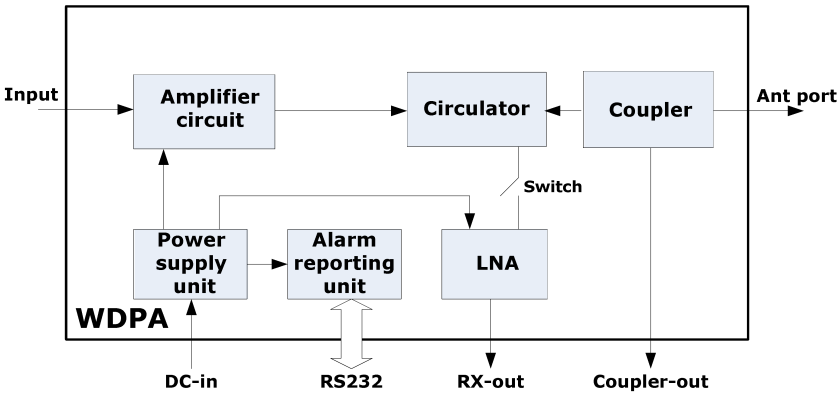
Short Description

The following describes the working principle of WiMAX Digital Power Amplifier (WDPA) module.

WDPA Work Principle

Figure 7 shows the work principle block diagram of WDPA module.

FIGURE 7 WDPA WORK PRINCIPLE



Description

The WDPA module consists of an amplifier circuit, circulator, coupler, power supply, alarm reporting unit and LNA . The function of each unit is described below.

- **Amplifier circuit** provides the main RF amplification channel.
- **Circulator** separates the receiving and sending signals.
- **Coupler** extracts the RF signal transmitted by base station. It is responsible for monitoring and measuring RF signal.
- **Power supply unit** provides power supply for each unit.
- **Alarm reporting unit** reports the temperature, high/low power and standing wave alarms.
- **Low Noise Amplifier (LNA)** amplifies the received signals.

WTRX

WTRX Functions

Short Description

In ZXMBW R9100, the WiMAX Transmitter & Receiver (WTRX) module is used for RF up/down-conversion.

The WTRX module performs the following functions:

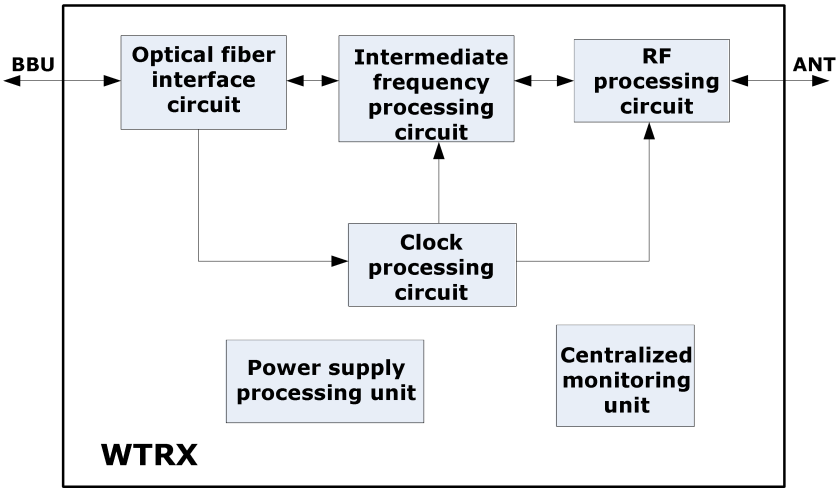
- Baseband RF clock extracting, restoring and distributing
- RRU centralized monitoring
- Digital intermediate frequency processing
- RF small signal up/down-conversion
- Power supply generation
- Supports OBSAI-RP3 interface.

WTRX Work Principle

WTRX Work Principle

Figure 8 shows the work principle block diagram of WTRX module.

FIGURE 8 WTRX WORK PRINCIPLE



Description

The WTRX module consists of an Optical fiber interface circuit, Intermediate frequency processing circuit, Clock processing circuit, RF processing circuit, Centralized monitoring circuit, and Power supply processing circuit. The function of each unit is described below.

- **Optical fiber interface circuit** interfaces with BBU, and it supports optical fiber loopback networking and optical fiber concatenating networking. The frame packing and unpacking in optical fiber are also supported.
- **Intermediate frequency processing circuit** and **RF processing circuit** accomplishes the forward transmission process; receives baseband signal, performs up-conversion and sends to power amplifier after amplification. It also performs standing wave checking at antenna feeder interface, forward automatic calibration and manual calibration.

  The circuit also accomplishes the reverse receiving process; receives RF WiMAX signal in reverse direction; performs pass band filtering, low noise amplification, RF frequency mixing and digital down-conversion to baseband rate. After optical interface processing, the signal is transmitted to Base station Baseband Unit (BBU) via an Open Base Station Architecture Initiative (OBSAI) protocol. It also performs the reverse Received Signal Strength Indicator (RSSI) measurement and Automatic Gain Control (AGC).
- **Clock processing circuit** restores, converts, and distributes the clocks. It also reports the temperature, low/high power, and standing wave alarms.
- **Centralized monitoring circuit** monitors and manages the power supply, version and electronic adjusting antenna. It monitors the exterior devices via trunking node and RS232 or RS485. It also regenerates the TDD time sequences.

- **Power supply processing circuit** provides power supply for each unit.

Cables

Cables List

The ZXMBW R9100 uses the following cables according to the applications:

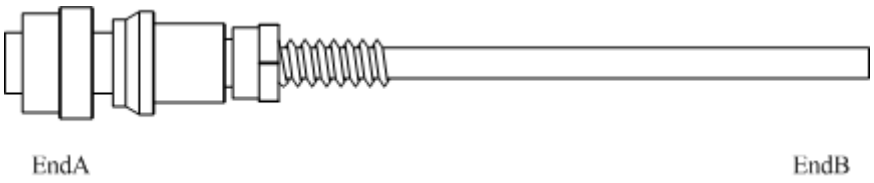
- Power Supply cable
- Grounding cable
- Optical fiber
- RF Jumper

DC Power Cable

Currently ZXMBW R9100 supports -48 V DC power supply only. The power cable directly connects DC input power source with DC IN interface at ZXMBW R9100 cabinet bottom.

Figure 9 shows the structure of -48 V DC power cable.

FIGURE 9 ZXMBW R9100 DC POWER CABLE STRUCTURE



Grounding Cable

The grounding cable is made of 10 mm^2 yellow/green burning-prevention cable. Circular unsheathed crimping connectors (lug) are used at both ends (A and B).

Figure 10 shows the structure of grounding cable.

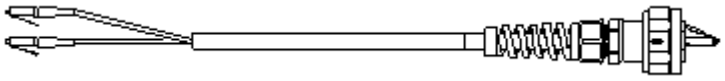
FIGURE 10 GROUNDING CABLE STRUCTURE

Optical Fiber

Optical Fiber Structure

Figure 11 shows the optical fiber structure used in ZXMBW R9100.

FIGURE 11 ZXMBW R9100 OPTICAL FIBER STRUCTURE



Description

The following describes some of the key points related to the physical structure of the fiber cable.

- The cable is a single mode fiber with LC/PC - DLC/PC connector.
- The sheath usually is black. The two core wires are yellow and blue.
- The sheath diameter is 7mm.

RF Jumper Cable

RF jumper cable is used to transfer signals between ZXMBW R9100cabinet and antenna, between ZXMBW R9100cabinet and main feeder cable, and between main feeder cable and antenna. The length of the RF jumper cable is determined according to the actual situation.

When the distance between antenna and ZXMBW R9100cabinet is less and the adopted feeder cable is of 1/2 in. then, the jumper cable is not used, rather ZXMBW R9100cabinet 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 12 shows the RF jumper cable.

FIGURE 12 RF JUMPER CABLE

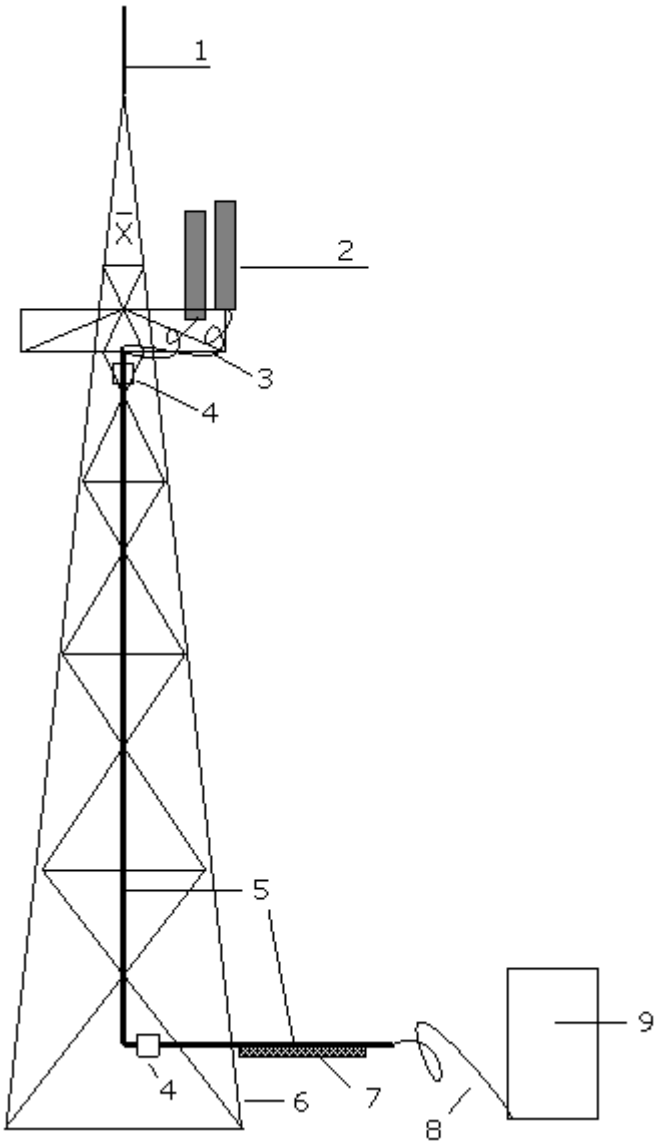
Main Antenna Feeder System

Main Antenna Feeder System Structure

The main antenna feeder system consists of the equipments related to antenna and feeder.

Figure 13 illustrates a typical structure of the main antenna feeder system.

FIGURE 13 MAIN ANTENNA FEEDER SYSTEM STRUCTURE



1. Lightning Rod
2. Antenna
3. Antenna jumpers
4. Lightning proof grounding clip
5. Main feeder cable
6. Iron tower
7. Cabling rack
8. Cabinet jumper
9. Cabinet

Note:

- Since RF transmission power of ZXMBW R9100 is relatively weak, the antenna is installed nearer to the cabinet. It usually adopts self-carried feeder cable. 1/2″ or 7/8" feeder cables are adopted only when the antenna is far from the cabinet.
- Usually, the number of antennas range between two to four.

Antenna Structure

Antenna is an important radio equipment adopted to transmit and receive electromagnetic wave. Antenna is divided into omni antenna and directional antenna by radiation direction; according to polarization mode, antenna can be divided into single-polarized antenna and bi-polarization antenna.Figure 14 illustrates the appearance of omni antenna and directional antenna.

FIGURE 14 THE APPEARANCE OF OMNI ANTENNA AND DIRECTIONAL ANTENNA

Feeder

The feeder is used to receive and transmit radio RF signals between the antenna and the ZXMBW R9100. There are many types of feeder cables such as 1/2 inch and 7/8 inch feeder cable.

When the distance between the ZXMBW R9100 cabinet and antenna is less, then 1/2 inch feeder cable is used. In this case, ZXMBW R9100cabinet is directly connected to the 1/2 inch feeder and 1/2 inch feeder cable is connected to antenna.

When the distance between theZXMBW R9100 cabinet and antenna is more, then 7/8 inch feeder cable is used. In this case, ZXMBW R9100cabinet 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

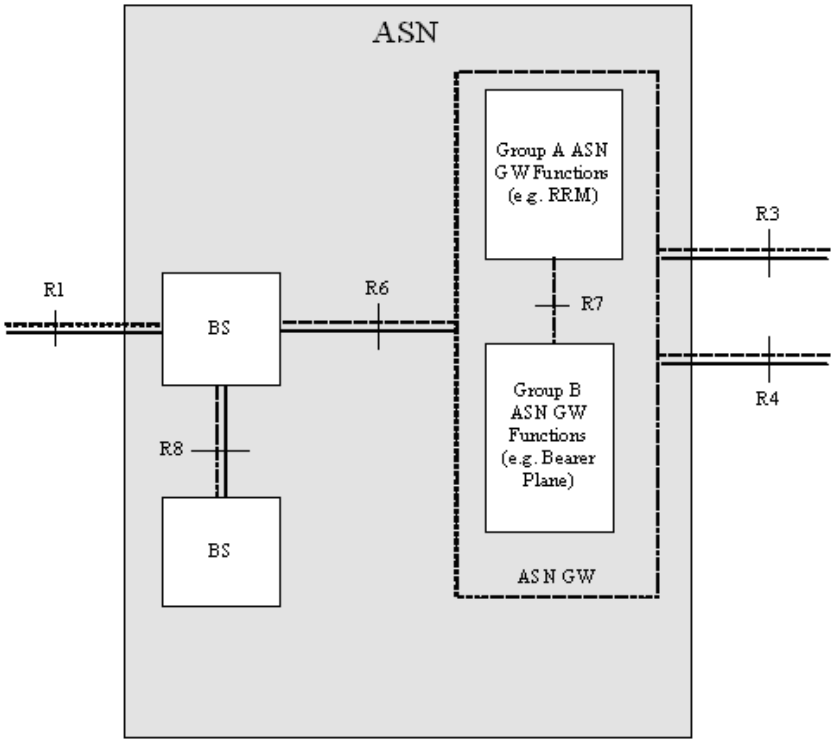
Protocol Interface Description

Table of Contents:

ASN Network Reference Model

The following describes the Access Service Network (ASN) network reference model. The ASN network reference model developed by the WiMAX (Worldwide Inter-operability for Microwave Access) NWG (Net Work Group) is shown in Figure 15.

FIGURE 15 ASN NETWORK REFERENCE MODEL



The interface of Figure 15 are described in Table 9.

TABLE 9 INTERFACES DESCRIPTION

Interface Name	Description
R1	Air interface between the terminal and the RRU.
R3	The interface between the AGW (ASN-GW, Access Service Network Gate Way) and the CN.
R4	Interface between ASNs, i.e. the interface between AGWs. It implements some switching-related signaling and established data channel to maintain data integrity during switching.
R6	The interface between the AGW and the BS.
R7	Internal interface of the AGW. It is selective. It divides the AGW into strategy judgment function and implementing function.
R8	Interface between BSs.

R1 Interface

R1 Interface Functions

The R1 interface performs the following functions:

- Co-operates with the Base station Baseband Unit (BBU) to perform measurement, management, and control of radio resources.
- Receives and transmits RF signals.

R1 Message Format

Description Figure 16 illustrates management message format of the R1 interface of Media Access Control (MAC) Layer.

FIGURE 16 R1 MESSAGE FORMAT

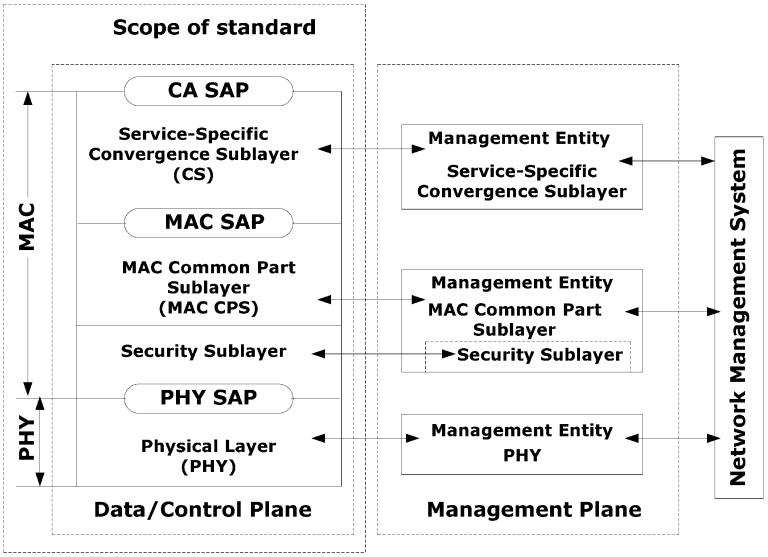
The management messages of MAC Layer are presented in MAC Protocol Data Unit (PDU) payload. All management messages of MAC Layer are composed of an initial field "Management Message Type" and "Management Message Payload". The length of the "Management Message Type" is 8 bit; the type of the management message depends on the requirements of an air interface protocol in IEEE 802.16.

The MAC management messages in basic connection, broadcast connection, and initial distance-testing connection are not divided into chips or bound into packets. But the MAC management messages in the primary management connection can be divided into chips or bound into packets.

R1 Protocol Stack

Overview Figure 17 illustrates a schematic diagram of R1 Interface Protocol Stack.

FIGURE 17 R1 INTERFACE PROTOCOL STACK



The R1 interface protocol stack includes MAC Layer and PHY Layer.

MAC Layer of R1 Protocol Stack

Description

MAC layer of R1 protocol stack contains three sub-layers (from top to bottom); Service-Specific Convergence Sub-layer (CS), MAC Common Part Sub-layer (MAC CPS) and Security Sub-layer.

1. Service-Specific Convergence Sub-layer (CS)

   Different protocol interfaces provide different CS specifications.

   The function of Service-Specific Convergence Sub-layer (CS) is to convert/map the external data received by the Convergence Sub-layer Service Access Point (CS SAP) into MAC Service Data Unit (MAC SDU) and send it to the MAC CPS through the MAC Service Access Point (MAC SAP). The other function of this layer is to sort external SDUs associated with suitable Service Flow Identifier (SFID), Connection Identifier (CID) and Payload Header Suppression (PHS).

2. MAC Common Part Sub-layer (MAC CPS)

   MAC CPS does not need to analyze the load information of the CS.

   MAC CPS realizes the core function of the MAC layer including bandwidth distribution, connection establishment and connection maintenance. It receives data of different CS layers through MAC SAP and sort them based on different MAC connection. Quality of Service (QoS) is applied in data transmission and scheduling of physical layer.

   Data, PHY control information and statistical information between the MAC CPS and PHY is transmitted through PHY SAP.

3. Security Sub-layer

   MAC contains an independent security sub-layer to provide authentication, security key exchange and realize encryption.

PHY Layer of R1 Protocol Stack

Description The PHY layer of R1 protocol stack contains multiple regulations. Each regulation corresponds to a specific frequency range and application.

The PHY layer of R1 protocol stack is based on the modulating mode of Orthogonal Frequency Division Multiplexing (OFDM).

Baseband-RF Interface

Baseband-RF Interface Functions

The ZXMBW R9100 baseband-RF interface performs the following functions:

- Data transmission from fiber-optical interfaces
  - Downlink I/Q data signals from the Base station Baseband Unit (BBU).
  - Uplink I/Q signals received by the ZXMBW R9100.
- Exchange of control signaling
  - ZXMBW R9100 running status measurement signaling and measurement result feedback.
  - Reset signaling and execution feedback of all boards in the R01P.
  - Link test, alarm report and processing between the ZXMBW R9100 and the BBU .
- Interaction of configuration signaling
  - I/Q channel configuration.
  - Frequency point initiation and reallocation.
  - RF power configuration, timely report of launched power, and report of Received Signal Strength Indicator (RSSI) measurement.
  - Configuration and re-configuration of environment monitoring threshold.

OBSAI Frame Structure

Overview The three layers of an Open Base Station Architecture Initiative (OBSAI) frame are Message Frame, Message Group (MG) and Master Frame.

Message Frame Message Frame is the basic unit of an OBSAI . The total length of the frame is 19 bytes, and is composed of address, type, time stamp (T-Stamp) and payload.

Figure 18 illustrates message frame format.

FIGURE 18 MESSAGE FRAME FORMAT

Address	Type	T-Stamp	Payload

Table 10 shows the length of each part of a message frame.

TABLE 10 MESSAGE FRAME'S FIELD LENGTH

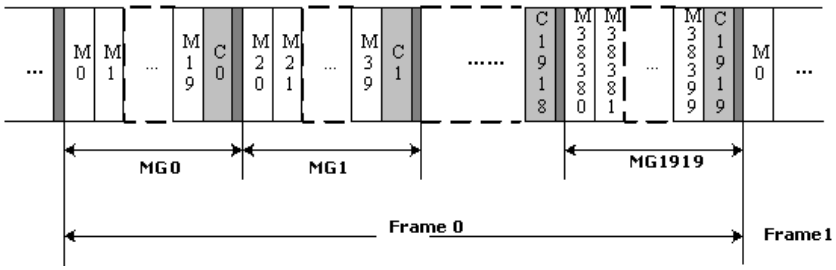
Field Name	Length (bits)
Address	13
Type	5
Time stamp (T-Stamp)	6
Payload	128
Total length	152 (19 bytes)

Message Group (MG)

Each MG contains M_MG pieces of message and K_MG pieces of IDLE code. The number of bytes in a MG is M_MG * 19 + K_MG = 21*19+1 = 400 (Bytes).

Figure 19 illustrates the structure of MG.

FIGURE 19 MESSAGE GROUP STRUCTURE



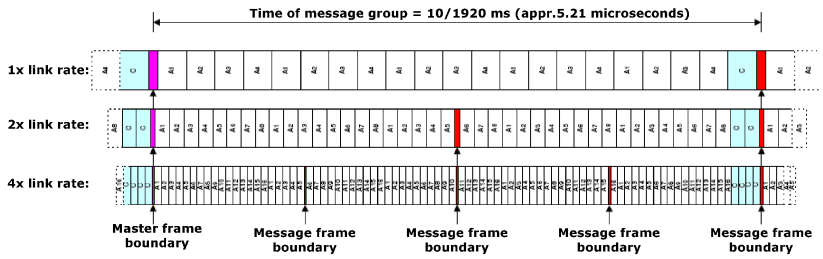
A RP3 frame contains N_MG pieces of MG and the length is (I * N_MG * (M_MG * 19 bytes + K_MG * 1)). I is the rate level (1, 2, 4). The recommended standards are M_MG = 21, K_MG = 1 and N_MG = 1920.

Master Frame

The number of bytes in a Master Frame (10 ms) are I * 1920 * 400 = I * 768000 (Bytes), where I = 1, 2, 4.

OBSAI supports 3 kinds of rate levels: 1x, 2x, and 4x. Figure 20 illustrates frame format under each rate level.

FIGURE 20 MASTER FRAME FORMAT



The master frame under the 3 rate levels is 10 ms. The line rate is: (I * 768000/10 ms) * 8 * 10/8 = I * 768 Mbps. For 1x, 2x and 4x, the rate are 768 Mbps, 1536 Mbps and 3072 Mbps respectively.

The usual optical modules are of 1.25 G and 2.5 G and cannot suit the above values. Therefore, the standard rate of OBSAI is adjusted to M_MG = 42, K_MG = 2, N_MG = 768 to realize the 1x rate of 614.4 Mbps, 2x rate of 1228.8 Mbps and 4x rate of 2457.6 Mbps. Therefore, transmission can be realized in 1.25 G and 2.5 G optical modules.

Baseband-RF Interface Physical Layer

Overview

The physical layer of the baseband-RF interface is based on differential signaling technology. Differential signaling with clock data recovery circuit provides high-speed serial data transmission between the RF and baseband modules. It also helps reduce power consumption and increases system reliability.

Features

The features of the baseband-RF interface physical layer are:

- Adaptive Modulation and Coding (AMC)
- Fast channel feedback
- Mutiple-in Multiple-out (MIMO)
  - Multiple antennas on sender and receivers
  - Increased spectral efficiency
- Hybrid Automatic Repeat Request (HARQ)
  - Adjusts automatically to channel conditions
  - Adds redundancy only when needed
  - Receiver saves failed transmission attempts to help future decoding

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List of Glossary

AGW - Access Service Network GateWay

AISG - Antenna Interface Standards Group

ASN - Access Service Network

BBU - BaseBand Unit

BBU - BaseBand Unit

BS - Base Station

CN - Core Network

EMI - Electromagnetic Interference

GPS - Global Positioning System

LNA - Low Noise Amplifier

MAC - Media Access Control

MG - Message Group

MIMO - Multiple-Input Multiple-Output

MS - Mobile Station

OBSAI - Open Base Station Architecture Initiative

OFDM - Orthogonal Frequency Division Multiplexing

PDU - Protocol Data Unit

QoS - Quality of Service

The performance specification of a communications channel or system. QOS may be quantitatively indicated by channel or system performance parameters, such as signal-to-noise ratio (S/N), bit error ratio (BER), message throughput rate, and call blocking probability. QOS is a subjective rating of telephone communications quality in which listeners judge transmissions by qualifiers, such as excellent, good, fair, poor, or unsatisfactory.

RF - Radio Frequency

RRU - Remote Radio Unit

RSSI - Received Signal Strength Indicator

The measured power of a received signal.

TDD - Time Division Duplex

A transmission method that uses only one channel for transmitting and receiving, separating them by different time slots. No guard band is used. This increases spectral efficiency by eliminating the buffer band, but also increases flexibility in asynchronous applications. For example, if less traffic travels upstream, the time slice for that direction can be reduced, and reallocated to downstream traffic.

VSWR - Voltage Standing Wave Ratio

WDPA - WiMAX Digital Power Amplifier

WiMAX - Worldwide Interoperability for Microwave Access

WRFE - WiMAX RF Front End Filter

WRPM - WiMAX RRU Power Module

WTRX - WiMAX Transmitter & Receiver