POSDATA

Mobile WiMAX

RAS
System Description

FLYNET makes the Internet fly!

Table of contents

Preface

Purpose

This manual provides basic description for the function of RAS6000 (Radio Access Station) series which is designed to be used for Mobile WiMAX as Base Station interfacing Mobile

Update

We are making every effort to ensure our manual is as up-to-dated as possible. None the less, if there is any confusion that needs to be clarify, please contact us by following contact information.

Classification of RAS System

RAS System can be classified into industrial equipment. We strictly observe the international standard FCC Class A relating to electromagnetic waves.

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Contact Information

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Chapter I. Introduction

What is Mobile WiMAX?

History

WiMAX (Worldwide Interoperability for Microwave Access Forum) has been formally launched in order to provide the service to the fixed users of wireless internet or to increase the capacity (high date rate) or enable long distance transmission of the microwave which is widely used in between wireless transmission section. This is known as "IEEE802.16-2004" standard.

However, as the standard becomes more and more specific and equipment development was ongoing, the demand to expand and apply these to mobile telecommunications has been growing substantially which led into the improved (advanced) "Mobile WiMAX" described by "IEEE802.16e."

Major features

- High transmission speed

WiMAX network offers not only far better transmission speed compare to existing 3G system or HSDPA/HSDPA (High Speed Downlink/Uplink Packet Access) but also high-frequency efficiency.

- IP Network

WiMAX is a network which introduces "All IP network" method to wireless communication for the first time. IP (Internet Protocol) can provide service independent without having interference by physical devices or OS (Operating System). Therefore WiMAX has practical advantages because of its IP intrinsic characteristics in depending of platform and simple service transferring to Network.

- QoS

There still exist some technological difficulties for real time voice streaming service since IP has only designed for unreal time data service. To cope with this fact, several technologies have been developed and applied to the service such as VoIP, but the quality seems slightly poor comparing with circuit base network according to various conditions. To make matter worse WiMAX consists of IP wire-line and wireless link having poor characteristics, so it is highly necessary to compensate poor condition of Wireless. Therefore Standards Coordinating Committee IEEE (standard IEEE 802.16d/e) or WiMAX Forum classifies this process.

- Wireless Connection

WiMAX supports large number of users at the same time by using OFDMA (Orthogonal Frequency Division Multiple Access). In addition, it uses TDD (Time Division Duplex) method for uploading (from subscriber to Network) or downloading (from Network to subscriber) communication.

- Frequency and Bandwidth

WiMAX strongly recommends using 2.3GHz, 2.5GHz, and 3.5GHz in terms of standard Bandwidth. Bandwidths are defined as 5MHz, 8.75MHz, 10MHz and 20MHz.

- Multi-antenna technology

WiMAX can apply both AAS (Adaptive Antenna System) and MIMO(Multi Input Multi Output) technologies which are newly developing as well as existing antenna system in order to improve wireless capacity and stability.

RAS in WiMAX

RAS(Radio Access Station) locates between PSSs and ACR, and plays various roles; such as connecting WiMAX terminal(PSS : Portable Subscriber Station) with network and transferring related signal and traffic data between PSSs and ACR as shown below.

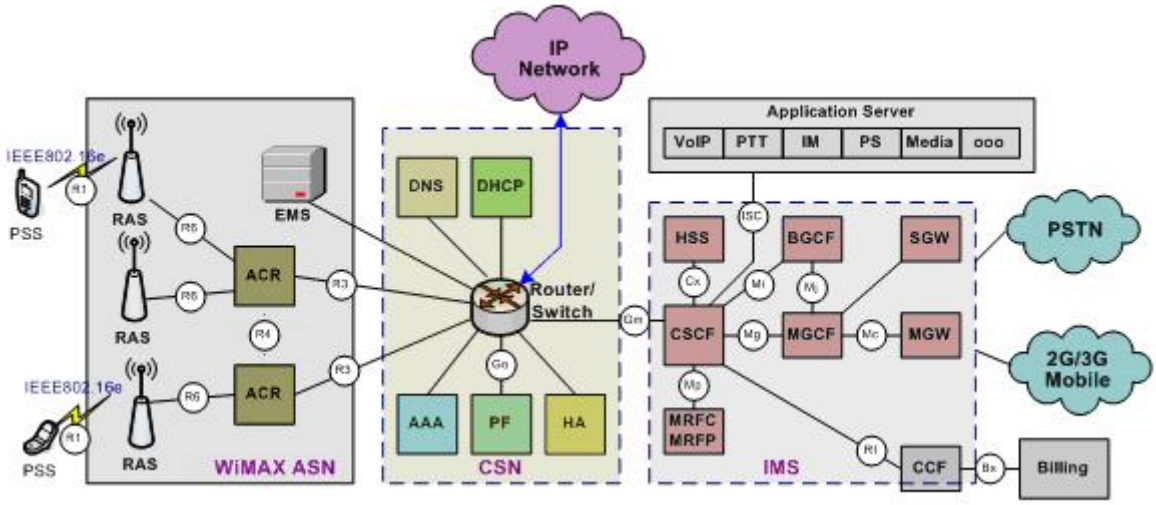


Figure I-1 WiMAX Network Architecture

Every name of interface has been indicated inside of individual diagram. This is a significant reference point which allows defining standards as well as each equipment from the others. RAS and ACR can be connected by reference point “R6” and RAS and PSS by “R1.”

[1],[2],[3],[4] shown below define reference point “R1” mostly, so do [5],[6] for “R3”, “R4”, “R6” mainly.

Major Applying Standards and Related Standards

[1] Air Interface for Fixed Broadband Wireless Access Systems, IEEE Std 802.16-2004

[2] Air Interface for Fixed and Mobile Broadband Wireless Access Systems, IEEE Std 802.16e-2005

[3] TTAS.KO-06.0064R1, “2.3 GHz Portable Internet standard – PHY “, Korea

[4] TTAS.KO-06.0065R1, “2.3 GHz Portable Internet standard – MAC “, Korea

[5] WiMAX End-to-End Network Systems Architecture (Stage 2: Architecture Tenets, Reference Model and Reference Points), Aug. 6, 2006

[6] WiMAX End-to-End Network Systems Architecture (Stage 3: Detailed Protocols and Procedures), Aug. 6, 2006

Chapter II. System Overview

This chapter describes outline of the features and function of RAS system.

Major features

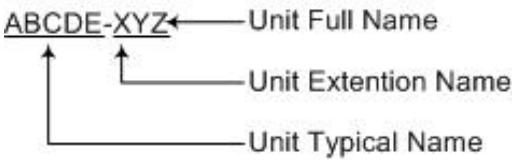
Major features of RAS 6000 series as follows;

- It 6000 Supports IEEE 802.16e-2005 Cor2/D3
- It is based on NWG System profile C structure of WIMAX Forum, and supports R6 standard interface between ACR and RAS.
- It supports IO MIMO (2Tx/2Rx) feature of WiMAX PHY/MAC Wave 1 & 2. It provides 20Watt output power amplifier per sector and filtering function for removing noise
- It supports max. 3FA/3Sector and can configure max. 9 Cell
- It Supports Class 1 (2.3 ~ 2.4GHz), Class 3 (2.469 ~ 2.69GHz) and supports channel bandwidth of 10MHz or 8.75MHz.
- It supports Common Public Radio Interface (CPRI) for system scalability and modularity
- Redundancy : RAS controller, RAS-ACR Interface and Power supply are Active/Standby or load sharing structure
- Call access control: When the PSS tries to access Network, RAS takes charge of authentication & authorization of the PSS by interfacing with other WiMAX system as well as Core Network using control signal.
- System synchronization: As various BSs are in operation nearby, exact time synchronization and frequency are highly necessary to be free of interference and interact with application. RAS, therefore, operates on the basis of GPS synchronized time and frequency.
- Base band Processing: RAS provides modulation and demodulation function in order to transfer traffic / control signal in wireless environment.
- Network interfacing functions: Supports network interfacing functions to transfer traffic data and control signal to and from ACR.
- QoS Support: In order to provide desired service quality, RAS maintains certain quality level of service.
- IPv4 Support: provides formally used IPv4.
- Mobile IP/Simple IP support: There are Mobile IP & Simple IP methods for terminal mobility. Currently, Simple IP & Proxy Mobile IPv4 is supported.
- Operation & Maintenance: Provides administrator, generally locating far from system, observation and monitoring function by interacting with EMS.

System Configuration and Specification

Defining each Unit

The method of naming as follows.



- Unit Full Name: Full name of unit. Consisted of 9 letters or below including "-. " Representative and extension unit names are commonly used.
- Unit typical name: Designates units generally, consisted of 5 initial letters or numerals.
- Unit Extension name: Defines either system configuration or frequency. Consisted of 3 letters/digits or below followed by "-"

Unit typical names will be used from now onwards unless there is confusion for simple explanation

Configuration

RAS 6000 system is DU/RU separation architecture and consists of MSS (Main Subsystem) and RSS (Remote Subsystem). It supports max. 3FA/3Sector and is divided into Type Ⅰ/Ⅱ according to system operation environment or RSS structure

- 3FA/3Sectors Configuration – Type Ⅰ (With single carrier RSS)

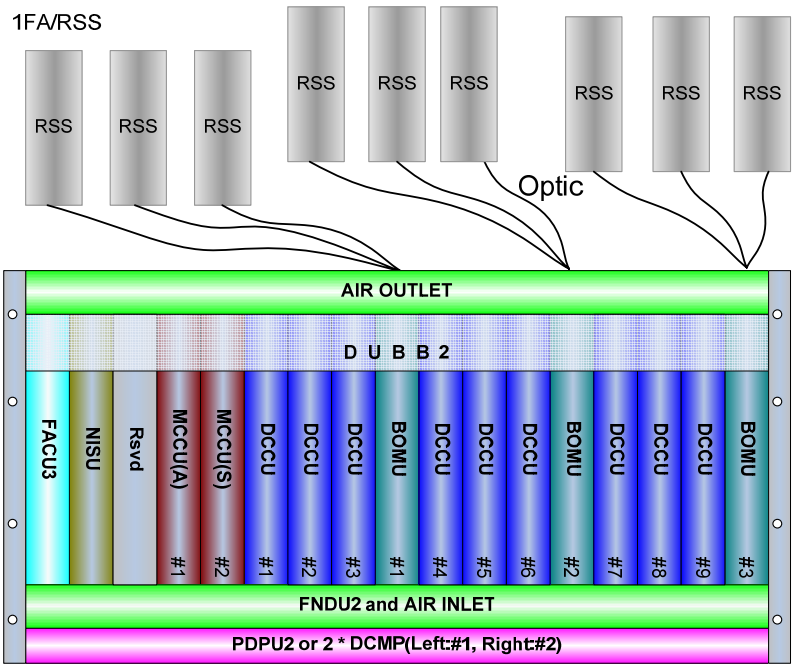


Figure II-1 RAS Type Ⅰ Configuration

- 3FA/3Sector Configuration – Type Ⅱ (With multi-carrier RSS)

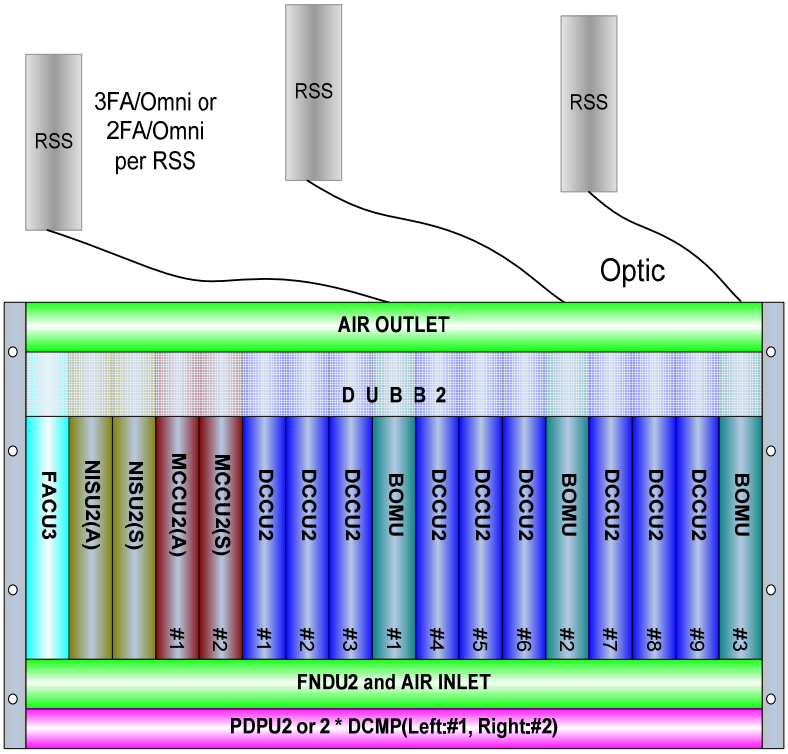
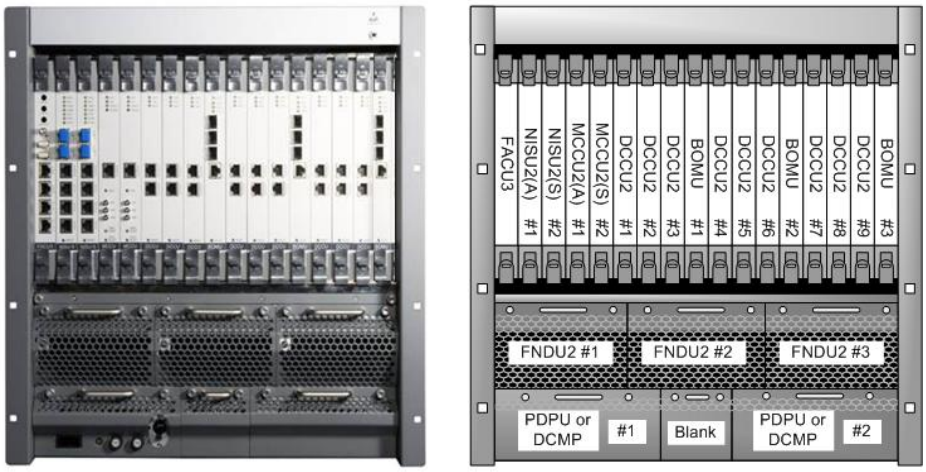
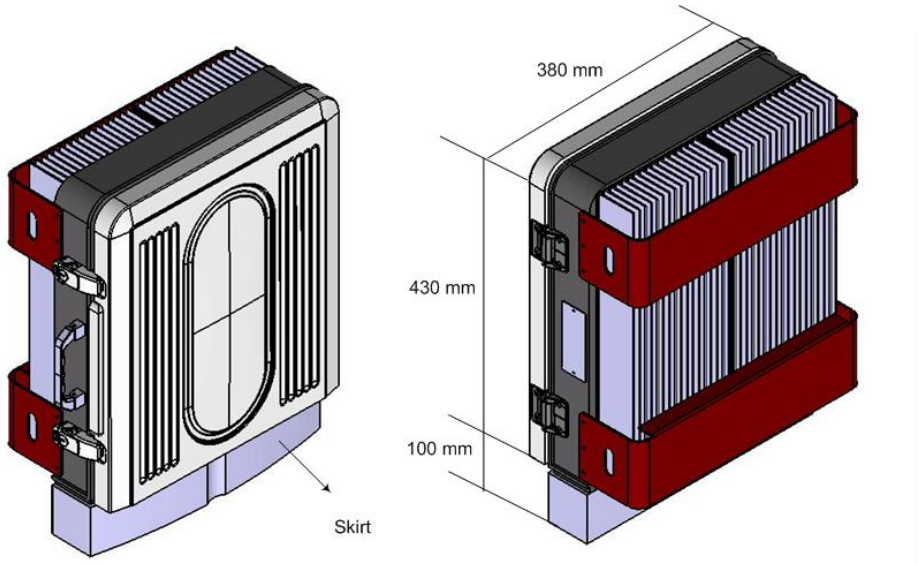


Figure Ⅱ-2 **RAS Type Ⅱ Configuration**

- Picture – MSS6000



- Picture – RSS6000



Unit Equipment

- Type Ⅰ/Ⅱ

Block	Unit	Unit Description
MSS	DCCU	Digital Channel Card Unit, BW 8.75/10MHz
	MCCU	Main Control and Clock Unit, 10/11.2MHz
	NISU	Network Interface Switch Unit, ACR I/F : 10/100/1000Base-T, 1000Base-X
	BOMU	BS Optic interface Unit for MSS (DU)
	FACU	Front Access Connector Unit

	DUBB	Digital Unit Back Board
	REMU	RAS Environment Monitoring Unit
	FNDU	Fan Unit 2 for DU
	PDPU	Power Distribution Panel Unit
	CMSS	Chassis for Main Subsystem
	DCMP	DC Conversion Minus to Plus, -48V to 27V
RSS(1)	TRB	Transceiver Block, Functionally include MSS I/F, DUC/DDC, RF Up/Down, Clock Recovery/Re-generation/Distribution
	PAB	Power Amplifier Block Functionally include Power Amplifier
	FEB	Front End Block. Functionally include Coupler, BPF, LNA
	PSB	Power Supply Block, Functionally DC to DC Converter and Distribution
Power	DCMP	DC Conversion Minus to Plus, -48V to 27V
	PDPU	Power Distribution Panel Unit
FAN	FNDU	FAN Digital part Unit, In/Out-door
RACK	RACK	CMSS(Chassis for Main Subsystem)

RSS(1): RSS is the only one unit or subsystem name that customer can recognize RF subsystem, but the RSS is functionally distinguished into functional blocks, such as TRB, FEB, PAB and PSB, and which are used by EMS and O&M.

Interface

- Air I/F: RAS 6000 system offers the maximum of 3 FA (Frequency Assignment)/3 Sec air interfaces. Channel bandwidth may vary on demand mainly 2.3GHz and 2.5GHz.
- RSS(RU) & MSS(DU) I/F: CPRI (Common Public Radio Interface) protocol is supported and is connected by optic media
- ACR I/F: NISU provides 2 port 100Base-Tx and 1000Base-X in order to connect RAS with ACR directly or indirectly by transmission equipment. And, link aggregation function is also provided.
- User I/F: As major unit offers CLI (Command Line Interface), the administrator can access by EMS or Telnet from remote location

Major System Specifications

System main specifications are as follows. For more details please refer to Appendix: Specification table.

- Wireless Interface: IEEE802.16e(Mobile WiMAX)
- Available frequency : 2.5GHz
- Capacity: Maximum 9 Cell (3FA/3sector or 1FA/9Cell)
- Channel Bandwidth : 10MHz
- ACR Interface : 100Base-Tx(Fast Ethernet) & 1000Base-X
- Maximum Throughput: About 18Mbps (1Tx/1Rx)
- Power : -48VDC (27VDC optional and separate box configuration in case of AC)
- Power consumption: 631.5W (Except RU)
- Application environment: Indoor or Outdoor
- OA&M : EMS (internal POSDATA protocol is to use)
- Size : 19inch rack mount, 600x400x535 mm for MSS, 380 x 430 x 180 mm for RSS
- Mount: 19inch Rack Mountable Shelf Type(MSS), Pole/wall Mountable (RSS)

Chapter III. System Hardware

Block Diagram

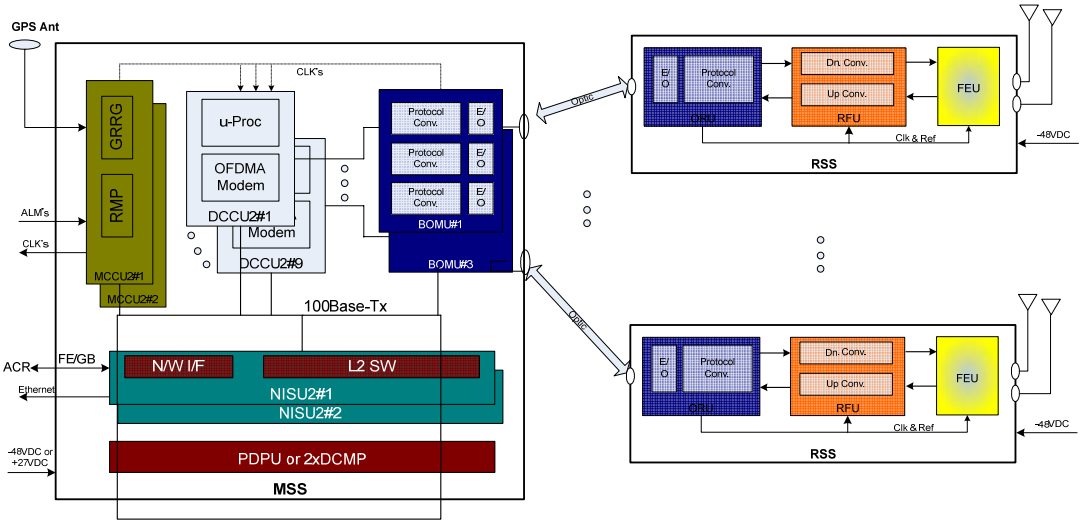


Figure III-1 RAS Block Diagram

As shown above in FigureⅢ-1, RAS system accesses to ACR as part of Network in WiMAX system and accesses to subscriber station using wireless media.

RAS can be accessed by ACR via Ethernet. There are various ways to access RAS such as Microwave, SDH, Laser, and Metro Ethernet method those allow transferring Ethernet. RAS and MS/PSS can be connected in wireless environment but repeater is another way to make it linked.

The signal that received by antenna from wireless MS/PSS continues to be processed via Front End Unit (FEU) of RSS module and noise/band pass filter, and then transferred to Up/Down converter(RFU). Then it modifies itself to digital I&O signal. This signal is converted to CPRI/OBSAI optic signal at ORU module and then transferred to BOMU of MSS. BOMU converts CPRI/OBSAI optic signal into baseband signal of OFDMA, and then converted to digital I&O signal and goes to DCCU. DCCU demodulates WiMAX signal then alters it into IP (Ethernet) and sends to ACR through Network Interface Unit (NISU).

In this procedure, RAS controller (MCCU) takes part in call processing and controlling RAS. MCCU also participates in synchronization of frequency and time to GPS.

Chassis Structure

MSS (Main Subsystem, DU)

MSS is a rack mountable 1-Shelf structure. MSS is basically designed on the basis of indoor environment, and can be used as outdoor type considering watertight-ness, refrigeration.

Cable connection is minimized in order to upgrade system stability, easy operation. And cable connection can be done the front side of the system except a part of cables

MSS consist of various units which process digital signal, and each unit inter-connects through signal cable of backplane. MSS use FACU in order to connect cable with external device at front side.

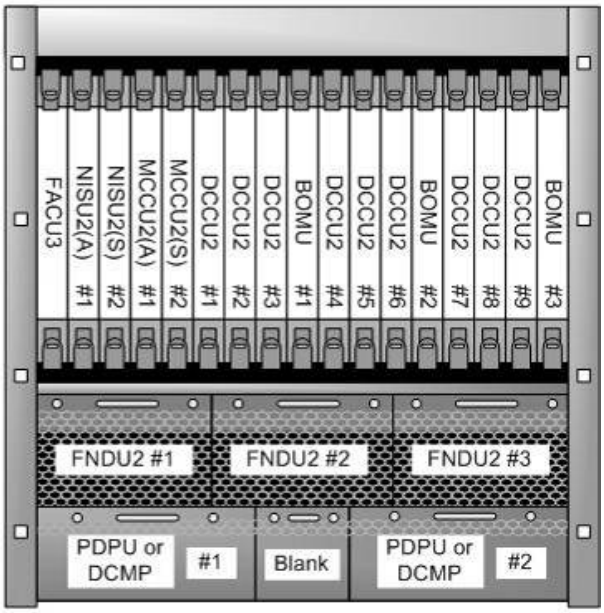


Figure III-2 MSS Basic Structure

Item	Unit	Unit Description
WiMAX Air Interface process	DCCU	- Provide PHY/MAC modem function of Mobile WiMAX - Provide 1Carrier/1Cell processing function per card - 2Tx/2Rx Diversity
RAS Control	MCCU	- Provide GPS Receiver/Clock Distributor (GPSR) - Provide 24 Hour Hold-over time function - Active/Standby structure
ACR Connection	NISU	- Ethernet L2 Switching function - Provide IP interface to RAS internal module or external system - 100Base-Tx 2 ports with RJ-45 Connector or 1000Base-X 2ports with SFP Connector. - Active/Standby structure
MSS-RSS Connection	BOMU	- Provide inter-connection between MSS and RSS - Support CPRI protocol - Manage 3 optic interface per card
Shelf Backboard	DUBB	- Provide electronic interface with each units in MSS
FAN	FNDU	- Provide heat management function in MSS - Load-sharing based architecture
Power Supply	DCMP	- Convert and distribute 48VDC to 27VDC
Power Distribution	PDPU	- Distribute 27VDC to each boards, when DCMP is used, PUPU is not needed

Environment Monitoring	REMU	- monitor and report status of MSS such as temperature, humidity, submersion, fire and so on for outdoor rack
MSS Shelf	MSS Shelf	- 19” rack mountable

RSS (Remote Subsystem, RU)

RSS consists of several components; CPRI interface and Digital IF function through optic, ORU to control RSS, Downlink drive amplifier, low-level noise amplifier, RFU to have down converter function, Band Pass Filter function, FEU acts as coupling role and PSU to provide power to each unit from DC -48V.

RSS system can be easily installed at pole, wall in case of outdoor type and installed at indoor wall in case of in-building usage. According to operation environments, RSS is composed of Indoor type and Outdoor type. Outdoor type is reflected in structure to consider watertight-ness, installation environment and refrigeration unlike outdoor type, so, external connection cable is located at rack below

RSS system provides the following functions

- RF frequency Change function (PLL parameter value)
- Attenuator Change function (Tx/Rx attenuator value)
- Alarm transmit function (PA/FEU/Transceiver)
- Periodic keep-alive transmit function
- Rx RSSI parameter detection value transmit function
- Tx Output power detection transmit function
- Inventory Read/Write function
- TDD status transmit function (PA/FEU)
- AGC Value transmit function
- PA Status value transmit function (Current Temperature, Current Power Value, VSWR, etc)
- PA control function
- HW/SW reset function
- HW/SW enable/disable function
- TDD On/Off function
- PA ALC, shut-down temperature, shut-down VSWR level function

Block configuration – RSS

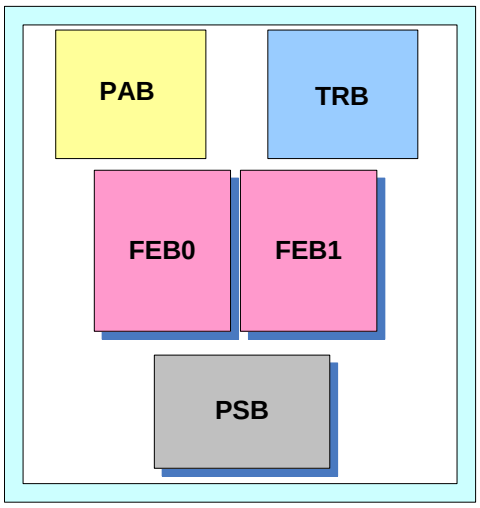


Figure III-3 RSS Block configuration

Item	Unit	Unit Description
RF Processing	PAB (Power Amp. Block)	- Power Amplifier - Provide 1Carrier/1Cell processing function per card
RF Front-end	FEB (Front-End Block)	- Provide filtering function for removing noise & Band pass
Transceiver & Optic Interface	TRB (Transceiver & Optic Block)	- Provide CPRI based interface - Provide optical interface between MSS and RSS
Power Supply	PSB (Power Supply Block)	- Convert and distribute -48VDC to 27VDC
RSS Chassis	RSS Chassis	- Outdoor type

System Installation & Operation

RAS 6000 system can be variously configured by system operation purpose or environment, and provides star topology according to connection method between MSS and RSS.

- System Installation / Operation Configuration

RAS 6000 system provides various installation / operation configuration such as 1FA/Omni, 1FA/3Sector, 3FA/Omni, 3FA/3Sector, 1FA/Omni 9 Cell, etc.

Power distribution diagram

PDPU for MSS

The power of MSS is PDPU as basic type. If external input power is -48VDC, PDPU is substituted for DCMP as redundancy architecture. AC input or Battery are separately configured as external device.

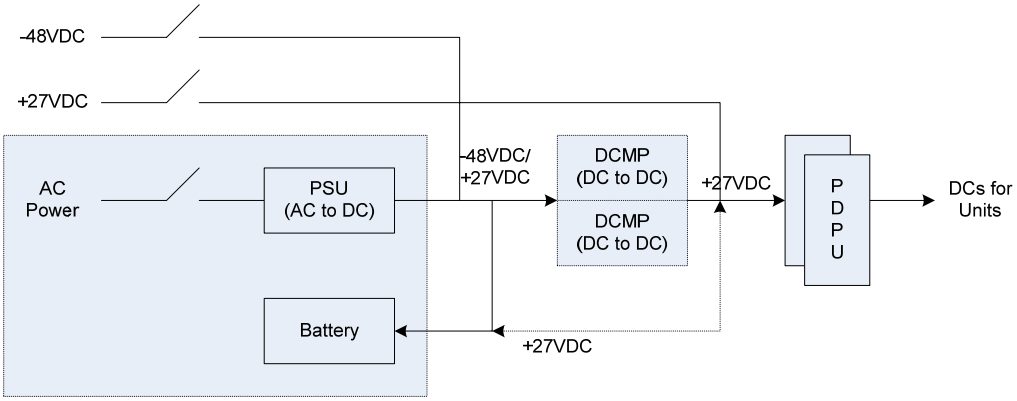


Figure III-4 PDPU for MSS

PSU for RSS

It is designed by condition of receiving DC (-48VDC) power from external rectifier, and major diagram is as follow.

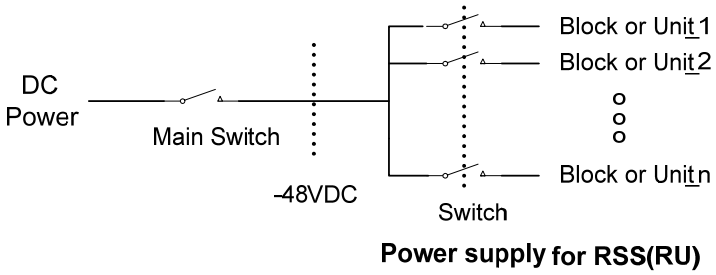


Figure III-5 PSU for RSS

Unit Description

MCCU (Main Control & Clock Unit)

Function

RMP (RAS Management Processor), GPS receiver/Clock Distribution and Call Processor are implemented within a MCCU which can be operable with duplication. This unit performs call control, communication and control of subordinate block, and collects alarm, then reports it to ACR.

In order to operate as WiMAX system which requiring exact time synchronization, MCCU

utilizes signals from GPS and distributes related signals to lower block with using the reference clock.

Block diagram

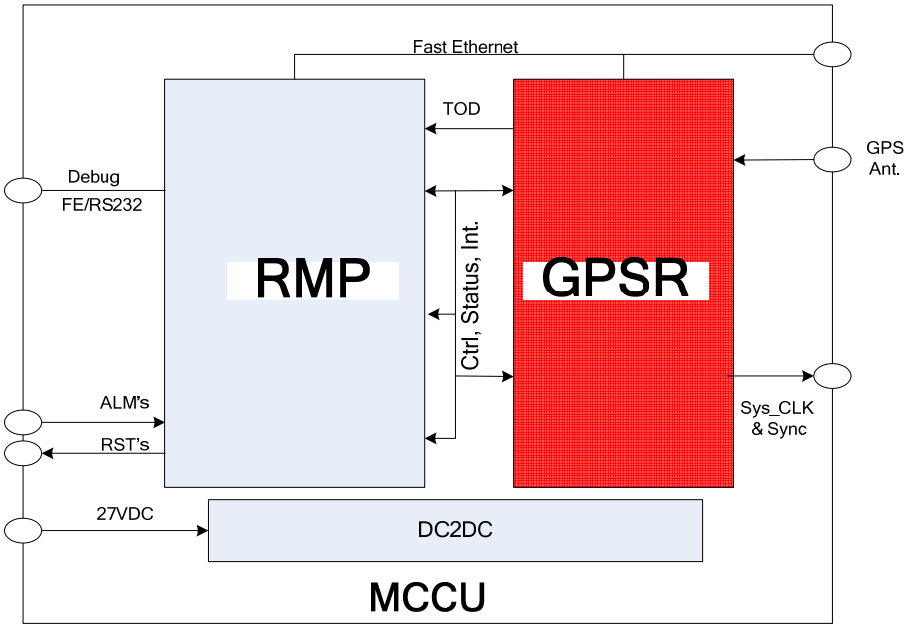


Figure III-6 Unit Block Diagram-MCCU

RMP has 2 different Fast Ethernet ports in order to communicate with ACR, channel card, units within RAS and Ethernet switch (NISU). These ports take in charge of processing calls, controlling RAS system, managing OA&M and alarming.

This unit also offers circuit which creates and distributes system clock by receiving signals from GPS and supports duplication.

Interface

The front side of MCCU is illustrated as below.

- DEBUG: Serial port(RS-232) which is used for unit debugging and generally is not used on normal operation. The developer or advanced administrator uses this to monitor or configure the unit.
- GPS: Input port where cables from GPS antenna can be connected.
- 10M1/10M2: 10MHz signal output port which synchronies system.
- (RMP)RESET: Resets RMP physically.
- (GPS)RESET: Resets GPS Processor physically.

LED

LED	Color	Operation	Remarks
RUN	Green	Processor is normal	
FAIL	Red	Processor is abnormal	
GPSACT	Green	Turns on if GPS is abnormal Blinks if GPS is normal	
GPSALM	Red	GPS is abnormal	

DCCU (Digital Channel Card Unit)

Function

DCCU which is commonly known as channel card processing WiMAX MAC/PHY modem functions. One unit supports 1FA/1sector capacity.

Realized IEEE802.16d/e related functions in channel card are as follows.

- Data randomization, Convolution (CC) and Convolution-Turbo (CTC) coding, interleaving
- Bandwidth and frame length for Full / Partial Usage Sub channel Assignments (FUSC and PUSC)
- Sampling frequency 10MHz/11.2MHz
- Initial and Periodic Ranging Support
- FFT-size : 1024 points
- 2Tx/2Rx (MIMO)
- Digital I & Q and Hybrid-ARQ support

Block diagram

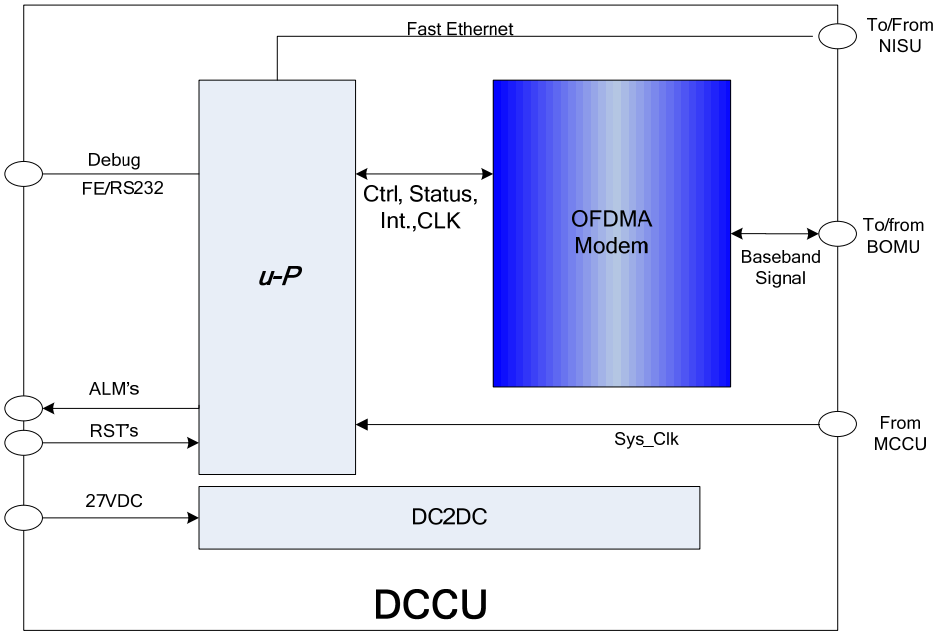


Figure III-7 Block Diagram-DCCU

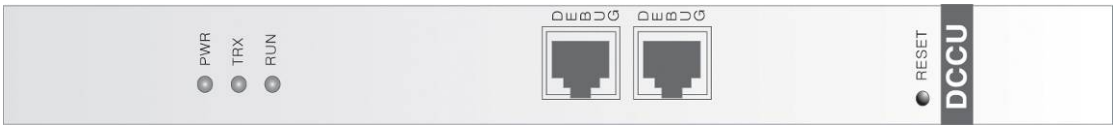
In the case of up link signal, (from PSS to Network) DCCU analyses IEEE 802.16d/e traffic and control signal received from TRXU and modifies into IEEE 802.3(Ethernet) signal. Traffic signal is transferred to ACR and control signal to MCCU via NISU.

In terms of down link signal from Network to PSS, traffic signal which received in the form of IEEE 802.3(Ethernet) from ACR via NISU and control signal that received as IEEE 802.3(Ethernet) format from MCCU via NISU are transferred to BOMU as the form of IEEE 802.16d/e signal.

This call processing excuses in the bases of TDD synchronization that created by the clock from MCCU. To interface with BOMU board Digital Interface (SERDES) is used, for MCCU Ethernet is used. In order to transmit traffic data received from PSS to ACR, it communicates with NISU (Network Interface Unit) by Ethernet.

Interface

The front side of DCCU is illustrated as below.



- DEBUG: Serial port (RS-232) which is used for unit debugging and generally is not used on normal operation. The developer or advanced administrator uses this to monitor or configure the unit. And this port is not used normally.
- RESET: Resets Processor physically.

LED

LED	Color	Operation	Remarks
PWR	Green	Power is normal	
RUN	Green	Processor is normal	

NISU (Network Interface Switch Unit)

Function

NISU is an Ethernet switch which offers Ethernet path for RAS to communicate with internal units as well as external devices. It gathers hardware alarm in RAS and reports to MCCU.

Block Diagram

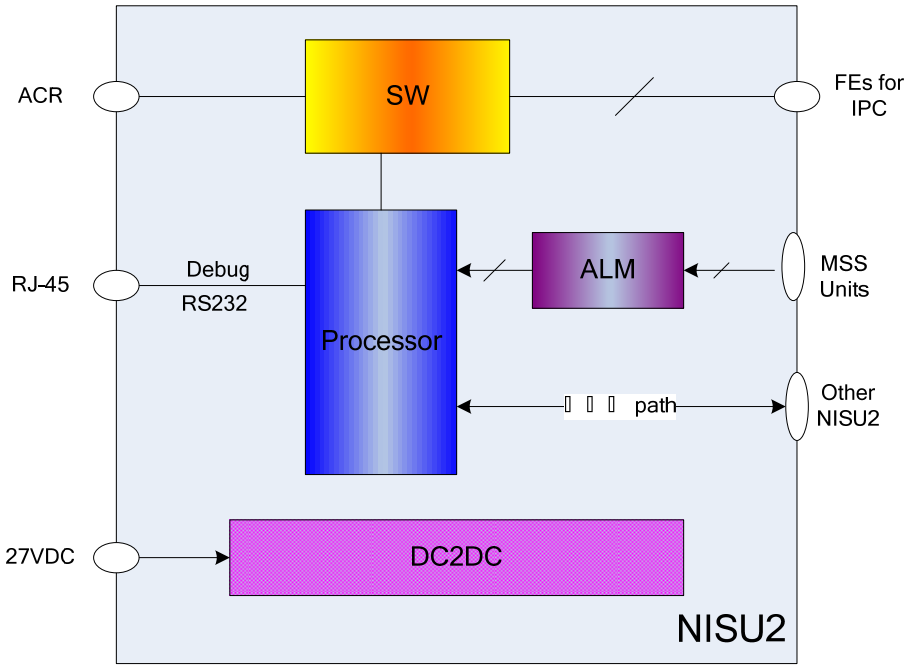
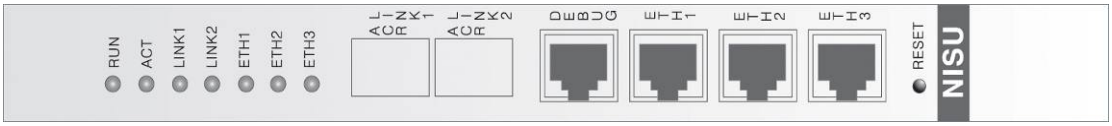


Figure III-8 Block Diagram-NISU

NISU is compose of Ethernet switch and related PHY element that provides 24 number of Fast Ethernet and 2 Gigabit/Fast Ethernet ports, Processor and hardware alarm detection circuit. NISU communicates with ACR by 2 Gigabit/Fast Ethernet ports and with internal RAS units by Fast Ethernet ports.

Interface

The front side of NISU is illustrated as below.



- ACR LINK1/2: Supports 1000Base-x Interface that connects to ACR and provides 2 ports for system stability and scalability.
- DEBUG: Serial port (RS-232) which is used for unit debugging and generally is not used on normal operation. The developer or advanced administrator uses this to monitor or configure the unit.
- ETH1/ 2/ 3 : Ethernet port(100Base-Tx). Supports Ethernet switch for other related equipments from the front side.
- RESET: Resets Processor physically.

LED

LED	Color	Operation	Remarks
RUN	Green	Processor is normal	
ACT	Green	Processor is normal	
LINK1/2	Green	Turns on if Ethernet Port is connected Blinks if Data is transmitting/receiving	
ETH1/2/3	Green	Turns on if Ethernet Port is connected Blinks if Data is transmitting/receiving	

BOMU(BS Optic interface Unit for MSS)

Function

BOMU is used for inter-connecting between MSS and RSS with CPRI/OBSAI in RAS 6000 system.

- Optical Interface board between channel card in MSS and RSS
- RSS Interface : CPRI Specification
- 3-optic Link in a BOMU board, 1FA per Link
- Support CPRI 3-AxC for 2Tx/2Rx per Link
- Support 3 Channel card per BOMU
- Support IPC by Fast Ethernet
- Monitor and control 3 RSSs through Fast Ethernet on the CPRI per board
- RS-232C Console interface (57.6kbps), RJ-45 connector

Block Diagram

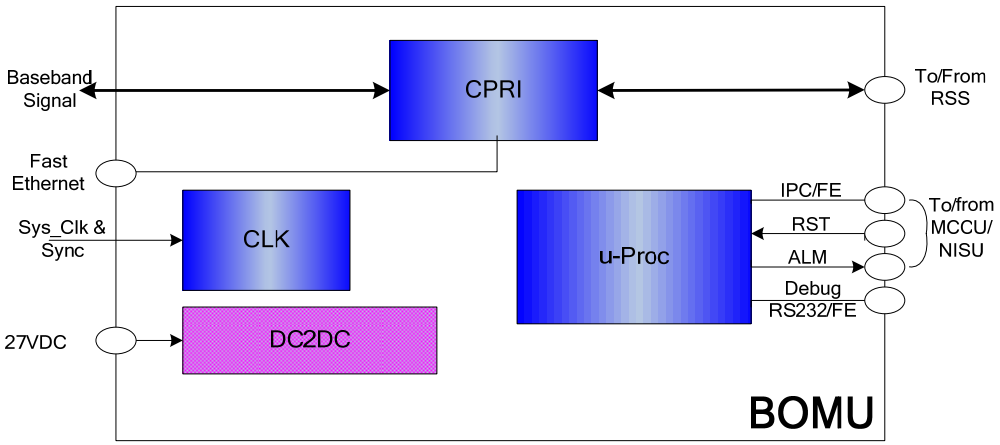


Figure III-9 Block Diagram-BOMU

Interface

The front side of BOMU is illustrated as below.

FACU (Front Access Connector Unit)

Function

FACU is devised to connect external device or inter-unit of MSS. The cable connection port can be done from the front side of the system, so it is very simple and fast

Interface

The front side of FACU is illustrated as below.

FAN

Function

The cooling fan located on top of the unit directs the air flow to the above side of the shelf then to the rear side of the RAS. It is operated by load sharing method

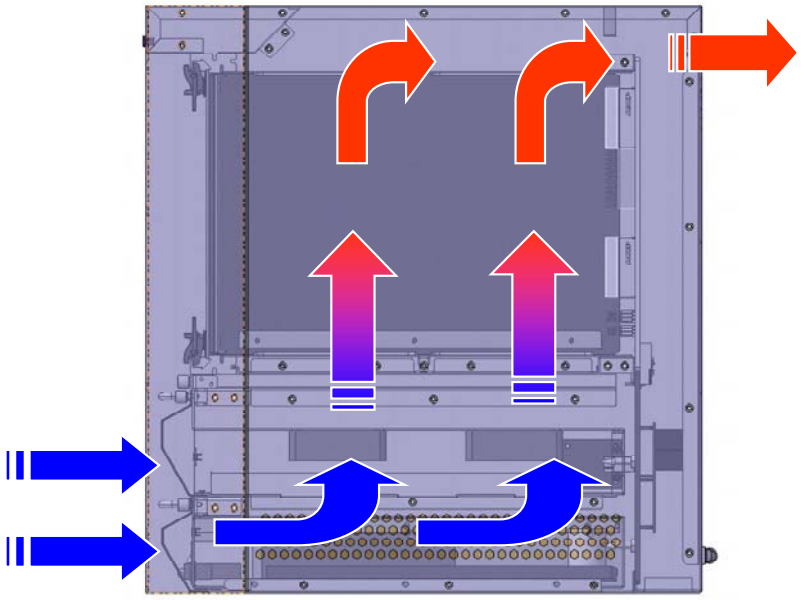


Figure III-10 Diagram-FAN

RSS (Remote Sub-system)

Function

RSS consists of several components; CPRI interface and Digital IF function through optic, TRB to control RSS, Downlink drive amplifier, low-level noise amplifier, PAB to have down converter function, Band Pass Filter function, FEB acts as coupling role and PSB to provide power to each unit from DC -48V

- RF frequency Change function (PLL parameter value)
- Attenuator Change function (Tx/Rx attenuator value)
- Alarm transmit function (include alarms in CPRI interface)
- Periodic keep-alive transmit function
- Rx RSSI parameter detection value transmit function
- Tx Output power detection transmit function
- Inventory Read/Write function
- TDD status transmit function
- PA Status value transmit function (Current Temperature, Current Power Value, VSWR, etc)
- PA control function
- HW/SW reset function
- HW/SW enable/disable function
- TDD On/Off function
- PA ALC, shut-down temperature, shut-down VSWR level function

Block Diagram

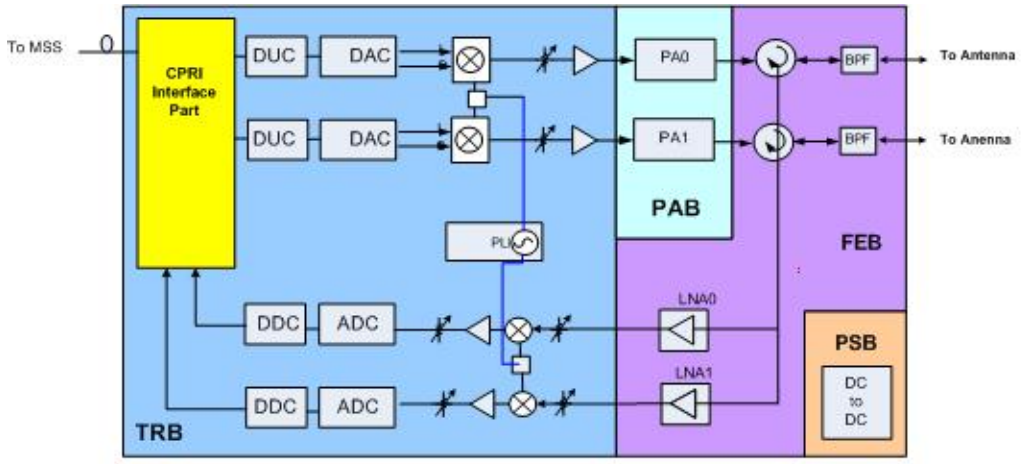


Figure III-11 Block Diagram-RSS6000

RSS Configuration Module

RSS consists of following unit;

- PAB (Power Amplifier Block)
  - ✓ Power Amplifier Block receives up converted down link signal from TRB and amplify the signal to transmit.
  - ✓ Shutdown Level : 43dBm+1.0dB
  - ✓ Operation range of ALC : 10dB
- FEB (Front End Block)
  - ✓ FEU consists of Band pass filter, Coupler and LNA
  - ✓ FEU provides Tx/Rx signal bandwidth filtering function & signal Coupling / Monitoring function
- TRB (Transceiver & Optic Block)
  - ✓ Major function
    - CPRI User Data & O&M Interface
    - Optic Interface (Connector : SFP – LC Type)
    - Up converting and down converting
    - Clock Distribution
    - Ethernet Interface
- PSB (Power Supply Block)
  - ✓ Specification: -48 V DC input Inverse voltage protection
  - ✓ It can have external rectifier and separate power device with battery

Chapter IV. System Software

Configuration and Function

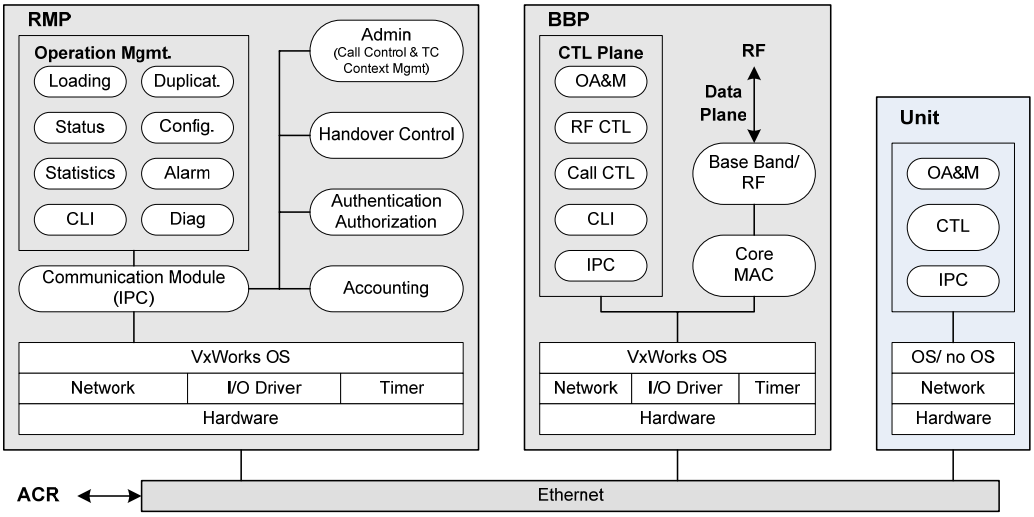


Figure IV-1 Software Block diagram

RAS software is composed with RMP (RAS Management Processor), BBP (Base Band Processor) and software for individual unit. RMP is installed in MCCU and BBP in DCCU.

Communication among each unit uses Ethernet protocol and NISU supports Ethernet switch function.

Each unit has Network software over Hardware so that can provide required communication from the higher application.

OS

- RMP, BBP, TRXU : VxWorks
- NISU : Linux
- Other units : N/A

Application Software

- RMP: Main control processor of RAS. RMP plays various roles; sets up and controls RAS system, call controls, overload and QoS, processes hand-over and alarm, performs authorization and authentication, gathers statistics, manages RAS in general and telephone traffic (including voice and data HO) for billing, diagnoses, OA&M
- BBP: Processes MAC and PHY defined by IEEE802.16d/e. BBP exchanges message related to MAC with PSS and processes by interacting with RMP and ACR. It also produces

information of traffic transferred and transfers it to RMP. Guarantees QoS by processing traffic data according to the priority determination and performs Power control and handover.

Message Flow

Data that transmits/receives within a RAS are composed of traffic data, signaling data, OA&M or control data which is related to setting.

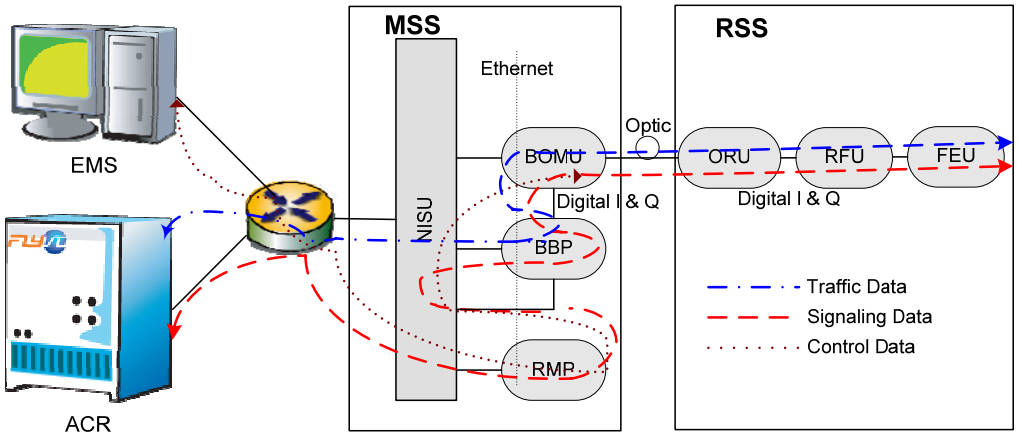


Figure IV-2 Signal Flow diagram

Traffic Data

ACR, NISU, BBP, BOMU or unit that related to RF transmits/receives the traffic data.

RAS system, in particular, uses IP CS (IP Convergence Sub-layer) which is defined by IEEE802.16d/e rather than Ethernet CS. Therefore it involves certain procedures such as BBP removing Ethernet related packet header of the traffic data from ACR, and replaces it by IEEE802.16d/e frame header to send the traffic to air in down link direction.

In up link direction,, BBP removes IEEE802.16d/e frame header of traffic data and packages IP packet using Ethernet frame header.

It means that BBP is the protocol terminating point converting protocol between Ethernet and IEEE802.16d/e.

Signaling Data

Signaling data heading on down link direction is transferred from ACR, RMP to BBP. Those data related to PSS continues to PSS. Whereas, on up link, signaling data is transferred from PSS, BBP, RMP to ACR.

Since all the communication between units uses Ethernet, it passes through NISU which is

Ethernet switch.

Control Data

Control data (mainly communicates with EMS) transfers from ACR to NISU, RMP and related unit in order. RMP analyses the packet on the way and sends it to related unit and confirms. Same as above, since all the communication between units uses Ethernet, it passes through NISU also.

Chapter V. Functions

HO connection procedure

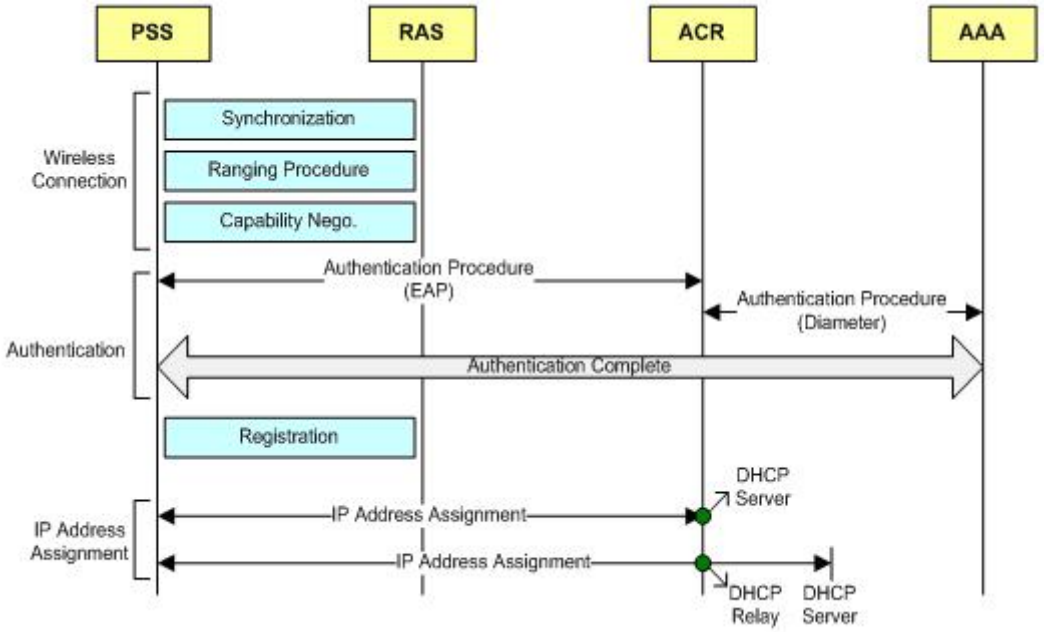


Figure V-1 General Call Connection Procedure

In order to access the services on WiMAX Network with PSS, certain processes are followed such as; synchronization after initialized, ranging, capability agreement, authentication, registration and IP assignment. Details are as follows;

- Synchronization: Synchronizes time and frequency between PSS and RAS. Every system operates synchronization mode for FDD/TDD operation.
- Ranging: Exchanges information about channel and system after synchronization.
- Capability agreement: Exchanges system capability and basic authentication capability of the system with PSS.
- Authentication: Authenticates PSS and server mutually.
- IP address assignment: Assigns IP address for IP communication to those subscribers who finished authentication. After then communication is possible.

Traffic control

Those PSS that completed authentication as well as IP address assignment is now ready to communicate. DNS of certain IP address or site where the PSS is willing to connect can assist PSS. General traffic which doesn't require QoS particularly processes packet by the best effort (BE) method which is the same as IP network that delivers packet only if there is available resources.

Service requiring QoS creates session in addition to BE and processes packet. It means that

service demanding QoS ensures required resources prior to packet transmission.

Other functions

Authentication

Security guarantees privacy and protects system and service from illegal user, hacker or arrear subscriber. Verification of valid subscribers not only authenticates but also secures the system.

IEEE 802.16e and WiMAX only define security in wireless section such as between RAS and PSS and other sections are not specified. Security requires these functions as follows;

- Authentication: Verifies user's identity and entity. Confirms integrity of the user's data. Authorization can be included.
- Encryption: Encrypts the information in case of transmission so that only authorized person can see and hear it.

In this procedure, RAS is responsible for forwarding EAP packet between PSS and ACR using PKMv2 standard.

Once authentication is completed, RAS encrypts packet using related key.

In order to keep key secure, the key changes from time to time.

IP Address Assignment

IP address which is an essential element for IP communication, but IP address assignment method and its handling process is different depending on mobility handling method of PSS.

However RAS takes in charge of managing subscriber by saving given IP and processing traffic rather than participating in actually all of IP address assignment process.

Location Update

RAS updates current location of PSS in order to provide services to PSS under certain condition such as when;

- Paging Group changes
- Certain period of time passes
- PSS powers down
- MAC Hash skip counter exceeds certain value continuously

Handover

The process that system provides service to PSS continuously when it moves another cell area is called Handover. By interacting with ACR and PSS, RAS system offers Handover to PSS between;

- Sector
- RAS
- FA(Frequency Assignment)
- Inter ACR

Subscriber management

In order to provide service to PSS (subscriber), it is necessary to manage information of PSS that is on operation (registered). The information such as;

- Ethernet MAC and IP address of PSS(subscriber)
- State(awake, sleep, idle mode) of PSS(subscriber)
- Authorization related key
- Service in process

Accounting

In order to charge the cost of service, it requires gathering and saving certain accounting information. Then the information passes to ACR when call completed or ACR demands. Information such as;

- Kinds of service
- Connect/disconnect time of the service
- Used packet amount

QoS

QoS applies to provide services that user demands with certain level of quality.

RAS communicates with ACR to insure certain level of quality and ACR with Policy Function (PF). RAS divides each service flow by the order of ACR and ensures the characteristic of QoS. The core factors of QoS are follows.

- Bandwidth
- Delay
- DSCP marking or re-marking

Redundancy

Power supply unit of RAS 6000 series offers redundancy on power(PSU), ACR interface link and MCCU optionally which is main controller of RAS system. The methods are as follows.

- PSU: Two number of PSU provides required power using load sharing. When one unit is out of order, the other unit can provide required power as usual so that system can operate

normally.

- MCCU: When active unit is experiencing problem, standby unit operates instead.
- Link: When one link is out of order, the other remained link can continues services if there are two Ethernet links.

Scalability

RAS 6000 series system provides maximum of 9 cells and can support 1 ~ 9 cell (3FA/3Sector or 1FA/9Cell)

Status management and maintenance

Status management

RAS system can be manageable from remote location using EMS and Telnet. CLI (Command Line Interface) can also operate RAS in the field.

EMS and Telnet operate the system in general and CLI only applies for system installation or error management in the field. EMS is designed on the basis of GUI so it helps to simplifying the system operation.

Orders related to status management is transferred by control data. It can be managed by RMP (located in MCCU) which owns IP address that allows external connection.

Configuration

Configures network/wireless related parameter in order to connect RAS to network.

- Network related parameter
  - IP address
  - ACR ID.
  - RAS ID
- Wireless related parameter
  - Frequency bands
  - FA
  - Sub-channel

Error maintenance

When error occurs from RAS system, it reports to EMS so that appropriate action can be done. Main functions are as follows.

- Unit installation/un-installation
- Main link operation
- Unit error
- Saving alarm Log

Statistics

Reports system management and related statistics to EMS so that appropriate action can be done. Main functions are as follows.

- Authentication success/failure information
- HO completion/ failure information
- Handover completion/ failure information

Chapter VI. Appendix

Specification Table

Area	Parameters		Value	Comments
System	Max. No. of Sector		3	3FA/3Sector
	Max No. of FA		3	3FA/3Sector
	Max. throughput / Sector	MISO	DL : 16.75 Mbps UL : 4.03 Mbps	DL:UL = 26:12 (default) DL-PUSC
		MIMO	DL : 29.56 Mbps UL : 4.03 Mbps	DL:UL = 26:12 (default) DL-PUSC
	Redundancy		MCCU, NISU, DCMP	1+1, Active/Standby, or Load Sharing
	Diversity		2Tx/ 2Rx	
	Network Interface		2 x 100Base-Tx 2 x 1000Base-x	Fast Ethernet
	Dimension (W x D x H, mm)		19inch x 460 x 487.5	MSS
			600 x 800 x 900	OCMSS(TBD, except Plinth)
			380 x 430 x 180	RSS(Except Skirt)
	Operation Condition		Indoor/Outdoor	MSS/OCMSS
	Weights(Kg)		40kg (Max.) 25kg (Inc. shelf, Fan, DCMP)	MMS
			120Kg	OCMSS(TBD)
			Less than 23kg	RSS
Radio Frequency	Operating frequency(GHz)		2.3, 2.5	
	Channel Spacing(MHz)		8.75, 10	
	Max. Output Power /Carrier		Max. 10+10Watts (43 dBm)	At the antenna port of RAS
	Frequency Tolerance		± 0.02 ppm	
	Channel Raster		250 KHz	
OA&M	Operation		EMS, Telnet, CLI	
	Items		Configuration, Alarm, Statistics	
Electrical	Input Power		+27 VDC	MSS
			-48 VDC	RSS
	Backup Battery		-	External Battery Rack (optional)
	Power consumption(W)		Max. 635W	MSS
			Max. 390 W	RSS
Environment	Operating Temperature(℃)		- 30 ~ + 50	Outdoor, RSS
			0 ~ + 50	Indoor, MSS

	Storage Temperature(℃)	- 40 ~ + 70	Outdoor/Indoor
	Operating Humidity(%)	10 ~ 95	Outdoor, RSS
		20 ~ 80	Indoor, MSS
	Storage Humidity(%)	10 ~ 95	Outdoor/Indoor
	Particle density	0 ~ 50 ㎍/㎥	
Standard Compliance	Environmental Sealing	NEMA 1X	
	Lightning Protection	ANSI 6241 Class B	
	Seismic Performance	BELLCORE GR-63	
	Random Vibration	BELLCORE GR-63	
	Sinusoidal Vibration	BELLCORE GR-63	
	Shock	BELLCORE GR-63	
	Intrusion Resistance	BELLCORE GR-487	
	Shotgun Resistance	BELLCORE GR-487	
	EMI	Class A for KN22 (EN 55022, CISPR22)	

System parameter Table

Parameter	8.75 MHz	10 MHz
Sampling factor (B)	8/7	28/25
Sampling frequency (C)	10 MHz	11.2 MHz
OFDMA symbol duration in μs (E)	115.2 μs	102.857143 μs
RTG in samples (F)	744 samples	672 samples
RTG in μs (G)	74.4 μs	60 μs
TTG in samples (H)	872 samples	1184 samples
TTG in μs (I)	87.2 μs	105.714286 μs
CP ratio	1/8	
Frame duration in ms	5 ms	
OFDMA symbol duration in samples	1152	
FFT size (A)	1024	
CP ratio	1/8	
Number of guard sub-carriers, Left	92	
Number of guard sub-carriers, Right	91	
Number of Used sub-carriers	841 , Number of all sub-carriers used within a symbol	
Number of data sub-carriers in each symbol per sub-channel	24	
Number of OFDMA symbols in DL and UL (J)	(30, 12) (29, 13) (28, 14) (27, 15) (26, 16) (25, 17) (24, 18)	(35, 12) (34, 13) (33, 14) (32, 15) (31, 16) (30, 17) (29, 18) (28, 19) (27, 20) (26, 21)

Ordering Information

Required number of board/module and the equipped position for MSS & RSS

Unit Name \ Config.		1FA/Omni	1FA/3S	9 x (1FA/Omni)	2FA/3S	Remarks
MCCU	Without Redundancy	1(#1)				
	With Redundancy	2(#1, #2)				
DCCU		1 (#1 for FA1/α)	3 (#1 for FA1/α, #2 for FA1/β, #3 for FA1/γ)	9 (#1 for 1st, #2 for 2nd, #3 for 3rd, #4 for 4th, #5 for 5th, #6 for 6th), #7 for 7th, #8 for 8th, #9 for 9th)	6 (#1 for FA1/α, #2 for FA2/α, #4 for FA1/β, #5 for FA2/β, #7 for FA1/γ, #8 for FA2/γ)	
NISU		1				
BOMU-SB		1 (#1-A for FA1/α)	1 (#1-A for FA1/α, #1-B for FA1/β, #1-C for FA1/γ)	3 (#1-A for 1st, #1-B for 2nd, #1-C for 3rd, #2-A for 4th, #2-B for 5th, #2-C for 6th), #3-A for 7th, #3-B for 8th, #3-C for 9th)	3 (#1-A for FA1/α, #1-B for FA2/α, #2-A for FA1/β, #2-B for FA2/β, #3-A for FA1/γ, #3-B for FA2/γ)	-A/B/C mean Port A/B/C of BOMU
FACU3		1				
FNDU2-I		1				
DUBB2		1				
PDPU		1				
DCMP	Without Redundancy	1(#1)				
	With Redundancy	2(#1,#2)				
CMSS		1				
RSS		1	3	9	6	

Note : The Equipped position is defined in the parenthesis, and refer to the section 2.3

Abbreviation and Definitions

- AAS : Adaptive Antenna System
- ACR: Access Control Router
- ADC: Analog to Digital Converter
- ARQ: Automatic Repeat reQuest
- CC: Convolutional Code
- CLI : Command Line Interface
- CPRI: Common Public Radio Interface
- CTC : Convolutional Turbo Code
- DAC : Digital to Analog Converter
- DCCU: Digital Channel Card Unit
- DUBB: Digital Shelf Backplane Board
- FA : Frequency Assignment
- FACU: Front Access Connector Unit
- FFT: Fast Fourier Transform
- FNDU: FAN Digital Part Unit
- FUSC: Full Usage of Sub-Channel
- HSDPA/HSUPA : High Speed Downlink/Uplink Packet Access
- IF : Intermediate Frequency
- MCCU: Main Control and Clock Unit
- MIMO : Multi Input Multi Output
- MRC : Maximum Ratio Combining
- NISU: Network Interface Switch Unit
- NWG: Network Working Group
- OFDMA: Orthogonal Frequency Division Multiple Access
- ORU : Optic Radio Unit
- PDPU: Power Distribution Panel Unit
- PSS : Portable Subscriber Station
- PSU : Power Supply Unit
- PUSC: Partial Usage of Sub-Channel
- FEU: Front End Unit
- RFU: Radio Frequency Unit
- RMP: RAS Management Processor
- SERDES: Serializer and Deserializer
- STC: Space Time Coding

- TDD: Time Division Duplex
- VoD: Video On Demand
- WiMAX : Worldwide Interoperability for Microwave Access Forum