HUAWEI

Airbridge cBTS3612 CDMA Base Station
User Manual

System Description

HUAWEI

Airbridge cBTS3612 CDMA Base Station
User Manual

Local Maintenance Terminal

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Airbridge cBTS3612 CDMA Base Station
User Manual

BTS Maintenance

1.5cm

Airbridge cBTS3612 CDMA Base Station

User Manual

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Airbridge cBTS3612
CDMA Base Station

User Manual

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1. System Description
2. Local Maintenance Terminal
3. BTS Maintenance

Airbridge cBTS3612 CDMA Base Station
User Manual

V100R002

Airbridge cBTS3612 CDMA Base Station
User Manual

Manual Version T2-030160-20030125-C-1.21

Product Version V100R002

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About This Manual

Version

The product version corresponds to the manual is Airbridge cBTS3612 CDMA Base Station V100R002.

Contents

This User Manual gives a systematic introduction on the technical principles, structures and maintenance methods of Airbridge cBTS3612 CDMA Base Station (cBTS3612 hereafter).

It is divided into three modules:

- Module 1 System Description

This module introduces the technical principles, software and hardware structures, functions, networking configurations and performance indices of cBTS3612.

- Module 2 Local Maintenance Terminal

This module introduces how to use the cBTS3612 local maintenance terminal. First is the guide to the local maintenance terminal, second is the detailed introduction of the local commands, including configuration commands and maintenance commands.

- Module 3 BTS Maintenance

This module introduces how to maintain the cBTS3612 BTS, including routine maintenance instructions, fault analysis and location, component replacement and component description.

Target Readers

The manual is intended for the following readers:

- Installation engineers & technicians
- Operation & maintenance personnel

Conventions

This document uses the following conventions:

I. General conventions

Convention	Description
Arial	Normal paragraphs are in Arial.
Arial Narrow	Warnings, cautions, notes and tips are in Arial Narrow.
`Terminal Display`	`Terminal Display is in Courier New`; message input by the user via the terminal is in **boldface**.

II. Command conventions

<table>
<tr><th>Convention</th><th>Description</th></tr>
<tr><td>boldface font</td><td>Command keywords (which must be input unchanged) are in boldface.</td></tr>
<tr><td>italic font</td><td>Command arguments for which you supply values are in italics.</td></tr>
<tr><td>[ ]</td><td>Elements in square brackets [ ] are optional.</td></tr>
<tr><td>{ x | y | ... }</td><td>Alternative keywords are grouped in braces and separated by vertical bars. One is selected.</td></tr>
<tr><td>[x | y | ...]</td><td>Optional alternative keywords are grouped in square brackets and separated by vertical bars. One (or none) is selected.</td></tr>
<tr><td>{ x | y | ... } *</td><td>Alternative keywords are grouped in braces and separated by vertical bars. A minimum of one and maximum of all can be selected.</td></tr>
<tr><td>[x | y | ...] *</td><td>Optional alternative keywords are grouped in square brackets and separated by vertical bars. Many (or none) are selected.</td></tr>
<tr><td>!</td><td>A line starting with an exclamation mark is comments.</td></tr>
</table>

III. GUI conventions

Convention	Description
< >	Message entered via the terminal is within angle brackets.
[ ]	MMIs, menu items, data table and field names are inside square brackets [ ].
/	Multi-level menus are separated by forward slashes (/). Menu items are in boldface. For example, [File/Create/Folder].

IV. Keyboard operation

Format	Description
<Key>	Press the key with key name expressed with a pointed bracket, e.g. <Enter>, <Tab>, <Backspace>, or<A>.
<Key1+Key2>	Press the keys concurrently; e.g. <Ctrl+Alt+A>means the three keys should be pressed concurrently.
<Key1, Key2>	Press the keys in turn, e.g. <Alt, A>means the two keys should be pressed in turn.
[Menu Option]	The item with a square bracket indicates the menu option, e.g. [System] option on the main menu. The item with a pointed bracket indicates the functional button option, e.g. <OK> button on some interface.
[Menu1/Menu2/Menu3]	Multi-level menu options, e.g. [System/Option/Color setup] on the main menu indicates [Color Setup] on the menu option of [Option], which is on the menu option of [System].

V. Mouse operation

Action	Description
Click	Press the left button or right button quickly (left button by default).
Double Click	Press the left button twice continuously and quickly.
Drag	Press and hold the left button and drag it to a certain position.

VI. Symbols

Eye-catching symbols are also used in this document to highlight the points worthy of special attention during the operation. They are defined as follows:

⚠ **Caution**, **Warning**, **Danger**: Means reader be extremely careful during the operation.

🕮 **Note Comment**, **Tip**, **Knowhow**, **Thought**: Means a complementary description.

Table of Contents

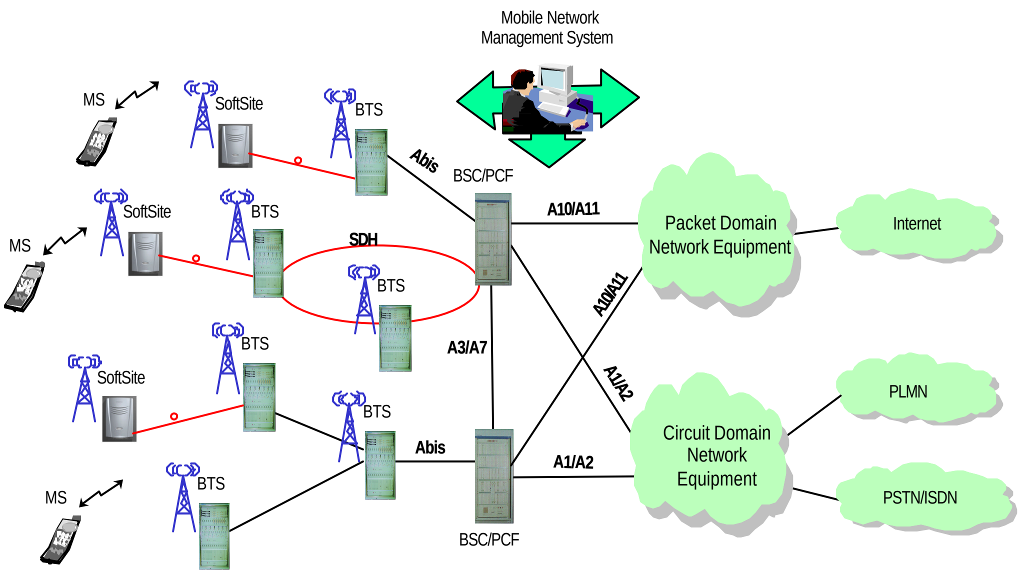
1 System Overview

This chapter firstly presents an outline of the cBTS3612 base station system, and then briefs the system features, technical indices and external interfaces, followed by an introduction to the system reliability design in aspects of hardware and software.

1.1 Brief Introduction

The cdma2000 1X mobile communication system comprises the Base Station Subsystem (BSS) and the Core Network (CN). The BSS comprises the Base Transceiver Station (BTS), Base Station Controller (BSC) and Packet Control Function (PCF), while the CN comprises the packet domain network and circuit domain network. The equipment of packet domain interworks with Internet, and that of the circuit domain interworks with the conventional PLMN and PSTN/ISDN. The system's operation and maintenance is implemented via the integrated mobile network management system (iManager M2000).

The position of BTS in CDMA system is as shown in Figure 1-1.



MS: Mobile Station
BSC: Base Station Controller
PLMN: Public Land Mobile Network
PCF: Packet Control Function
BSS: Base Station Subsystem
BTS: Base Transceiver Station
ISDN: Integrated Service Data Network
PSTN: Public Switched Telephone Network
Softsite: Soft Site
CN: Core Network

Figure 1-1 Network structure of cdma2000 1X mobile communication system cBTS3612 is located between the Base Station Controller (BSC) and the Mobile Station (MS) in the cdma2000 1X mobile communication system.

Under the control of the BSC, the cBTS3612 serves as the wireless transceiving equipment of one cell or multiple logical sectors. Connecting to BSC via the Abis interface, it assists the BSC on the radio resource management, radio parameter management and interface management. It also implements, via the Um interface, the radio transmission between the BTS and the MS, as well as related control functions.

cBTS3612 cabinet is shown in Figure 1-2.

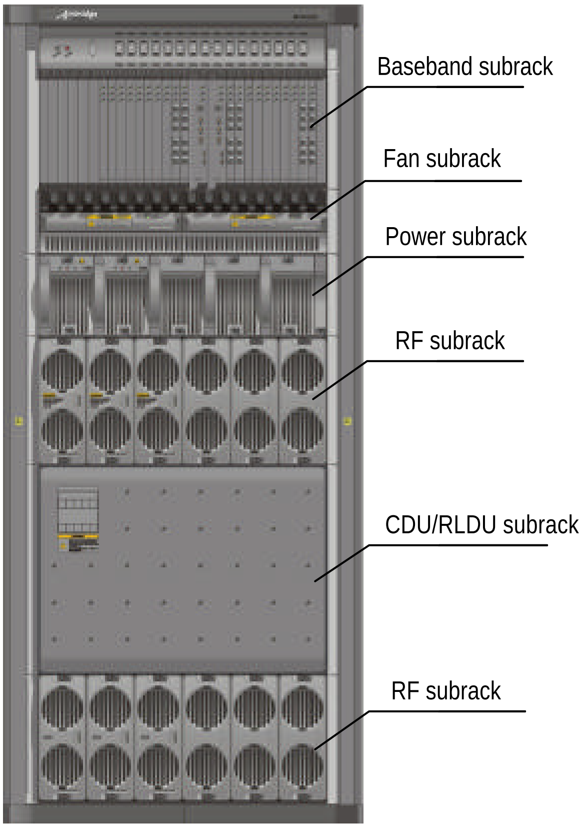


Figure 1-2 cBTS3612 cabinet

cBTS3612 has the following functions:

I. Interface function

- Um interface supports IS2000 Release A. It is fully compatible with IS-95A/B.
- The physical layer supports a rate as high as 307.2kbit/s.
- Hard handoff, soft handoff and softer handoff are supported.
- Quick forward power control, slow forward power control, quick reverse power control and reverse open-loop power control are available.

- Support omni-cell, directional 3 sectors and 6 sectors configurations.
- Abis interface supports E1/T1 trunk mode and optical fiber transmission mode (optical fiber transmission mode will be available in the coming version). E1/T1 trunk mode supports as many as 16 E1/T1 trunk lines and optical fiber transmission mode will support 2 pairs of STM-1 optical fibers.
- Chain, star and tree networking modes are supported.
- Softsite (ODU3601C) can be extended afar via optical fibers.

II. Basic functions of operation and maintenance

- Software downloading
- Abis interface management
- Air interface (Um) management
- Test management
- Status management
- Event report handling
- Equipment management
- Data configuration management
- BTS operation tracing
- Telnet logon

1.2 System Features

cBTS3612 features large capacity, high integration and low power consumption. One cabinet can accommodate as many as 12 sector carriers. It can satisfy the customer's demands on capacity, configuration, installation, power supply, transmission and service. It's a typical "All In One" BTS. Its features are highlighted as follows:

1.2.1 Advanced Technology and Excellent Performance

cBTS3612 integrates the following technologies to improve its performances:

- Based on well-developed Huawei ATM platform and cell switching & broadband processing technology, standard interface and open application is enabled.
- Designed with the resource pool concept, which helps increase the availability of hardware resources and the system's fault-tolerance.
- Equipped with the digital intermediate frequency technology to enhance wireless signal transmitting and receiving capability.
- Designed with the technology of diversity receiving to improve the radio signal receiving performance.
- Supporting remote installation of the SoftSite via optical fibers, thus making networking more flexible.

- Equipped with the blind mate technology on the radio frequency module for convenient maintenance.
- Intelligent fans with prolonged service life and reduced noise.

1.2.2 Protecting User Investment

The cBTS3612 is compatible with IS-95A/B and cdma2000 1X, and can be upgraded to cdma2000 1X EV smoothly. When the network is upgraded from IS-95 to cdma2000 1X, or from cdma2000 1X to cdma2000 1X EV, the user's investment can be saved.

The cBTS3612 features large-capacity design, modular structure and high integration. A single cabinet can accommodate up to 12 sector carriers. It also supports 36 sector carriers with three fully configured cabinets combined together.

Its baseband processing employs the resources pool design to reduce equipment redundancy and improve reliability.

Its Abis interface supports 16 E1s or 2 STM-1 optical interfaces (in the coming version), oriented to future high-speed data service.

Its excellent inheritance capability guarantees the original antenna and feeder components can be used in the event of BTS expansion or upgrade. The components include DU, RLDU, antenna, feeder and the optional TMA (The TMA only applies to 19000MHz band). The DU includes CDU, DFU and DDU, the difference between these 3 DUs will be introduced in "2.3 RF Subsystem".

1.2.3 Convenient Operation and Maintenance

Emergency serial ports are provided for the boards, so that the alarm information can be reported in the case of communication link fault.

Real-time status query, online board test and system fault locating as well as system restart functions are provided.

Telnet Server is provided so that the user can log in to the BTS via the local Ethernet interface in the standard Telnet mode to perform O&M.

Modem dial-up is supported so that the remote O&M can be performed.

All boards of baseband subrack support hot plug/unplug for the sake of ready maintenance, upgrade and expansion.

Blind mate of the radio frequency module guarantees that all operations can be done at the front side of the equipment. During expansion and configuration, wiring at the back need not be modified.

Its modularized structure reduces the internal connections and improves the reliability of the system, and thus makes the installation and maintenance easier.

In the case of whole BTS interruption due to power supply or transmission causes, the cBTS3612 system can restart automatically right after the faults are cleared.

1.2.4 Flexible Networking Mode

I. Networking for large capacity and wide coverage

- A single cabinet supports as many as 12 sector carriers. 3 cabinets can be combined to provide a maximum capacity of 36 sector carriers.
- Large-capacity trunk. Abis interface of BTS supports as many as 16 E1s transmission. The coming version will support STM-1 optical transmission in ATM mode at Abis interface and provide two STM-1 ports for Abis interface trunk.
- Support multiple BTS configurations such as omni 4 carriers, 1×3, 2×3, 12×3, 6×6(carrier×sector) configurations.

II. Supporting multiple BTS networking modes such as chain, star and tree

Refer to "4.1 Transmission Networking" for details.

III. Soft BTS networking (the SoftSite will be available in the coming version)

In this networking mode, the baseband unit adopts the centralized processing mode. The baseband signals and maintenance information are transferred through the fiber to the SoftSite (ODU3601C). The SoftSite can be applied indoors, outdoors or underground.

The SoftSite, small in size, is equipped with built-in power supply, temperature regulator and monitoring device. It can be used in severe environments, e.g. outdoors. The feeder loss of the SoftSite is trivial, making large coverage for macro cells possible.

SoftSites in the chain-networking mode are applicable to highways and subways. A maximum of 6 SoftSites can be connected in serial in one pair of optical fibers.

1.2.5 Reliable Power Supply System

The DC/DC power supply with -48V DC power input, and +27V DC output is adopted. The whole power supply system is composed of 5 modules in full configuration, with automatic current equalization function, 4+1 redundancy, meeting the requirement of 8000W power supply.

Current equalization hot backup, centralized management, and decentralized power supply are enabled. It makes the power supply system safer and more reliable. It provides automatic alarming through monitoring interface for the power fan, input under-voltage, output over-voltage, overheat and protection against reverse connection. This ensures the reliability of the power system. Remote power on/off function enables unattended BTS operation and remote maintenance.

1.2.6 Multi-band supported

Now the cBTS3612 base station support the following band class specified in TIA/EIA-97-D Recommended Minimum Performance Standards for cdma2000 Spread Spectrum Base Stations.

Band Class 0 (800 MHz Band).

Band Class 1 (1900 MHz Band).

Band Class 5 (450 MHz Band).

To support the different band classes, RF modules with different specifications should be configured in cBTS3612 base station.

1.3 Technical Index

I. Structure and environment indices

Cabinet dimensions (Top set excluded)	1800mm x 800mm x 650mm (H x W x D)
Power supply	-48V DC (-40 - -60V DC)
Operational environment	Temperature: -5°C ~ 50°C Relative humidity: 5% ~ 90%
Equipment room noise	70dBA (With intelligent fan control. The noise varies with the ambient temperature)

Note:

In terms of environment adaptability, cBTS3612 conforms to the following specifications: IEC 60721-3 series, IEC 60068-2 and ETS 300 019-2 series. For details, please refer to Appendix C Environment Performance.

Equipment room noise is In compliance with ETS 300 753 Noise Requirement for telecommunication equipment and base station environment. When the inside temperature of cBTS3612 equipment room is 50°C, the equipment noise is less than 70dBA, and when the temperature is 25°C, the equipment noise is less than 60dBA.

II. Clock indices

Frequency stability	<±5 x 10-8
Annual aging rate	<±5 x 10-10

III. System capacity

Full configuration of one cabinet	12 sector-carriers
Full configuration of three cabinets	36 sector-carriers

IV. Power consumption and cabinet weight

Site configuration	Power consumption (W)	Cabinet weight (kg)
S(1/1/1)	<1500	351
S(2/2/2)	<2800	388
S(4/4/4)	<5500	550

V. Transmitter indices

- 450MHz Band

Working band	460 - 470MHz
Channel bandwidth	1.23MHz
Channel precision	25kHz
Frequency tolerance	±0.05ppm
Transmitting power	20W (The maximum value measured at the cabinet-top feeder port)

- 800MHz Band

Working band	869 - 894MHz
Channel bandwidth	1.23MHz
Channel precision	30kHz
Frequency tolerance	±0.05ppm
Transmitting power	20W (The maximum value measured at the cabinet-top feeder port)

- 1900MHz Band

Working band	1930 - 1990MHz
Channel bandwidth	1.23MHz
Channel precision	50kHz
Frequency tolerance	±0.05ppm
Transmitting power	20W (The maximum value measured at the cabinet-top feeder port)

VI. Receiver indices

- 450MHz Band

Working band	450 - 460MHz
Channel bandwidth	1.23MHz
Channel precision	25kHz
Sensitivity of signal receiver	Better than -126dB (RC3, main and diversity receiving)

- 800MHz Band

Working band	824 - 849MHz
Channel bandwidth	1.23MHz
Channel precision	30kHz
Sensitivity of signal receiver	Better than –127dBm (RC3, main and diversity receiving)

- 1900MHz Band

Working band	1850 - 1910MHz
Channel bandwidth	1.23MHz
Channel precision	50kHz
Sensitivity of signal receiver	Better than –126dBm (RC3, main and diversity receiving)

VII. Rate configuration on Um interface

Rate configuration	Forward	Reverse
Mode 1	RC1	RC1
Mode 2	RC2	RC2
Mode 3	RC3 or RC4	RC3
Mode 4	RC5	RC4

VIII. EMC indices

ETSI EN 300 386 Electromagnetic compatibility and Radio spectrum Matters (ERM) - Telecommunication network equipment - ElectroMagnetic Compatibility (EMC) requirements is the universal EMC standard of telecommunication equipment. The EMC indices of the cBTS3612 comply with ETSI EN 300 386 V1.2.1 (2000 – 03).

IX. System reliability

MTBF (hour)	100000
MTTR (hour)	1
Availability (A)	99.999%

Note:

The performance of cBTS3612 base station satisfies or excels TIA/EIA-97-D: Recommended Minimum Performance Standards for cdma2000 Spread Spectrum Base Stations.

1.4 External Interface

1.4.1 Overview

The external interfaces of cBTS3612 are shown in Figure 1-3.

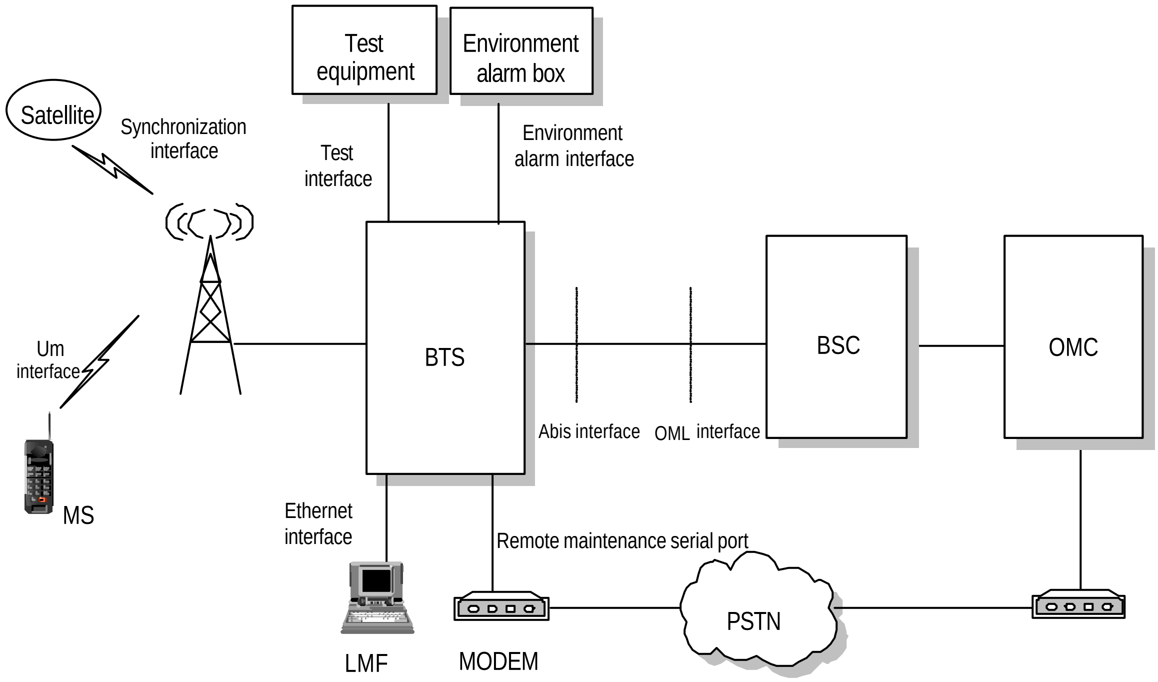


Figure 1-3 BTS external interface

- Um interface: interface with MS.
- Abis interface: interface with BSC.
- OML interface: interface with the remote OMC. It shares the transmission resources with Abis interface.
- LMF interface: interface with BTS local maintenance console.
- System synchronization interface: including GPS/GLONASS antenna interface and system external synchronization interface. When GPS/GLONASS is not available and there is other clock synchronization equipment, the clock synchronization output of the equipment can be connected with the external synchronization interface of BTS system.
- BTS test interface: interface for BTS test, providing such signals as 10MHz and 2s signal.
- Remote maintenance serial interface: another interface to remote console. This is a standby maintenance interface can be used when the active maintenance link between OMC and BTS is interrupted.
- Environment alarm interface: interface with environment alarm collection box.

1.4.2 Um Interface

I. Overview

In Public Land Mobile Network (PLMN), MS is connected with the fixed part of the network through the radio channel, which enables the subscribers to be connected with the network and to enjoy telecommunication services. To implement interconnection between MS and BSS, systematic rules and standards should be established for signal transmission on radio channels. The standard for regulating the radio channel signal transmission is called radio interface, or Um interface.

Um interface is the most important interface among the many interfaces of CDMA system. Firstly, standardized radio interface ensures that MSs of different manufacturers are fully compatible with different networks. This is one of the fundamental conditions for the roaming function of CDMA system. Secondly, radio interface defines the spectrum availability and capacity of CDMA system.

Um interface is defined with the following features:

- Channels structure and access capacity.
- Communication protocol between MS and BSS.
- Maintenance and operation features.
- Performance features.
- Service features.

II. Um interface protocol model

Um interface protocol stack is in 3 layers, as shown in Figure 1-4.

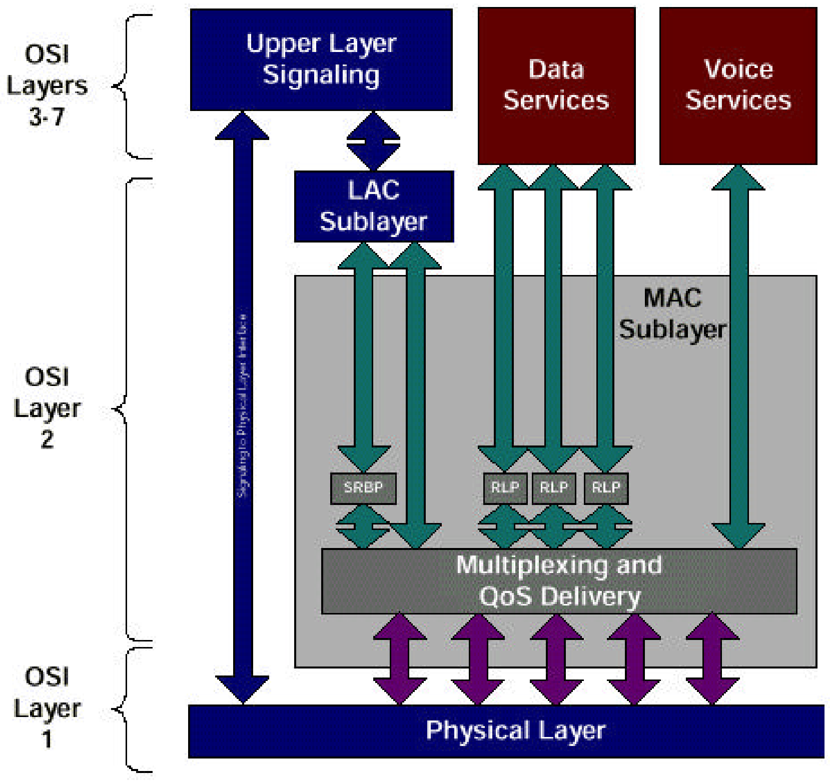


Figure 1-4 Um interface layered structure

- Layer 1 is the physical layer, i.e. the bottom layer. It includes various physical channels, providing a basic radio channel for the transmission of higher layer information.
- Layer 2 is the data link layer, including Medium Access Control (MAC) sublayer and Link Access Control (LAC) sublayer. The cdma2000 MAC sublayer performs the mapping between logic channels and physical channels, and providing Radio Link Protocol (RLP) function. The cdma2000 LAC sublayer performs such functions as authentication, Automatic Repeat Request (ARQ), addressing and packet organization.
- Layer 3 is the top layer. It performs Radio Resource Management (RM), Mobility Management (MM) and Connection Management (CM) through the air interface.

III. Physical layer

1) Operating band

Band	Forward Band	Reverse Band	Duplex	Channel	Carrier Space
450MHz	460 - 470MHz	450 - 460MHz	10MHz	1.23 MHz	1.23 MHz
800MHz	869 - 894 MHz	824 - 849 MHz	45MHz	1.23 MHz	1.25 MHz
1900MHz	1930 - 1990 MHz	1850 - 1910 MHz	80MHz	1.23 MHz	1.25 MHz

2) Physical layer function

- Service bearer: the physical channel in the physical layer provides bearer for the logic channel of the higher layer.
- Bit error check: the physical layer provides a transmission service with error protection, including error checking and error correction.
- User identification: the physical layer provides an exclusive ID for every user by code division.

3) Radio configuration

The cdma2000 physical layer supports multiple Radio Configurations (RCs). Different RCs support different traffic channel data rates. For detailed introduction, please refer to Section 4.5.4 Radio Configuration and Channel Support.

IV. Data link layer

Data link layer at Um interface includes two sublayers: MAC and LAC. The purpose of introducing MAC and LAC is to:

- Support higher level services (signaling, voice, packet data and circuit data).
- Support data services of multiple rates.
- Support packet data service and circuit data service of higher quality (QoS).

- Support multi-media service, i.e. processing voices, packet data and circuit data of different QoS levels at the same time.

1) MAC sublayer

To support data service and multi-media service, cdma2000 1X provides powerful MAC layer to ensure the reliability of services. MAC layer provides two important functions:

- Radio Link Protocol (RLP), ensuring reliable transmission on the radio link.
- Multiplex function and QoS function, with diversified services and higher service quality.

2) LAC sublayer

LAC layer performs such functions as Automatic Repeat Request (ARQ), authentication and addressing.

V. Layer 3

The higher layer signaling performs the functions such as radio resource management, mobility management and call control management on air interface.

1) Radio resource management

It is mainly used to establish, operate and release radio channels, and help to realize soft handoff, softer handoff and hard handoff.

2) Mobility management

It is mainly used to support the mobility features of the mobile user, performing such functions as registration, authentication and Temporary Mobile Subscriber Identifier (TMSI) re-allocation.

3) Connection management

It is mainly used to setup, maintain and terminate calls.

VI. Power control

Um interface utilizes power control technology to reduce the system interference and improve the system capacity. There are forward power control and reverse power control available.

1) Forward power control supports closed-loop power control

Forward power control includes power control based on power measurement report, control based on EIB, and quick forward power control.

Forward closed-loop power control means that MS checks the quality of received frames and received power, makes judgment and sends request to BTS for controlling BTS transmitting power. Then BTS adjusts its transmitting power according to the request. Power control command is sent at a rate of 50bit/s or 800bit/s.

2) Reverse power control includes open-loop power control and closed-loop power control.

- Reverse open-loop power control means that MS adjusts its transmit power as the received power changes.
- Reverse closed-loop power control means that BTS compares the received MS transmit power with the preset power control threshold and sends power control command based on the comparison. MS changes its transmit power as required by the received power control command. Power control commands are transmitted on F-TCH at a rate of 800bit/s.

For more information about power control, please refer to Section 4.5.1 Power Control.

VII. Handoff

Um interface supports many handoff technologies. It supports three types of handoff in traffic channel communication:

1) Hard handoff: MS breaks the connection with the old BTS before establishing connection with a new BTS.

2) Soft handoff: MS establishes connection with a new BTS while maintaining the connection with the existing one.

3) Softer handoff: soft handoff that occurs between different sectors of the same BTS.

Soft handoff technology can improve the rate of handoff success, reduce call drops and effectively improve the system performance.

For more information, please refer to Section 4.5.2 Handoff.

1.4.3 Abis Interface

I. Overview

Abis interface is defined as the interface between BSC and BTS, the two functional entities in the Base Station Subsystem (BSS). It is the interface defined for BTS accessing BSC via the terrestrial link.

1) Composition of Abis interface

Abis interface consists of three parts: Abis traffic, Abis signaling and OML signaling, as shown in Figure 1-5.

Abis traffic is the interface connecting SDU of BSC and the channel processing unit of BTS. It is used to bear user traffic.

Abis signaling is the signaling transmission channel between BSC and BTS. It is used to control the cell setup, transmission of messages in paging channels and access channels, and call setup & release.

OML signaling is used to perform operation and maintenance. It is defined by equipment manufacturers. On Abis interface, there is a transparent channel used to bear OML between OMC and OMU of BTS.

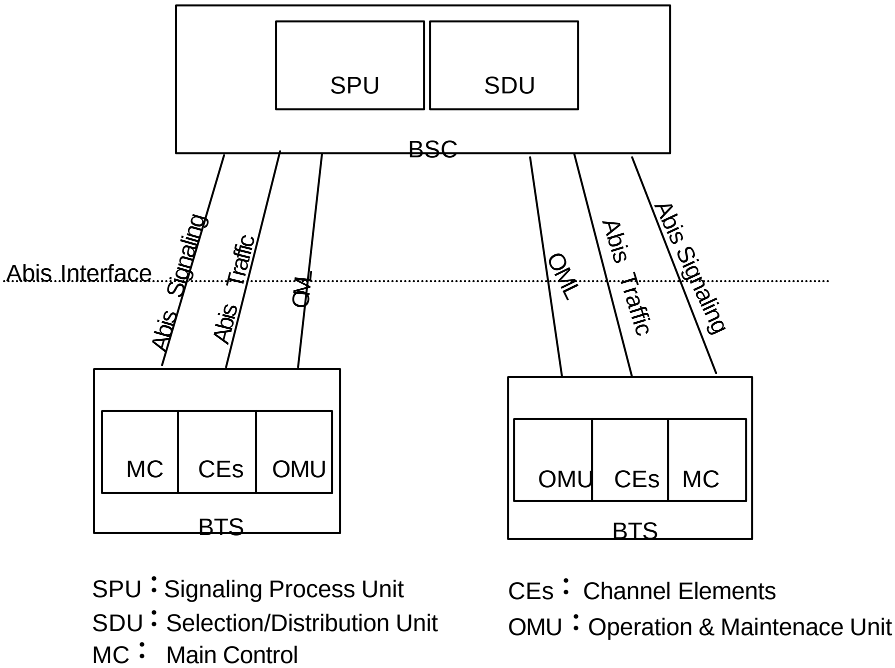


Figure 1-5 Composition of Abis interface

2) Protocol stack of Abis interface

The protocol stack used by Abis signaling and the signaling for operation & maintenance is as follows:

Abis Signaling Application/OAM Application
TCP
IP
AAL5
ATM
Physical Layer

Protocol stack used by Abis traffic is as follows:

Abis Traffic
SSSAR
AAL2
ATM
Physical Layer

II. Physical layer

The physical layer of Abis interface can use E1/T1 interface or STM-1 interface.

With E1/T1 interface used, its physical electric parameters comply with CCITT G.703 recommendations. The multiple E1/T1 trunk lines transmit ATM cells by means of Inverse Multiplexing on ATM (IMA).

III. Data link layer

ATM is used in the data link layer of Abis interface.

Adaptation of Abis signaling is performed on the basis of AAL5, and is borne in IP Over ATM (IPoA) mode. At Abis interface, Abis signaling path connects the main control software (MC) and SPU of BSC via Permanent Virtual Circuit (PVC) to transmit Abis signaling. So it is with the transmission path of signaling that performs operation & maintenance. It also uses PVC to connect OMU of BTS and BSC, which will forward it to OMC transparently. BSC does not process any signaling that performs operation and maintenance.

Adaptation of Abis traffic is performed on the basis of AAL2. At Abis interface, BCPM uses several PVCs to connect the channel processing unit of BTS and SDU of BSC, for BTS to transmit the uplink data received from the air interface to BSC, and for BSC to transmit the downlink data to be transmitted via the air interface to BTS.

IV. Layer 3 - traffic management

At Abis interface, Abis signaling and Abis traffic are in the domain of traffic management. Specifically, Abis traffic management includes the following functions:

1) BTS logic operation & maintenance function

- Resource status indication: with this function, BTS requests logic configuration from BSC, reports logic status to BSC and checks logic resource regularly.
- Cell configuration: with this function, BSC configures logic parameters of cells for BTS, including cell pilot Pseudo Noise (PN) offset, sector gain, common channel number and parameter.
- Overhead message updating: with this function, BSC configures or update overhead message to BTS.

- Cell breath control function.
- Cell blocking function.
- Radio measurement report function.

2) Common channel management procedure

Paging channel management procedure: it is used to transmit paging channel messages from BSC to MSs through Abis interface.

Access channel management procedure: it is used to transmit access channel messages received on the access channel of BTS to BSC through Abis interface.

3) Procedure of dedicated channel setup and release

It is used to control the setup and release of dedicated radio channel and Abis interface terrestrial channel.

Abis interface supports the setup and release of various dedicated channels specified in IS95A/B and cdma2000 1X, specifically including IS95-FCH, IS95-SCCH, IS2000-FCH, IS2000-DCCH and IS2000-SCH.

Each radio channel is allocated with one AAL2 link on Abis interface to bear user traffic data.

Caution:

Softer handoff is only allocated with one AAL2 link on Abis interface.

4) Traffic channel bearing procedure

BTS needs to process Abis interface frame protocol, to transmit the data received from the reverse traffic channel on the air interface to BSC and the data from BSC through the forward traffic channel at the air interface.

Traffic channel bearing procedure also performs functions such as AAL2 traffic matching, time adjustment of traffic data frame, reverse outer loop power control adjustment and forward power control adjustment.

5) Power control

Abis interface supports various power controls. Power control is performed through parameter configuration. Power control falls into 4 types: quick forward closed-loop power control, slow forward closed-loop power control, quick reverse closed-loop power control and reverse open-loop power control.

1.4.4 OML Interface

OML interface is between BTS and remote OMC. It is actually one of the Abis interface applications, but in the application layer, OML interface is between BTS and the remote OMC. OML interface shares resources of Abis interface, including physical layer, ATM, AAL5 and TCP/IP. For details, please refer to the introduction to Abis interface.

OML interface is used for OMC to perform operation and maintenance to BTS. It is defined by equipment manufacturers. On Abis interface, it is a transparent path.

1.4.5 LMF Interface

LMF interface is the interface between BTS and Local Maintenance Function (LMF). Its interface protocol stack is shown as below:

LMF Signaling Application (self-defined)
TCP
IP
Data Link Layer
Physical Layer (10/100 Base-T)

1.4.6 System Synchronization Interface

System synchronization interface includes GPS/GLONASS antenna interface and system external synchronization interface.

1) GPS/GLONASS antenna interface: GPS is in compliance with *ICD200c: IRN-200C-001-IRN-200C-004*: *Interface Control Document of GPS*. GLONASS is in compliance with *GPS/GLONASS Receiver Interface Language (GRIL)*.

2) System external synchronization interface: the external synchronization interface without GPS/GLONASS is in compliance with the requirement of *CDMA Digital Cellular Mobile Communication Network GPS/GLONASS Dual-Mode Receiver and Base Station Interface Specifications.*

1.4.7 BTS Test Interface

BTS test interface provides 10MHz and 2s signals that may be necessary for testers.

1.4.8 Remote Maintenance Serial Port

Remote maintenance serial port is an RS-232 serial port, connected with PSTN via an external Modem. It is used for emergency maintenance by dial-up with a Modem when OML between OMC and BTS is interrupted.

1.4.9 Environment Alarm Interface

Environment alarm interface is an RS-485 serial port connected with the external environment alarm collection box, performing a centralized monitoring to the environment. A communication protocol defined by Huawei is used between BTS and the environment alarm collection box. Therefore, supported environment alarm collection box should be used for the BTS.

1.5 Reliability Design

Reliability design of a system is shown in the stability and reliability of the product during operation.

Huawei cBTS3612 is designed based on reference to the following standards:

- *YD/T 1029-1999 800MHz General Technical Specifications of CDMA Digital Cellular Mobile Communication Network Equipment*
- *YD/T 1030-1999 800MHz Technical Requirement for Interface of CDMA Digital Cellular Mobile Communication Network*
- *TIA/EIA/IS-97D Minimum Performance Standard of CDMA Base Station*
- Huawei product reliability design index and related technical specifications

The design of boards is in strict accordance with the requirement of above standards pertaining to reliability design, with measures taken to improve the reliability. In addition, some key parts of the system are designed with redundancy (such as active/standby mode and resource pool) to improve the reliability of the system.

System reliability indices are:

MTBF: 100000 hours MTTR: 1 hour A : 99.999%

Note:

Reliability refers to the product capability of performing specified functions in the specified conditions and specified time.

There are 3 main indices to describe the reliablity of a system:

MTBF: Mean Time Between Failures, normally applicable to recoverable systems.

MTTR: Mean Time To Repair, inlcuding the time of fault checking, isolation, unit replacement and recovery.

A: Availability, a comprehensive index to measure the system availability.

1.5.1 Hardware Reliability Design

cBTS3612 is designed with substantial hardware reliability, such as board active/standby operation, load sharing and redundancy configuration. In addition, system maintainability is improved with fault detection and isolation technology on the board and system. In respect of hardware reliability, the following considerations have been taken:

I. De-rating design

To improve system reliability and prolong the service life of components, components are carefully selected and strictly tested, and less stress (electrical stress and temperature stress) is to be borne than its designed rating.

II. Redundancy design

Redundant configuration of key units is applied in the BTS system. The system or equipment will not fail unless the specified sets of units fail. In the BTS system, common measures such as active/standby and load-sharing modes are adopted, e.g. for BCIM, BCPM and BCKM.

III. Selection and control of components

The category, specifications and manufacturers of the components are carefully selected and reviewed according to the requirements of the product reliability and maintainability. The replaceability and normalization of components is one of the main factors for the decision, which help to reduce the types of components used and hence improve the availability of the system.

IV. Board level reliability design

Many measures have been taken to improve the board reliability. Moreover, the system reliability is improved through the redundancy design of key parts.

- Key circuits are designed by Huawei, which lays the foundation of high reliability.
- The hardware WATCHDOG is equipped for the board, and the board can automatically reset in case of fault.
- The board is provided with the functions of over-current and over-voltage protection and the function of temperature detection.
- The board also provides emergency serial port, and can keep contact with the main control board in case of emergency.
- Strict thermal analysis and simulation tests are conducted during the design of boards for the purpose of ensuring longtime operation.
- The board software and important data is stored in the non-volatile memory, so that the board can be restarted when the software upgrading fails.

V. Overvoltage and overcurrent protection

The BTS system provides various means of over-voltage and over-current protection.

- Over-voltage and over-current hardware protection is provided for the DC/DC power supply module.
- For secondary power supply to boards, slow-start is employed to prevent the great impact on the whole power supply load when the boards are powered on. Fuse is installed for each board against over-current.
- For E1 interface circuit, serial-port circuit and network interface circuit, protection measures are taken in accordance with the corresponding design specifications of Huawei.

VI. Power supply reliability

The reliability of power supply is improved by means of over-current and over-voltage protection, internal temperature adjustment, and redundancy backup.

VII. Fault detection, location and removal

The BTS system is equipped with the functions of self-detection and fault diagnosis that can record and output various fault information. The common software and hardware faults can be corrected automatically.

The hardware fault detection functions include fault locating, isolating and automatic switchover. The maintenance engineers can identify the faulty boards easily with the help of the maintenance console.

When faults occur to software, certain automatic error-correction function will be executed, including restarting and reloading.

The BTS system also provides manual and automatic re-initialization of different levels, and supports the reloading of configuration data files and board execution programs.

VIII. Fault tolerance

When faults occur, the system usually will not be blocked, as the BTS system provides the E1 connection in conformity with the IMA protocol, and has certain line backup capabilities.

The boards of important devices in the system have been backed up, ensuring that the BTS system can switch the service from the faulty board to a normal board, or perform reconfiguration of the system.

The system will make a final confirmation on a hardware fault through repeated detection, thus avoiding the system reconfiguration or QoS deterioration due to contingent faults.

IX. Thermal design

The influence of temperature on the BTS system has been considered in the design of the system. Thermal design primarily concerns the selection of components, circuit design (including error tolerance, drift design and derating design), structure design and heat dissipation, so that the BTS system can work reliably in a wide range of temperatures.

The first consideration in thermal design is to balance the heat distribution of the system. Corresponding measures are taken in the place where heat is more likely to be accumulated.

X. Maintainability

The purpose of maintainability design is to define the workload and nature of the maintenance, so as to cut the maintenance time. The main approaches adopted include standardization, modularization, error prevention, and testability improvement which can simplify the product maintenance work.

XI. EMC design

The design ensures that cBTS3612 will not degrade to an unacceptable level due to the electromagnetic interference from other equipment in the same electromagnetic environment. At the same time, cBTS3612 will not cause other equipment in the same electromagnetic environment to degrade to an unacceptable level due to the EMI from it.

XII. Lightning protection

To eliminate the probability of lightning damage on the BTS system, proper measures are taken in the following three aspects:

- Lightning protection for DC power supply
- Lightning protection for BTS trunk lines
- Lightning protection for antenna and feeder system

For details, please refer to "2.7 Lightning Protection System".

1.5.2 Software Reliability Measures

Software reliability mainly includes protection performance and fault tolerance capability.

I. Protection performance

The key to improve software reliability is to reduce software defects. Software reliability of BTS is ensured in the whole process from system requirement analysis, system design to system test.

Starting from the requirement analysis, software development process goes under regulations such as CMM (Capability Mature Mode), which aim to control faults in the initial stage.

In software design, much attention is devoted to the designing method and implementation: the software is designed in a modular structure, and in a loose coupling mechanism. When a fault occurs to one module, other modules will not be affected. In addition, preventive measures such as fault detection, isolating and clearing are also important in improving the system reliability. Other effective methods include code read-through, inspection, and unit test.

Various software tests are necessary to improve the software reliability. Test engineers participate the whole software develop process, from unit test to system test. They make plans strictly compliant with the demand of the upper level flow, which ensure the improvement of software reliability. Additionally, test plans are improved with the tests and become more and more applicable.

II. Fault tolerance capability

Fault tolerance capability of the software system means that the whole system would not collapse when a minor software fault occurs, i.e. the system has the self-healing capability. The fault tolerance of software is represented in the following aspects:

- All boards work in a real-time operating system of high reliability.
- Important data on BCKM are backed up on real-time basis. Operation is switched to the standby board when a fault occurs.
- When a fault occurs to some transmission links, traffic borne on them can be transferred to other links smoothly.
- Each board's software on the board has a static backup on BCKM.
- If software loading fails, the system can return to the version that was loaded successfully last time.
- Important operations are recorded in log files.
- Different authority levels are provided for operations, to prevent users from performing unauthorized operations.
- Prompts are given for the operations that will cause system reboot (such as reset operation), which requests the operator to confirm it before executing such operation.

2 Hardware Architecture

The beginning of this chapter briefs cBTS3612 hardware architecture, followed by the details of four subsystems: baseband, RF, antenna & feeder, and power supply system. This chapter also covers BTS environment monitoring and lightning protection systems.

2.1 Overview

In cdma2000 1X mobile communication system, BTS functions as a radio relay. One end is connected with MS through Um interface and the other end connected with BSC through Abis interface.

The architecture of BTS is as shown in Figure 2-1.

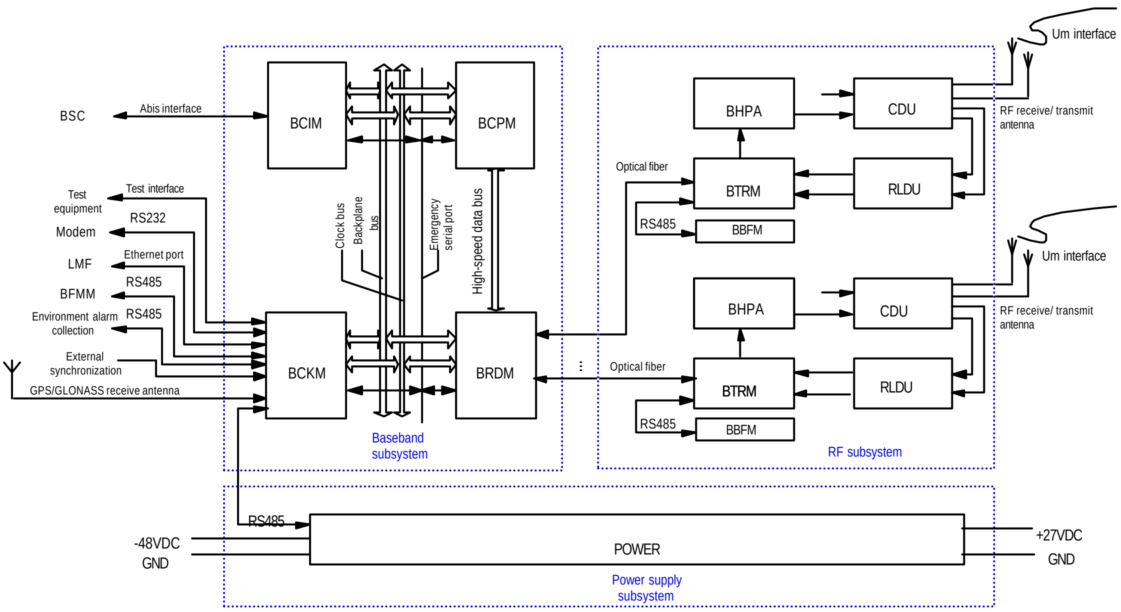


Figure 2-1 BTS architecture

📖 **Note:**

In Figure 2-1, the duplexer is CDU, and actually the right duplexer should be selected according to the band class BTS supported. CDU applies to 800MHz band and 450MHz band, DFU applies to 450MHz band, and DDU applies to 1900MHz band, as for the difference between the CDU, DFU and DDU, please refer to "2.3 RF Subsystem".

BTS is mainly composed of baseband subsystem, RF subsystem, antenna & feeder subsystem (which comprises RF receive/transmit antenna and GPS/GLONASS receive antenna) and power supply subsystem. Baseband subsystem in physical structure also carries a clock synchronization unit, receiving GPS/GLONASS clock and providing system time, synchronous clock and frequency reference.

I. Baseband subsystem

The main functions of baseband subsystem are: processing Abis interface protocol, modulating/demodulating baseband data, channel encoding/decoding, processing protocols of physical layer and MAC layer on air interface, system operation/maintenance and connecting baseband data optical interface of RF module.

Baseband subsystem is located in the BTS baseband subrack. It consists of BTS Control & Clock Module (BCKM), BTS Resource Distribution Module (BRDM), BTS Channel Processing Module (BCPM), BTS Control Interface Module (BCIM) and CDMA Baseband Backplane Module (CBKM). Functions of all boards are highlighted as follows:

1) BCKM

At most 2 BCKMs are configured in hot standby. BCKM receives GPS signals (or other synchronization satellite signals), generates local clock and provides time signals 16×1.2288MHz, 10MHz, PP2S for the boards in the system. This is mainly the responsibility of the clock module of BCKM. Besides clock signal, BCKM also provides main control function for channel resources. Its MPU module performs a number of operations and functions such as resource management, equipment management, performance monitoring, configuration management, software downloading, MPU active/standby switchover, operation & maintenance (O&M), environment monitoring interface, as well as board control inside the system.

2) BRDM

BRDM is logically located between BTRM and BCPM. The data sent by BTRM module are sent to BRDM via the optical fiber. Then BRDM distributes the data before sending them to BCPMs via the high-speed data bus. BRDM can also build daisy chains for BCPMs. The BRDM connects via the shorter daisy chain provided to BCPM to form a standard daisy chain, which helps to improve the utilization ratio of channel resource and facilitates the flexible configuration of channel capacity for each sector carrier. BRDM exchanges O&M information with BCKM through the backplane bus. The emergency serial port of BRDM is attached on the UART of the backplane as a standby node.

3) BCPM

BCPM processes BTS baseband signals, both for the forward traffic and reverse traffic. For forward traffic, it performs functions such as encoding (convolutional code, TURBO code), interleaving, spectrum spreading, modulation and data multiplexing. For reverse traffic, it performs functions such as demultiplexing, demodulation, de-interleaving and decoding (convolutional code, TURBO code). Regarding the user data flow, BCPM is between BRDM and BCIM.

4) BCIM

BCIM transfers data between BTS and BSC, including voices, data and O&M commands. With the Inverse Multiplexing on ATM (IMA) technology, BCIM multiplexes the BTS uplink data to IMA link set that is composed of multiple E1s, and then transmits it to BSC via coaxial or optical fiber. Inversely, it can also demultiplex the IMA link set signals from BSC into an ATM cell flow and transmit it to BTS boards via the backplane bus.

5) CBKM

CBKM performs interconnection of high-speed data links between boards in the baseband part and the interconnection of various management and control signals of boards.

II. RF subsystem

BTS RF subsystem is composed of five parts: BTS Transceiver Module (BTRM), BTS High Power Amplifier Module (BHPA), BTS Transceiver Backplane Module (BTBM), Duplexer Unit and Receive LNA Distribution Unit (RLDU). Functions of all parts are briefed as follows:

1) BTRM

BTRM consists of BTS Intermediate Frequency Unit (BIFU), and BTS Radio up/down-conversion Unit (BRCU). Its functions are as follows:

BIFU: BIFU performs such functions as A/D conversion in the reverse receiving path and D/A conversion in the forward transmitting path, digital frequency up/down -conversion, received signal filtering, baseband molded signal filtering, Digit Automatic Gain Control (DAGC), uplink & downlink RF Automatic Gain Control

(AGC), multiplexing/demultiplexing of forward & reverse orthogonal (IQ) signals, clock recovery and RF module operation & maintenance.

BIFU also performs the control over BTRM, including power-on initialization, function configuration, alarm collection and reporting, and processing of O&M related messages.

BRCU: BRCU is composed of 5 logic functional units: main/diversity transmit unit, main/diversity receive unit and frequency source unit.

- Transmit unit realizes analog up-conversion and spurious suppressed filtering for transmitted signals output by BIFU.
- Main/diversity receive unit realizes analog frequency down-conversion, channel selective filtering and received nose coefficient control for BTS main/diversity received signals output by RLDU.
- Frequency source unit is responsible for the synthesis of the low phase noise, high-stability local oscillation signals that are necessary for the analog frequency conversion in transmit and receive paths.

2) BHPA

BHPA performs high power linear amplification for a transmitted carrier signal, checks its own working status in real time and generates alarm. It is composed of main signal power amplification unit and signal detection alarm unit. Signal detection is to check whether the input is too excited, whether the temperature is too high or whether the gain is lowered strikingly (device failure).

3) BTBM

BTBM performs structure support and signal communication between BTRM and BHPA.

4) Duplexer Unit

There are following three types of Duplexers. They can be configured according to actual requirements.

Combiner and Duplexer Unit (CDU): combining and filtering of two transmitting carriers, transmitting and receiving signals duplexing and isolating, and diversity receiving signal filtering. CDU operates at 800MHz band and 450MHz band.

Duplexer and Filter Unit (DFU): transmitting and receiving signal duplexing, isolating and filtering of one channel, diversity receiving signal filtering. DFU operates at 450MHz band.

Dual Duplexer Unit (DDU): transmitting and receiving signals duplexing, isolating and filtering of two channels, It does not provide combining function. DDU operates at 1900MHz band.

6) RLDU

RLDU performs low noise amplification and division of the receiving signals, providing standing wave alarm and forward power checking voltage output, checking the physical connection of the antenna port and monitoring whether the output of BRCU, BHPA signals is normal.

III. Antenna & feeder subsystem

BTS antenna & feeder subsystem includes two parts: RF antenna & feeder and dual-satellite synchronization antenna & feeder. The former mainly transmits the modulated RF signals and receives MS information while the latter provides precise synchronization for CDMA system.

IV. Power supply subsystem

Power supply subsystem consists of power input component (EMI filter, lightning arrester of power supply), high power DC/DC power supply module, power distribution box, medium/low power DC/DC power supply module for boards (or modules).

The power supply subsystem provides power for the whole BTS.

2.2 Baseband Subsystem

2.2.1 Overview

The baseband subsystem is one of the major parts of BTS. Its structure is shown in Figure 2-2.

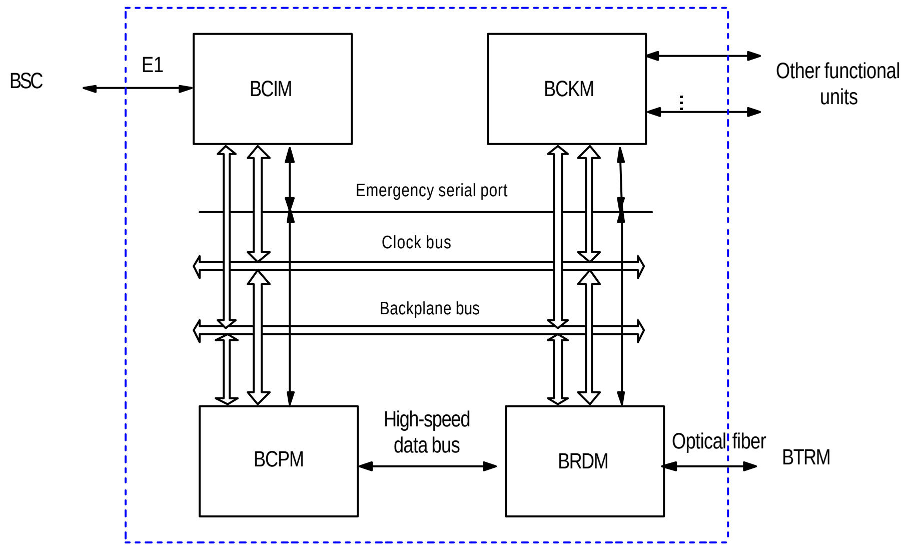


Figure 2-2 Structure of baseband subsystem

Baseband subsystem is connected with BSC through Abis interface provided by BCIM. The transmission in this subsystem is performed through E1 trunk (The coming version will provide STM-1 optical transmission). BRDM and BTRM are connected by optical fiber to support RF module extended afar mode.

Baseband subsystem also provides some other interfaces through BCKM:

- LMF interface: 10/100 Base-T interface, connecting Local Maintenance Function (LMF).
- Remote maintenance serial port: The interface is an RS232 serial port, connected with PSTN via an external Modem. When OML between OMC and BTS is interrupted, maintenance can be performed through telephone line dial-up connection.
- GPS/GLONASS antenna interface: It is used to receive clock signal from GPS/GLONASS.
- System external synchronization interface: When GPS/GLONASS is not available, it makes the system clock synchronized with external clock.
- Fan module interface: It is connected with fan module through RS485 serial port, monitoring the fan module.
- Environment alarm interface: It is connected with an external environment alarm collection box, providing environment monitoring alarm information of the equipment and monitoring information of the primary power supply.
- Power monitoring interface: It is connected with power supply module, reporting various alarm information of the power supply.
- Test interface: It is an interface for BTS test, providing 10MHz and 2s signals.

Baseband subsystem is physically located in the baseband subrack, powered by power supply subsystem (in the power subrack). Boards generate their own 3.3V, 1.8V power through the distributed power supply module.

The configuration of baseband subrack (including board position) is as shown in Figure 2-3.

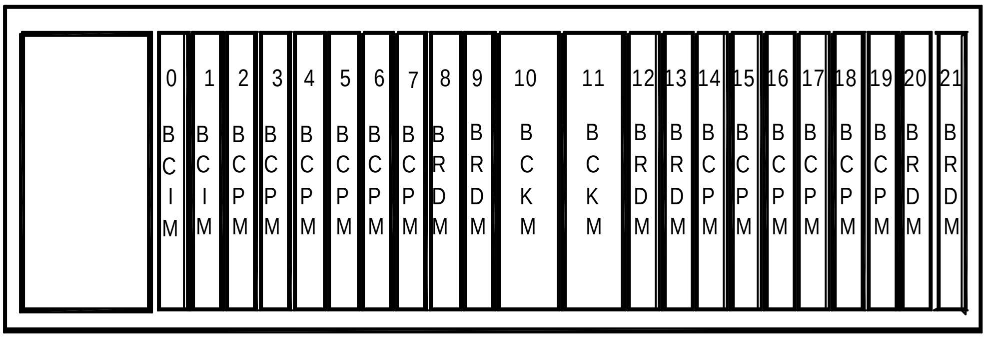


Figure 2-3 Baseband subrack configuration

Baseband subrack supports the following boards:

- BCIM: BTS control interface module, to be inserted in E1 interface slot, providing Abis interface for connection with BSC and supporting E1/T1 transmission. In the coming version, BCIM slot can also accommodate BEOM (BTS Electric-Optical Module) to support STM-1 optical transmission.
- BCPM: BTS channel process board, processing the data of CDMA forward channel and reverse channel.
- BRDM: BTS resource distribution module, connecting BCPM and RF module, realizing the control of resource pool for BCPM.
- BCKM: BTS control & clock board, providing clock for BTS system and realizing the control of BTS system resource.

2.2.2 Control & Clock Module (BCKM)

I. Overview

BCKM is located in the baseband subrack of BTS. BCKM performs two major functions: main control module (MPU, Main Processing Unit) and clock module (CLK, Clock) functions. Here MPU performs Abis interface signaling processing, O&M management, while CLK provides reference clock signals for the whole BTS system.

Main functions of BCKM:

- MPU module provides BTS system with a hardware control platform, on which the operating system and system software are running to implement control and management tasks of BTS system.

- Perform operation and maintenance via the backplane bus for other boards in the baseband subrack, realizing in-band signaling communication.
- Connected with Local Maintenance Function (LMF) through the 10/100M compatible Ethernet interface.
- The active/standby asynchronous serial port serves as a path for out-band signaling backup. MPU functions as the main node and other boards function as the standby nodes. When a fault occurs to the in-band signaling path, signaling communication can be maintained with this standby path.
- Provide an interface connected with Modem in compliance with RS232 serial communication standard, realizing remote maintenance and monitoring in case of OML link failure.
- Connected with an external monitoring module in compliance with RS485 standard, collecting and processing the equipment room environment information (such as fire alarm/water soaking/temperature/humidity).
- CLK unit is the clock source of BTS system, providing working clock for all boards. It provides high precision oscillation clock and can be synchronized with an external clock (such as GPS clock).
- BCKM provides active/standby switchover function, working in active/standby mode in the system. When a fault occurs to the active BCKM, the standby BCKM is switched to active status under the control of specific software. A fault occurring to either MPU or CLK module of the BCKM will result in the switchover of the whole BCKM.

II. Structure and principle

The structure of BCKM module is as shown in Figure 2-4.

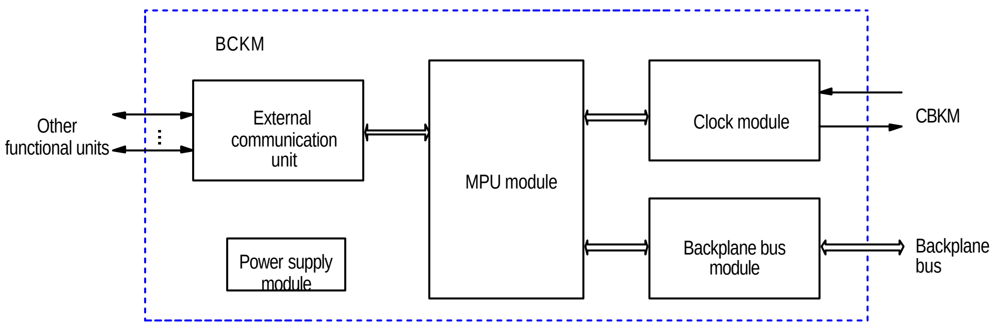


Figure 2-4 Structure of BCKM module

BCKM comprises the following parts:

1) MPU module

MPU controls logic circuits to initialize components. It realizes control and management over BTS system through system software.

2) Clock module

Clock module is the clock source of BTS, providing working clock for boards. Clock module is available in two modes: external synchronization mode (locked mode) and free oscillation mode (holdover mode). The clock module can provide high-precision oscillation clock (voltage control constant temperature crystal oscillator) or be synchronized with external clock source (GPS, GLONASS, external synchronization equipment).

3) Backplane bus module

The communication port of the Central Processing Unit (CPU) is connected with other boards of BTS through the backplane bus module, processing or transmitting O&M signaling from other boards of BTS (BRDM, BCPM and BCIM).

4) External communication module

External communication module utilizes the multiple communication control ports provided by the main control CPU to implement functions such as LMF interface, external monitoring module interface, debugging interface, and out-of-band signaling serial port.

5) Power supply module

BCKM includes two isolated secondary power supply modules, converting +27V voltage into +5V, +3.3V and +2.5V for various modules of local board.

III. Interface

- LMF interface (10/100 Base-T)
- Remote maintenance serial port (RS232)
- Environment alarm interface (RS485)
- GPS/GLONASS antenna port
- 2s and 10MHz test port
- Inter-board interface, and interfaces with other boards in the baseband subrack.

IV. Index

The board size is 460mm×233.35mm, powered with +27V, power consumption <20W.

2.2.3 Control Interface Module (BCIM)

I. Overview

BCIM is located in BTS baseband subrack. It is a functional entity for the connection of BTS and BSC. Its major functions are as follows:

- In uplink direction, backplane bus receives O&M command from BCKM and traffic data from BCPM, and transmit ATM cells on the multiple E1 links with IMA technology in compliance with G.804 standards to BSC.
- In downlink direction, it receives ATM cells distributed on the multiple E1 links from BSC, multiplexes them into a single ATM cell flow with IMA technology and finally sends them to corresponding processing boards through the backplane bus.
- Each BCIM provides 8 E1 links, which can support at most 4 IMA link sets. In BTS, there are two BCIMs, providing physical interfaces to BSC in load sharing mode. At most 16 E1 links can be provided.
- It communicates with BSC through IMA state machine program on the local board, and monitors the working status of E1 link and ensuring the implementation of IMA protocol.
- It transmits O&M command through backplane bus or out-band signaling serial port, reports the status information of the local board to BCKM and provides interface for board maintenance and network management.

II. Structure and principle

The structure of BCIM is as shown in Figure 2-5.

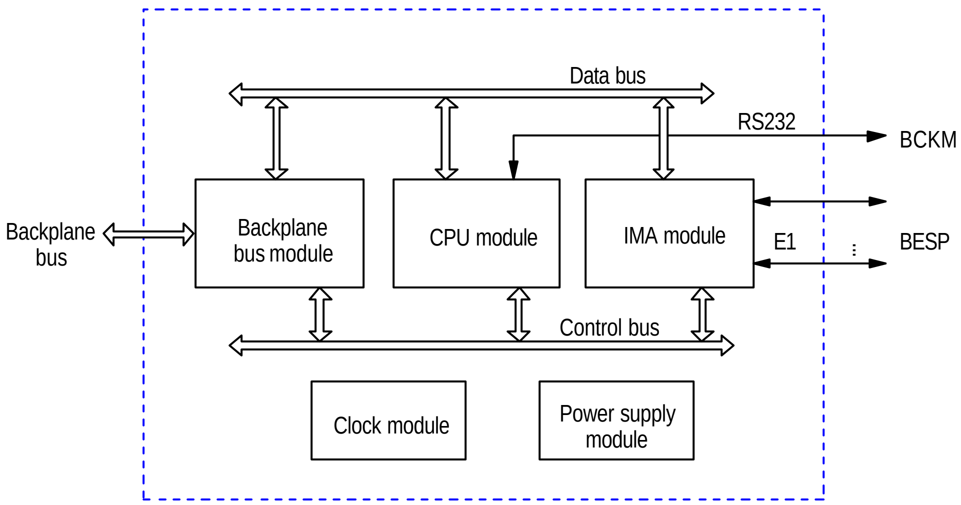


Figure 2-5 Structure of BCIM module

BCIM comprises the following parts:

1) IMA module

The purpose of IMA is to inversely multiplex an ATM cell flow based on cells into multiple physical links for transmission. Another purpose is to remotely multiplex the cell flows transmitted on different physical connections into a single ATM cell flow.

In uplink direction, IMA module receives AAL2 traffic cells from BCPM and AAL5 signaling cells from BCKM through the backplane bus. It splits the ATM cell flow into cells, transmits them on multiple E1 link according to G.804 standard before sending them to BSC.

In downlink direction, it receives ATM cells from BSC that are distributed on multiple E1 trunk lines, inversely multiplexes them into a single ATM cell flow. Then it sends AAL2 traffic cells to BCPM and AAL5 signaling cells to BCKM through the backplane bus

2) CPU module

The main control CPU on BCIM implements such functions as initialization of devices on BCIM, IMA protocol processing, executing OAM function of IMA, as well as E1 trunk line management and communication with BCKM.

3) Backplane bus module

BCIM communicates with other boards in the baseband part through the backplane bus module, including control information communication with BCKM and traffic data communication with BCPM.

4) Power supply module

The power supply module implements DC/DC power conversion from +27V to 3.3V.

5) Clock module

It provides working clock for the local board.

III. Interface

- E1 interface

Interface with BSC

- Backplane bus interface

Interface with other boards in the baseband part.

- RS-232 serial port

As an emergency serial port, it is connected with UART as a standby node, used for communicating with BCKM when other part of the board is faulty.

IV. Index

The board size is 460mm×233.35mm, powered with +27V, power consumption<10W.

2.2.4 Channel Processing Module (BCPM)

I. Overview

BCPM is logically located between BRDM and E1 interface board on BTS. BCPM is the service processing board of the system with 12 equipped in full configuration. Data of various forward channel traffic and reverse channel traffic are processed by this board. BCPM also processes digital signals, including encoding/decoding baseband signals and one-time modulation and demodulation of baseband signals. In addition, it processes high layer control signals. The main functions are as follows:

- In forward direction, after ATM cell data from the network side are processed by the high performance processor, BCPM performs functions such as encoding (convolutional code, TURBO code), interleaving, spread spectrum, modulation and data multiplexing, and converts them into high-speed signals. Then the signals are processed by a dedicated processing chip and transmitted through the radio interface side of the channel processing board.
- In reverse direction, data received by BCPM are demultiplexed, demodulated, de-interlaced and decoded (convolutional code, TURBO code). Then under the control of the high performance processor, the data are sent to BSC via E1 interface in the form of ATM cells.
- BCPM supports in-board and inter-board daisy chains, forming a resource-processing pool.
- High performance processor, two kernels, internal cache, level-2 cache can be attached externally at the same time to improve processing capacity.

II. Structure and principle

BCPM module comprises the following parts as shown in Figure 2-6:

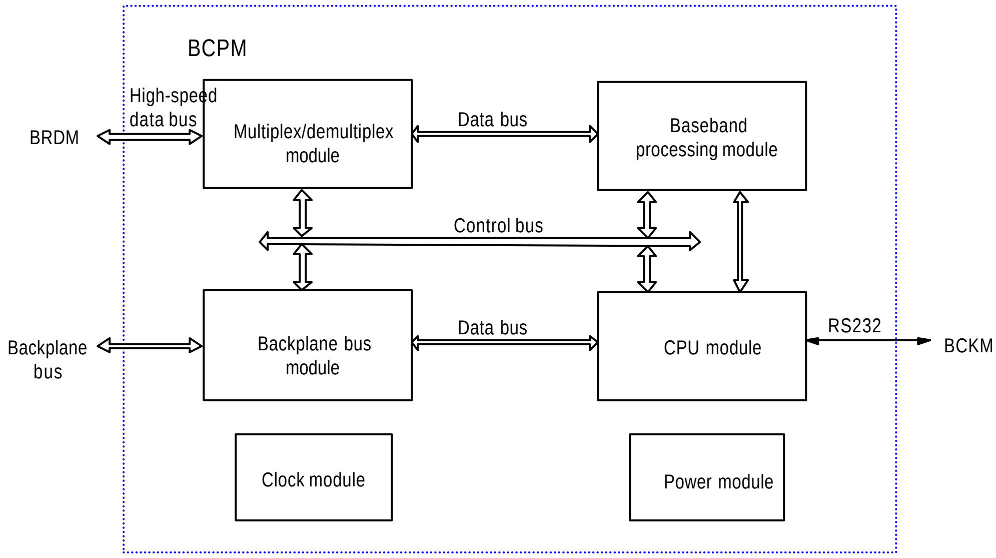


Figure 2-6 Structure of BCPM module

1) Multiplex/demultiplex module

In forward direction, baseband data in the channel processing board are multiplexed into high-speed signals and sent to radio side in the form of differential signals. In reverse direction, the high-speed differential signals are demultiplexed and sent to baseband processing chip.

2) Baseband processing module

The QUALCOMM new generation processing chip is used to perform forward and reverse baseband data processing. With the help of in-board and inter-board data daisy chains, channel processing capability is increased greatly. Maximal 6 sectors can be supported.

3) CPU module

The high performance control CPU on BCPM mainly processes the forward & reverse high-speed traffic data and control data and reports board status. At the network side, the processing module receives control signaling, receives/transmits ATM cells and communicates with BSC through E1 interface. At the radio side, it controls the dedicated baseband processing chip to generate orthogonal (IQ) data. After multiplexing, the data pass BRDM as high-speed differential signals, to implement data exchange with radio side.

4) Backplane bus module

BCPM communicates with other boards in the BTS baseband part through backplane bus, including control information communication with BCKM and traffic data communication with E1 interface board.

5) Clock module

The clock module performs double-frequency phase-locking to the clock signals from the backplane, provides clock for boards, and drives and co-phases the clock signals generated on the local board, to get satisfactory clock signals.

6) Power supply module

It performs DC/DC power conversion from +27V to 3.3V.

III. Interface

- High-speed data bus interface

Interface with BRDM.

- Backplane bus interface

Interface with other boards of baseband part

- RS232 serial port

As an emergency serial port, it is connected with UART as a standby node, used for communicating with BCKM when other part of the board is faulty.

IV. Index

The board size is 460mm×233.35mm, powered with +27V, power consumption <30W.

2.2.5 Resource Distribution Module (BRDM)

I. Overview

BRDM is logically located between BTRM and BCPM, providing path for orthogonal data connection (IQ) and exchange between the two so as to support the flexible configuration relation between BCPM and BTRM. BRDM also support daisy chain cascading between BCPMs.

Data from BTRM are sent to BRDM through optical fiber. BRDM distributes the data before sending them to BCPMS via the high-speed data bus. BRDM can also build daisy chains for BCPMs. BRDM connects via the short daisy chain provided to the BCPM to form standard daisy chain. This can help to improve the utilization ratio of channel resource and facilitates the flexible configuration of the channel capacity of each sector carrier.

BRDM has the following functions and features:

- Six pairs of optical interfaces provide high-speed data paths to BTRM.
- When it is necessary to extend optical interfaces, BRDM board can be inserted in BCPM slot.
- 16 pairs of high-speed data bus interfaces are prvoded for connection with 16 BCPM slots through the backplane.
- Flexible data distribution and exchange between BTRM and BCPM are enabled.
- Flexible data exchange between BCPMs is enabled. It can be cascaded to form daisy chains, so BCPM resource pool can be achieved. Resource pool improves the utilization ratio of channel resource and makes the configuration of channel capacity of each sector carrier flexible.
- It exchanges O&M information with BCKM through the backplane bus or emergency serial port.
- It forwards and receives O&M information of BTRM via optical fiber and provides O&M link between the baseband subrack and BTRM.

II. Structure and principle

The structure of BRDM module is as shown in Figure 2-7.

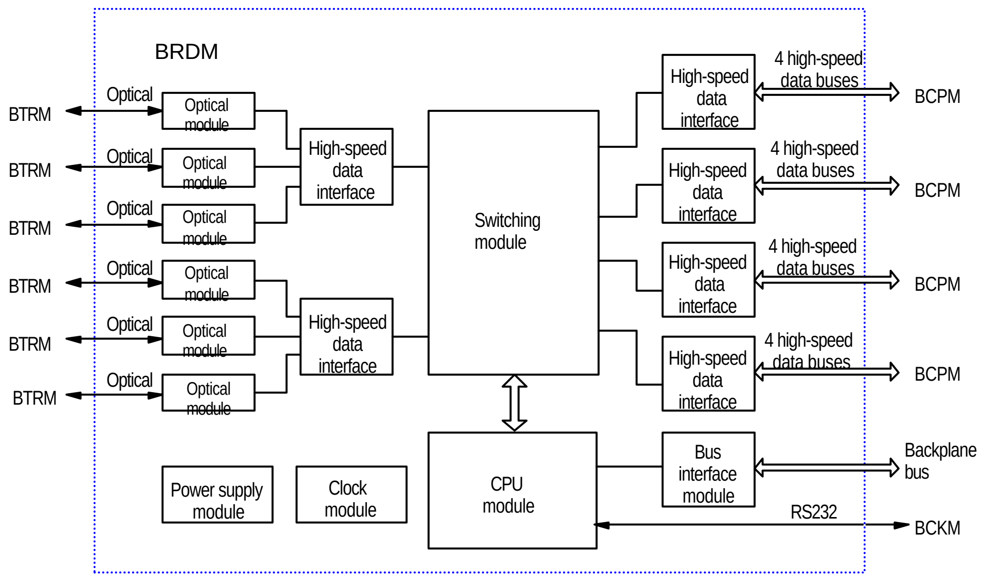


Figure 2-7 Structure of BRDM module

As shown in Figure 2-7, BRDM board is composed of optical module, high-speed data interface module, switching module, CPU module, bus interface module, power supply module and clock module.

- Optical module

This module converts optical signal into electrical signal.

BRDM can be classified into single-mode BRDM and multi-mode BRDM according to different type of optical module. The single-mode BRDM can be further classified into two kinds, namely 10km and 70km, according to the transmission capability of the optical module.

The multi-mode BRDM is used to connect with BTRM in the cabinet, while the single-mode BRDM is used to cascade SoftSite (ODU3601C).

Equipped with 6 optical modules, the multi-mode BRDM provides 6 pairs of optical fiber ports. Equipped with 3 optical modules, the single-mode BRDM provides 3 pairs of optical fiber ports.

- High-speed data interface module

High-speed data interface module mainly performs rate conversion of high-speed signals, for the convenient processing of the switching module.

- Switching module

Switching module segments and paste data as required. It is a core processing module of this board. Data from BTRM are sent to this board, where the switching module will distribute and paste them before sending to BCPM. The switching module can also provide daisy chain cascading for the BCPMs through the distribution and pasting of data.

- CPU module

CPU module processes O&M information and configures switching parameters. The O&M information from BCKM is sent to this board via the bus interface module. Then CPU module processes the information and sends the necessary O&M information to the corresponding BTRMs. The parameters of the switching module should also be configured by CPU module.

- Bus interface module

This module performs conversion of interface between the board and the backplane, and provides a path for the O&M information between this board and the backplane.

- Power supply module

This module converts the input DC +27V power into digital +3.3V, +1.8V and analog +3.3V powers for the modules on the local board.

- Clock module

The clock module provides 2S, 16×1.2288MHz, 100×1.2288MHz clocks for the local board.

III. Interface

- Optical interface

They are on the front panel, 6 pairs altogether. They are connected with BTRMs, transmitting orthogonal (IQ) data and O&M information.

- High-speed data interface

The interfaces are connected with 16 service slots through the backplane, for transmitting orthogonal (IQ) data.

- Backplane bus interface

It is used for transmitting O&M information between the BCKMs.

- Clock interface

It is connected with BCKM via the backplane. It receives 2S, 16 ×1.2288MHz clock signals and clock active/standby selection signal.

- RS232 serial port

As an emergency serial port, it is connected with UART as a standby node, used for communicating with BCKM when other part of the board is faulty.

- Power interface

Led out from the power connector on the backplane, the interface is connected with +27V power, +27V power ground and PGND.

IV. Index

The board size is 460mm×233.35mm, powered with +27V, power consumption<45W.

2.2.6 Baseband Backplane Module (CBKM)

I. Overview

CBKM is used to make interconnection of high-speed data links among the boards of baseband part, and exchanges various management and control information of boards with high-speed backplane technology.

Specifically, the backplane:

- Realizes interconnection of various signals between boards.
- Supports hot plug/unplug of all boards.
- Supports active/standby switchover of BCKM.

- Leads in system power and provides distributed power to all boards.
- Leads in the signal monitoring line for fan subrack and power subrack.
- Provides protection against misplug.

II. Structure

Functional units in CBKM are as shown in Figure 2-8.

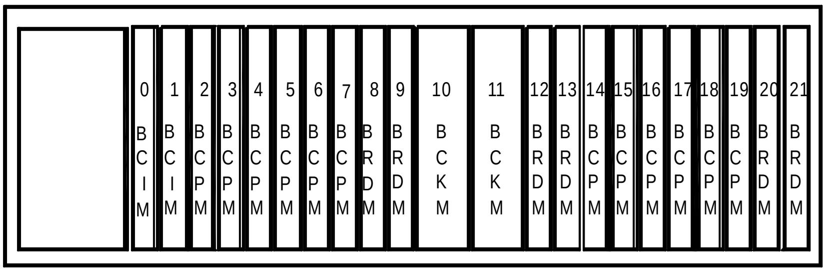


Figure 2-8 Functional units of all slots in CBKM

A backplane includes the connector and board slot.

Connector part includes a slot for test board, input connector of backplane +27V power/ground, and 3 DB37 D-connectors. Power input connector, D-connector are all crimped devices.

Slots of the backplane are defined as follows:

- Slots 0~1 are for BCIMs.
- Sots 10~11 are for BCKMs.
- Slots 8~9, 12~13, 20~21 are for BRDMs.
- Slots 2~7, 14~19 are for BCPMs.

III. Interface

The interfaces between the backplane and external devices include:

- System power interface
- Remote maintenance serial port
- Environment alarm interface
- Fan alarm serial port in baseband subrack
- System external synchronization interface
- 16 E1 interfaces

IV. Index

CBKM size: 664mm×262mm.

2.2.7 E1 Surge Protector (BESP)

I. Overview

BESP is placed in the upper part of BTS. It is a functional entity for BTS to implement lightning protection with E1 trunk line. Two identical BESPs are installed for each cabinet in consideration of limited space on top of the equipment and the convenience of installation and dismounting. The 8 pairs of lightning protection units are used to discharge the transient high voltage on the sheath and core of E1 trunk line to PGND.

II. Structure and principle

Board structure is as shown in Figure 2-9.

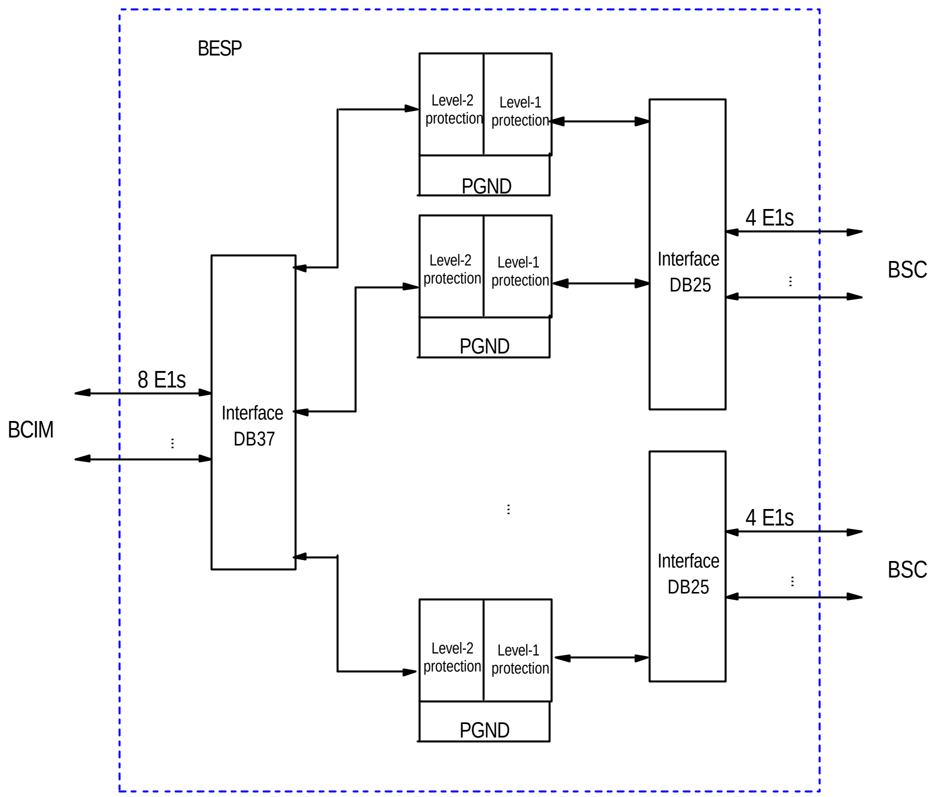


Figure 2-9 Structure of BESP

The board consists of three parts: DB25 connector, lightning protection unit and DB37 connector.

When the BTS E1 trunk line is struck by the lightning, high voltage will arise first on DB25. The high voltage will spread to the lightning protection units. The lightning protection units have two protection levels: air discharge tube and voltage limit mesh.

The air discharge tube discharges the high voltage to the ground and lowers the voltage to less than 600V. Then the voltage limit mesh further lowers the voltage to less than 30V.

III. Interface

- E1interface

Interface with BSC (DB25).

Connection with BCIM (DB37)

IV. Index

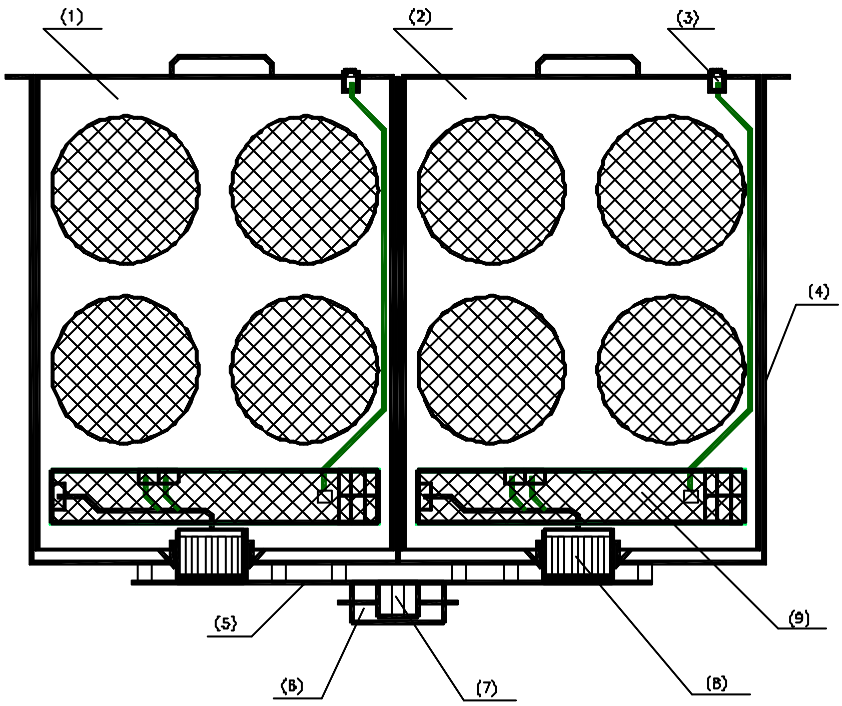
Board size: 140mm×120mm

Bearable surge current: >10kA (common mode), >5KA (differential mode)

Output residual voltage: <30V.

2.2.8 Fan Module (BFAN)

BFAN is installed right under the baseband subrack, serving as a part of the blower type cooling system of the baseband subrack. The fan module consists of two fan boxes, each of which has 4 fan units (24V DC brush-free fan), and one BTS Fan Monitor Module (BFMM). Fan enclosure is used for installation of fan boxes. The outside of the fan enclosure is the BTS Fan Block Interface Board (BFNB) that provides a system interface. The structure of BFAN is as shown in Figure 2-10.



(1) Fan box 2	(2) Fan box 1	(3) LED indicator
(4) Fan enclosure	(5) BFNB	(6) System signal interface
(7) Power input interface	(8) Blind mate connector	(9) BFMM

Figure 2-10 Structure of BFAN

I. BTS Fan Monitor Module (BFMM)

1) Overview

BFMM is built in the fan box. It communicates with BCKM and receives instructions from BCKM. It can perform PWM speed adjustment on the fan units and report board status information to BCKM when it is queried. BFMM can guarantee a safe and proper cooling system and lower system noise. Its main functions are as follows:

- Control rotating speed of the fans.
- Check whether fan units are in position and report their information.
- Check and report fan unit blocking alarm.
- Drive fan operating status indicator.
- Communicate with the Main Control Unit (MCU) of BCKM and report in-board status information.

2) Structure and principle

BFMM's position is as shown in Figure 2-10. Its function is as shown in Figure 2-11.

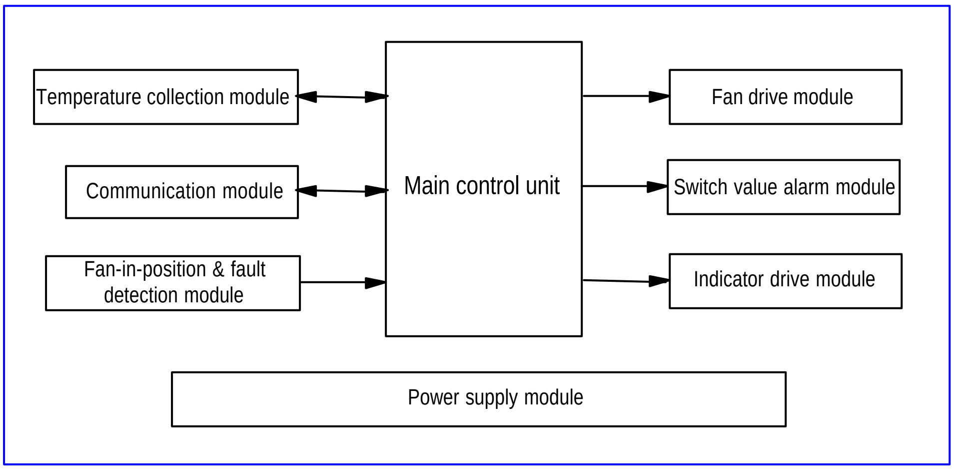


Figure 2-11 Illustration of BFMM

- Power supply module:

System input DC power is +27V, board power consumption is less than 5W.

- Main Control Unit (MCU):

MCU controls the fans and communicates with BCKM. Specifically, it generates control PWM signal according to the instruction sent from BCKM to control the speed of fans. MCU can also detect fan alarm signal and in-board logic alarm signal, and report them to BCKM. It generates panel indicator signal.

- Communication module:

It performs serial communication with BCKM.

- Fan driving module:

PWM control signal generated in MCU provides controlled power input for fans by isolating driving circuits.

- Fan in position and fault detection module:

This module isolates the fan-in-position signal and fan blocking alarm signal, then convert them into logic level for MCU to sample and analyze.

- Temperature collection module:

The module collects the ambient temperature information of BFMM in real time, which is realized by MCU in query operation.

- Indicator driving module:

When functional alarm (such as communication interruption in main control mode) occurs to the board or fan blocking alarm occurs to the motor, this module provides LED optical alarm interface inside the fan block, to drive the LED indicator on the fan block front panel.

3) Interface

- Power interface

It is used to lead in working power for BFMM.

- Communication serial port 0, 1

Serial port communication ports 0 and 1 provide access for system active/standby serial port. When the system has only one serial port, only port 0 is used.

- LED indicator driving output interface

This is the driving interface for LED status indicator on the panel of the fan box.

- Fan unit driving interface

Maximally 6 such interfaces are provided. They also serve as the interfaces for fan-in-position detection and fan blocked detection.

4) Index

The size of BFMM: 280mm×35mm.

+27V power supply, power consumption <5W.

II. BTS Fan block iNterface Board (BFNB)

1) Overview

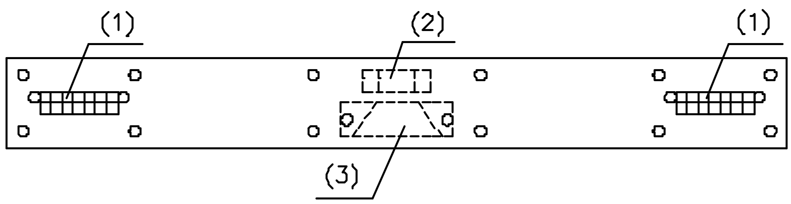
BFNB provides electrical connection between the fan box and the system. On one hand, it provides blind mate interface for the fan box. On the other hand, it provides the system with power interface and serial communication interface.

2) Structure and principle

BFNB's position is shown in Figure 2-10.

BFNB implements interface conversion function. Refer to "3) Interface" for the definition of interface.

BFNB's structure is shown in Figure 2-12.



(1) MOLEX connector (2) Large 3PIN power socket (3) DB-15 signal socket

Figure 2-12 Illustration of BFNB structure

3) Interface

- Fan box electrical interface

Power supply ports and serial port communication ports are provided for the two fan boxes through MOLEX connectors.

- System power supply interface

The interface leads in system power through big 3-pin connector.

- System serial communication interface

External serial communication interface is provided through DB-15.

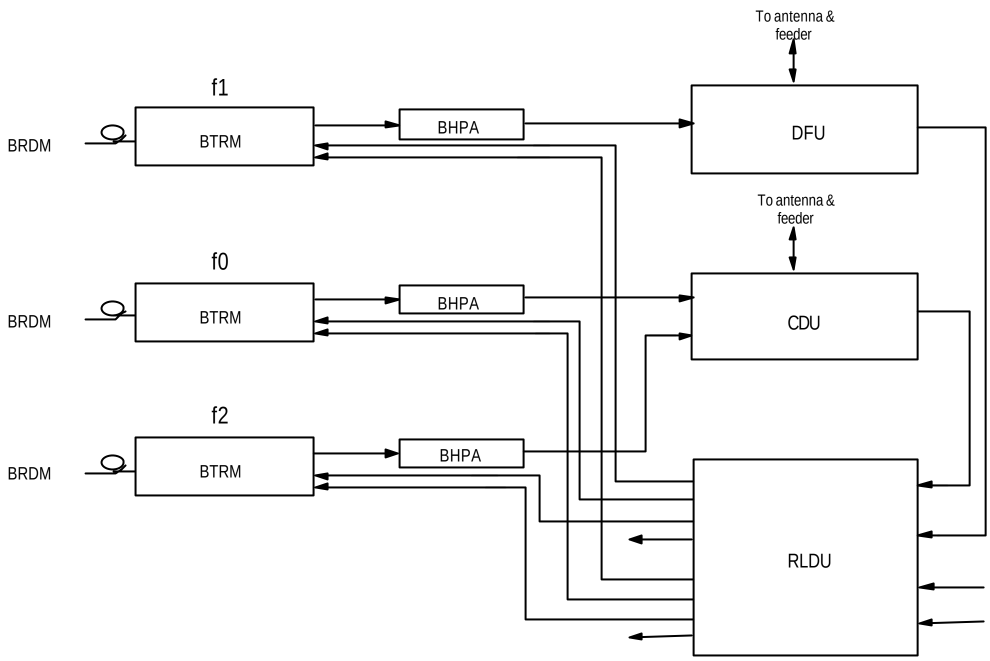
4) Index

The size of BFNB: 380mm×30mm.

2.3 RF Subsystem

2.3.1 Overview

The structure of RF subsystem is as shown in Figure 2-13.



BRDM: Resource Distribution Module
BTRM: Transceiver Module
BHPA: High Power Amplifier Unit
CDU: Combining Duplexer Unit
DFU: Duplexer Filter Unit
RLDU: Receive LNA Distribution Unit

Figure 2-13 Structure of RF subsystem

Note:

The above figure illustrates the RF configuration for 450MHz band. For 800MHz band, the duplexer would be CDU. For 1900MHz band, the duplexer would be DDU.

In forward link, it performs power adjustable up-conversion and linear power amplification to the modulated transmission signals, filtering the transmission signals to meet the corresponding air interface standard.

In reverse link, it filters the signals received by the BTS antenna to suppress out-band interference, and then performs low-noise amplification, noise factor adjustable frequency down-conversion, and channel selective filtering.

2.3.2 BTS Transceiver Module (BTRM)

BTRM is in charge of modulating/demodulating of baseband signal, Analog/Digital and Digital/Analog (AD/DA) conversion, digital up/down conversion and radio up/down conversion.

I. Structure and principle

BTRM consists of BTS Intermediate Frequency Unit (BIFU) and BTS Radio up-down Converter Unit (BRCU). Its structure is shown in Figure 2-14.

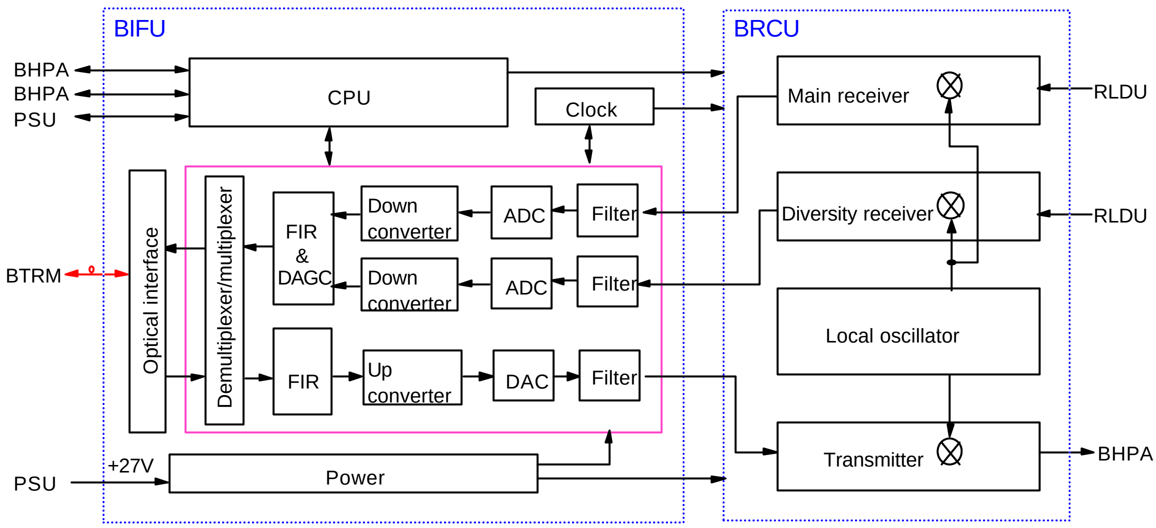


Figure 2-14 Structure of BTRM

1) BTS Intermediate Frequency Unit (BIFU)

BIFU consists of up-converter, down-converter, multiplexer/demultiplexer, optical interface, clock, CPU, and power supply sub-unit. It is in charge of the conversion between the analog intermediate frequency signals and the digital baseband signals, and the control of the MTRB. The functions of each sub-unit are as below:

- Up-converter

The up-converter accomplishes the wave filtering, digital up-conversion and digital-analog conversion of the signals in the transmit path.

On receiving the baseband I/Q signals that have been de-multiplexed, it performs digital up-conversion after baseband filtering. Then the digital intermediate frequency signals are converted into analog intermediate frequency signals after digital-analog conversion and wave filtering. At last, the analog intermediate frequency signals are sent to the transmitter in BRCU via radio frequency (RF) interface. BRCU.

- Down-converter

The down-converter accomplishes the analog-digital conversion, digital down-conversion and baseband filtering of the signals in the receive path.

On receiving the analog intermediate frequency signals via the radio interface, it converts them into digital intermediate frequency signals via analog-digital conversion. Then the digital intermediate frequency signals are converted into baseband I/Q signals via digital down-conversion and baseband filtering. As last, the I/Q signals are transmitted to the demultiplexer/multiplexer.

- Demultiplexer/multiplexer

Under the control of the CPU, the demultiplexer/multiplexer de-multiplexes the forward I/Q signals, and multiplexes the reverse I/Q signals. At the same time, it multiplexes/de-multiplexes the operation & maintenance (O&M) signals of the OML.

- Optical interface

The optical interface performs channel coding and decoding, and accomplishes optical-electrical signal conversion and electrical-optical signal conversion. It is the interface between the BIFU and the BRDM of the upper-level BTS, and the interface between the BIFU and the MTRM (Micro-bts Transceiver Module) in the lower-level SoftSite.

- Clock

The clock generates all the clocks needed by the BIFU, which include the clocks for up/down conversion, analog-digital conversion (ADC), and digital-analog conversion (DAC), and other working clocks. At the same time, it also provides the reference clock for the BRCU.

- CPU

The CPU is in charge of the control of BTRM, which includes the initialization upon power-on, alarm collecting and reporting, and processing operation & maintenance related messages.

- Power supply

With input voltage of +27V, the power supply sub-unit provides power supply to BIFU and BRCU.

2) BTS Radio up-down Converter Unit (BRCU)

BRCU consists of transmitter, main/diversity receiver and local oscillator. It up-converts, amplifies the intermediate frequency signals output by BIFU, and performs spuriousness-suppression wave filtering. It also performs analog down-conversion, amplification of BTS main/diversity receiving signal input from the RLDU, and channel-selection wave filtering. The functions of each sub-unit are as below.

- Transmitter

When receiving the modulated analog intermediate frequency signals output by BIFU, the transmitter converts them to specified RF band via two times of up-conversions. Before and after the up-conversion, wave filtering, signal amplification and power control are performed, so as to ensure the RF signals output meet the protocol requirements on power level, Adjacent Channel Power Radio (ACPR) and spuriousness.

- Main/diversity receiver

It converts the RF signals output by RLDU to specified intermediate frequency signals via down-conversion, and performs wave filtering, signal amplification and power control before/after the down-conversion, so as to ensure the intermediate frequency signals output can be received by BIFU.

- Local oscillator

It consists of the intermediate frequency source and transmit/receive RF synthesizer. The intermediate frequency source generates the local frequency signals for intermediate frequency up-conversion in transmit path. The RF synthesizer generates the local frequency signals for the up-conversion of the transmit path and the local frequency signals for the down-conversion of main/diversity receive path.

II. Interface

There are interfaces between BTRM and BHPA/RLDU/BRDM/PSU. The descriptions of each interface are given as below:

- BTRM-BHPA RF interface

The RF transmitting signal is output via this interface to BHPA, where the signal is amplified and then outputted.

- BTRM-BHPA RS485 interface

This interface is used to transfer alarm and control signal, and power detection signal.

- BTRM-RLDU RF interface

The main/diversity RF receiving signal output by RLDU is received via this interface.

- BTRM-BRDM optical interface

Baseband data are transmitted or received via this interface.

- +27V power supply interface

This interface is used to provide power supply to BTRM.

III. Index

- Supported frequency band: 450MHz band, 800MHz band, 1900MHz band
- Power supply: +27V
- Power consumption: 51W
- Module size: L×W×T=460mm×233.5mm×64mm

2.3.3 BTS High Power Amplifier Module (BHPA)

I. Overview

BHPA is located in RF subrack of BTS cabinet, and used for amplifying the RF modulation signals output by BTRM. Its main functions are:

- RF power amplification: perform power amplification for the RF modulation signals from BTRM.
- Over-temperature alarm: when the temperature of power amplifier base board exceeds a specified threshold, BBFM will process the over-temperature alarm signal generated by HPAU and report it to BTRM.
- Over-excited alarm: when the power level of BHPA input RF signal exceeds a specified threshold, BBFM will process the over-excited alarm signal generated by HPAU and report it to BTRM.
- Gain decrease alarm: when the gain of the power amplifier drops over 6dB, BBFM will process the gain decrease alarm signal generated by HPAU and report it to BTRM.
- Fan monitoring: BBFM is installed in BHPA, performing such functions as fan alarm and power amplifier alarm signal processing & reporting, and fan speed adjustment.

II. Structure and principle

The structure of BHPA module includes the following parts, as shown in Figure 2-15:

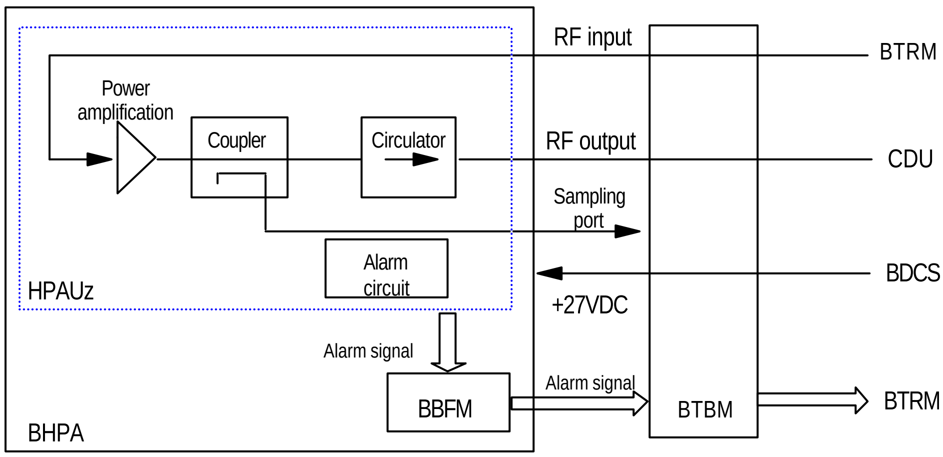


Figure 2-15 Block diagram of BHPA module

1) High Power Amplifier Unit (HPAU)

HPAU mainly consists of two parts: power amplifier and alarm circuit. The power amplifier amplifies the RF signals from BTRM. The amplified RF signals are then sent to CDU or DFU via BTBM. Alarm circuit monitors the power amplifier status and generates over-temperature alarm, over-excited alarm and gain decrease alarm signals when necessary. The alarm signals will be sent to BBFM, where they will be processed and reported to BTBM. The coupler is used to couple the RF output signals to the sampling port for test purpose.

The output power of HPAU can be adjusted by controlling the RF output signal of BTRM.

2) BTS BTRM Fan Monitor (BBFM)

BBFM processes fan alarm signals and power amplifier alarm signals, and sends them to BTRM via BTBM, and then BTRM will report them to upper level. BBFM can adjust the fan speed based on the ambient temperature and the actual BHPA output power in order to lower the noise of fans.

III. Interface

External interfaces of the BHPA module are D-type combination blind mate connectors, including:

- RF interface

The RF interface of BHPA has one input port and one output port. They are connected respectively with BTRM RF output port via BTBM and CDU/DFU/DDU RF input port via coaxial cable.

- Power supply interface

Interface with BTS Direct Current Switch box (BDCS).

- Alarm interface

Interface with BTRM. Fan alarm signals and power amplifier alarm signals are sent via BTBM to BTRM.

IV. Index

- Supported frequency band: 450MHz band, 800MHz band, 1900MHz band
- Max. average output power: ⩾ 40W (for 450MHz band and 1900MHz band)

  ⩾ 30W (for 800MHz band)

- Power supply: +27V
- Power consumption: <380W
- Module size: L×W×T=460mm×233.5mm×64mm

2.3.4 BTS Transceiver Backplane Module (BTBM)

BTBM interconnects six BTRMs and six BHPAs. It provides six sets of 2mm connectors for BTRM, six sets of 24W7 combination D-type blind mate connectors for BHPA, and three DB9 connectors for RLDU alarm collection, and six sets of temperature sensors.

The above parts form three independent function groups, as shown in Figure 2-18.

- BTRM 2mm connector

Each set of 2mm connectors includes one 5×22pin A-connector and three 3-socket-N-connectors. A-connector transfers RLDU alarm signals from DB9 connector and RS485 interface message from BHPA 24W7 combination D-connector. N-connector transfers the main/diversity input/output RF signal of BTRM and +27V DC power signal needed by BTRM.

- BHPA 24W7 D-type combination blind mate connector

Each 24W7 D-type combination blind mate connector includes 2 coaxial contacts (transferring BHPA input/output RF signals), 2 high-current power contacts (transferring +27V power supply and PGND signals), one set of RS485 signal contacts and a group of contacts for temperature sensor signals.

- DB9 connector

There are 3 angled DB9 connectors on BTBM for 3 RLDUs alarm signals transferred to BTRM.

- Temperature sensor

There are 6 temperature sensors for the 6 BHPA slots, used for sensing the air temperature at each BHPA air outlet. They will convert the information into current and send to BFMM on BHPA for processing. In this way, fan speed is controlled in real time.

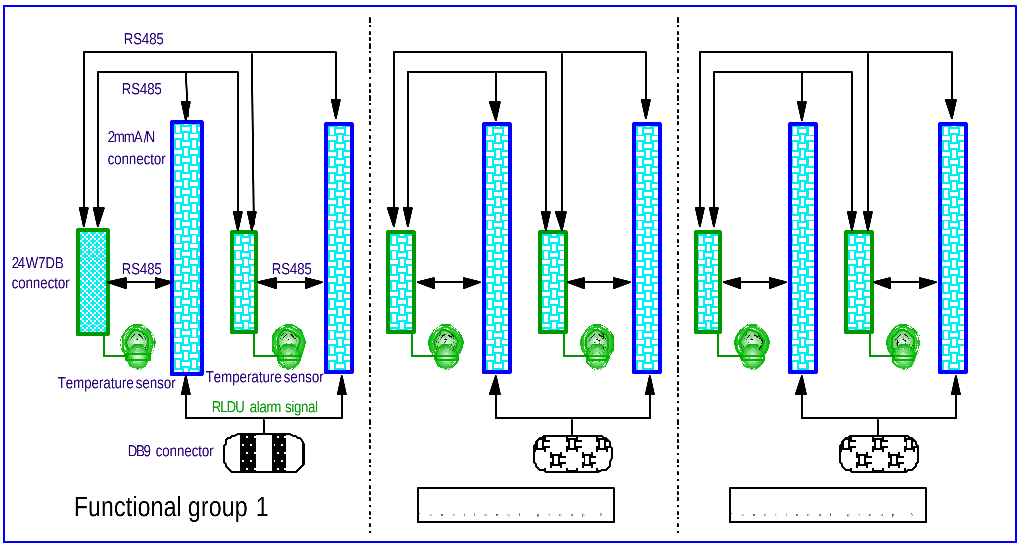


Figure 2-16 Functional blocks of BTBM

- Index

Board size: L×W×T= 664mm×262mm×3mm

2.3.5 Combining Duplexer Unit (CDU)

I. Overview

CDU mainly has the following functions:

- Combine two carrier signals from the two BHPAs into one signal.
- Isolation and filtering of receiving and transmitting signals.
- Filtering of transmitting signals so as to suppress BTS spurious emissions.
- Filtering of receiving signals so as to suppress the interference from outside the receive band.

Key internal parts of CDU include isolator, 2-in-1 combiner, duplexer, and directional coupler.

II. Structure and principle

CDU structure is as shown in Figure 2-17.

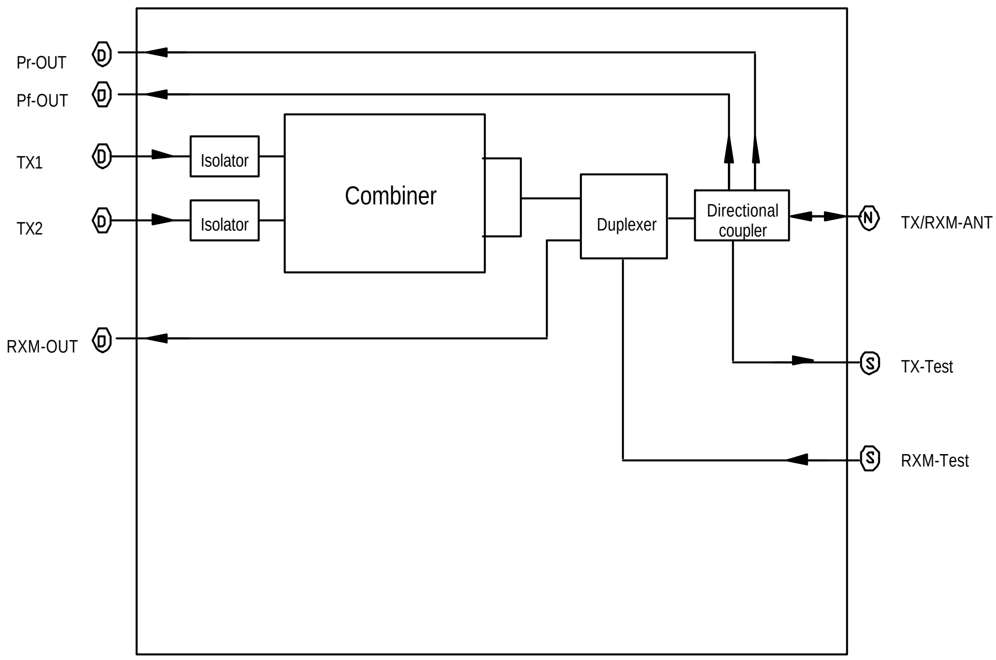


Figure 2-17 Structure of CDU

- Isolator

There are two isolators at each input port of the combiner in CDU. They are used to isolate the two carriers from two input ports.

- 2-in-1 combiner

The combiner is a narrow band cavity filtering combiner. In comparison with broadband combiner, it features lower insertion loss and effective isolation.

- Duplexer

The duplexer is used to isolate transmitted signals and received signals, suppress transmission spurious and reduce antenna quantity.

- Directional coupler

The directional coupler couples forward/reverse power to RLDU, and monitors the antenna VSWR.

III. Interface

CDU is a module shared by transmit and receive path of the BTS. It has interfaces with other modules both in the transmitting and receiving paths. Its external interfaces include a set of 8W8 D-type combination blind mate connectors on the backside, and a set of N-connectors and SMA connectors on the front side. The interface signals include:

- RF signals between CDU combiner input ports and BHPA output ports. They are transferred through the blind mate connectors on the backside.
- BTS transmitting signals, which are transferred to the cabinet-top antenna interface through the RF cable connected with the N-connector at the front side of CDU.
- BTS receiving signals, which are transferred from the cabinet-top antenna interface through the RF cable connected with the N-connector on the front side of CDU.
- BTS receiving signals output from the duplexer. They are sent to RLDU via the blind mate connector on the backside.
- Forward/reverse coupled RF signals, which are sent to RLDU via the blind mate connector on the backside.
- Forward/reverse coupled test signals, which are outputted through the standard SMA connector on the front side of CDU.

IV. Index

- Number of combined channels: 2
- Supported frequency band: 450MHz band, 800MHz band
- Module size: L×W×H=450mm×100mm×344.8mm

2.3.6 Duplexer Filter Unit (DFU)

I. Overview

DFU mainly fulfills the following functions:

- Isolation and filtering of transmitting and receiving signals for the single carrier.
- Filtering of diversity receiving signals in order to suppress out-band interference.

Key parts of DFU includes low-pass filter, duplexer, diversity receive filter and directional coupler.

II. Structure and principle

DFU structure is shown in Figure 2-18.

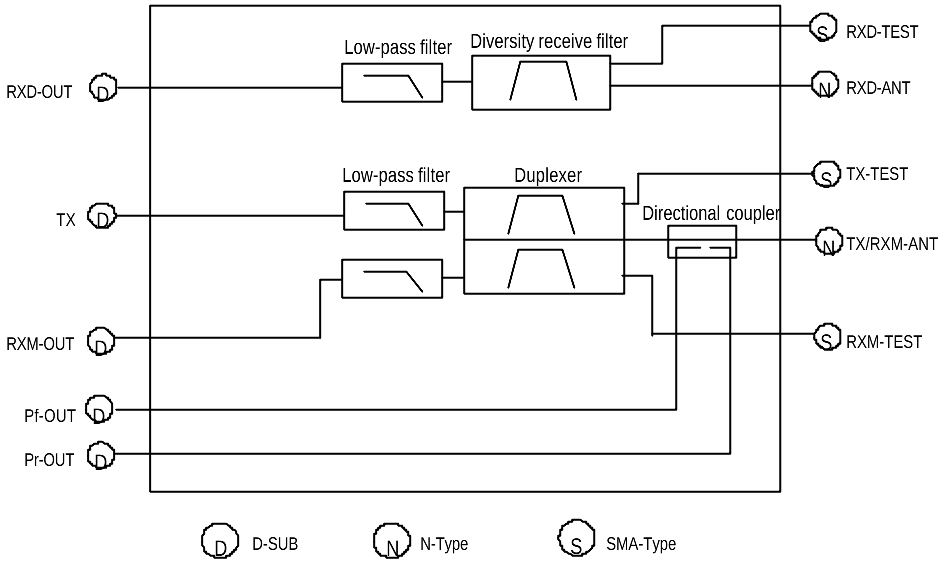


Figure 2-18 Structure of DFU

- Low-pass filter

At the transmitting signal input port and main/diversity receiving signal output port, there are three low-pass filters used for low-pass filtering of transmitting and main/diversity receiving signals.

- Duplexer

The duplexer is used to isolate transmitting and receiving signals, suppress transmission spurious and reduce antenna quantity.

- Diversity receive filter

The diversity receive filter of DFU is a separate path. Signals received by the diversity antenna must be filtered by the diversity receive filter in DFU before being sent to the low-noise amplifier in RLDU for amplification.

- Directional coupler

The directional coupler couples forward/reverse power for RLDU, and monitors the antenna VSWR.

III. Interface

DFU is a module shared by transmit and receive path of the BTS. It has interfaces with other modules in the transmit and receive paths. Its external interfaces include a set of 8W8 D-type combination blind mate connectors on the backside, and a set of N connectors and SMA connectors on the front side. The interface signals include:

- The signals between DFU and BHPA, which are transferred through the blind mate connectors on the backside.

- BTS transmitting signals, which are transferred to the cabinet-top antenna interface through the RF cable connected with the N-connector at the front side of the module.
- BTS receiving signals, which are transferred from the cabinet-top antenna interface to DFU for filtering through the RF cable connected with the N-connector on the front side of the module.
- BTS receiving signals output from the duplexer and diversity receive filter. They are sent to RLDU via the blind mate connector on the backside.
- Forward/reverse coupled RF signals, which are sent to RLDU via the blind mate connectors on the backside.
- Forward/reverse coupled test signals, which are outputted through the standard SMA connector on the front side.

IV. Index

- Supported frequency band: 450MHz band
- Module size: L×W×H=450mm×100mm×344.8mm

2.3.7 Dual Duplexer Unit (DDU)

I. Overview

DDU completes the following functions:

- Isolation and low-pass filtering of two receiving and transmitting signals.
- Providing two DC feeds to T-type tower-top amplifier.
- Voltage Standing Wave Ratio (VSWR) test on transmit channels in both forward and backward directions.
- Coupling test of transmitting and receiving signals.

Key components within DDU include Bias-T DC feed connector, low-pass filter, duplexer, and bi-directional coupler.

II. Structure and principle

DDU structure is shown in Figure 2-19.

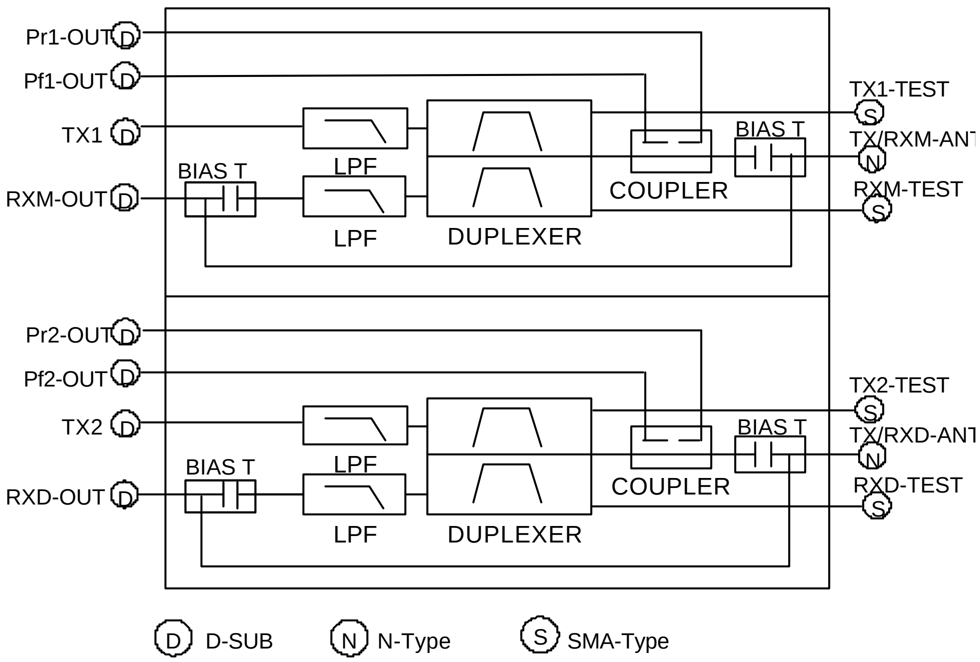


Figure 2-19 Structure of DDU

- Low-pass filter

The low-pass filter is used to suppress the high-order harmonic wave. The low-pass filter on receive channel also functions to suppress the interference from the transmit channel.

- Duplexer

The duplexer is used to isolate transmitting signals and receiving signals, suppress transmission spurious and reduce antenna quantity.

- Bi-directional coupler

The bi-directional coupler couples forward/reverse power for RLDU, and monitors the antenna VSWR.

- T-type feed connector

This connector receives the RF signals and divides/combines DC feeds, so that the RF signals and DC go through different channels, realizing the DC supply to the tower-top amplifier.

III. Interface

DDU is a module shared by the transmitting and receiving paths of the BTS. It has interfaces with other modules both in the transmitting and receiving paths. Its external interfaces include a set of 8W8 DB combination blind mate connectors on the backside, and a set of N-connectors and SMA connectors on the front. The interface signals include:

- Signals between transmit input port and BHPA port. They are transferred through the blind mate connectors on the back side.
- Transmitting signals, which are transferred to the cabinet-top antenna port through the RF cable connected with the N-connector at the front side of DDU.
- Receiving input signals, which are transferred from the cabinet-top antenna port through the RF cable connected with the N-connector on the front side of DDU.
- Signals output from the receive filter. They are sent to RLDU via the blind mate connector on the back side.
- Transmitting forward/reverse coupled RF signals, which are sent to RLDU via the blind mate connector on the back side.
- Transmitting and receiving coupled test signals, which are outputted through the standard SMA connector on the front side of DDU.

IV. Index

- Supported frequency band: 1900MHz band

Module size: L×W×T=450mm×100mm×344.8mm

2.3.8 Receive LNA Distribution Unit (RLDU)

I. Overview

RLDU consists of Low Noise Amplifier), distribution unit, configuration switch and alarm monitoring circuit. Its main functions are:

- Low noise amplification and distribution for BTS receiving signals.
- Built-in electronic RF switch supports multiple BTS configurations (3 sectors or 6 sectors).
- Antenna VSWR monitoring and alarming, BTS forward RF power detecting, LNA running status monitoring and alarming.

II. Structure and principle

RLDU structure is shown in Figure 2-20.

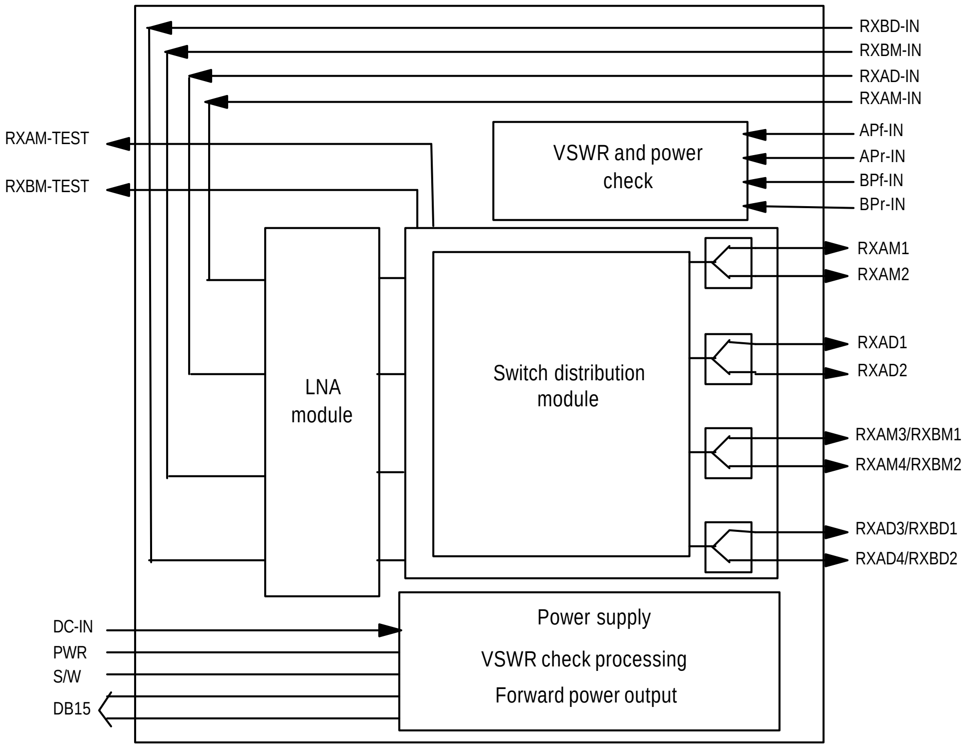


Figure 2-20 Structure of RLDU

1) Receiving signal low noise amplification and distribution unit

There are 4 LNAs and distributors inside RLDU, which can process 4 signals. The 4 LNAs have the same specifications such as gain, noise factor and dynamic, so the 4 receive paths are balanced.

2) Configuration switch unit

The electronic switches inside RLDU are designed for supporting different BTS configurations. When the BTS is configured in 3-sector mode, the electronic switches can be set to make RLDU operate in a single-sector mode that has two main/diversity receiving paths (Each path provides 1-in-4 output to support 1~4 carriers configuration for each sector). When the BTS is configured in 6-sector mode, the electronic switches can be set to make RLDU operate in two-sector mode each of which having 4 main/diversity receive paths (Each path provides 1-in-2 output, supporting 1~2 carriers configuration for each sector).

3) Antenna VSWR and LNA status monitoring unit

The transmitted forward/reverse power coupling signals from CDU or DFU or DDU are processed in the antenna VSWR monitoring circuit inside RLDU. When the VSWR of transmitting antenna exceeds a specified threshold, alarm will occur. At the same time, RLDU also converts transmit coupling power signal into DC level signal through its RF power detecting circuits. Through this DC level signal, any exception of transmit signal power of antenna can be monitored in real time. LNA status monitoring circuit monitors the voltage and current of the 4 LNAs inside RLDU. It gives alarm when fault t is found.

III. Interface

RLDU is the reverse link function module of the BTS, which interfaces with CDU/DFU and BTRM in both input side and output side through the two sets of 8W8 D-type combination blind mate connectors on the backside of the module.

1) Interface signals between RLDU and CDU/DFU/DDU are:

- Main/diversity path receiving RF signals outputted from two CDU/DFU/DDU receive filters. They are amplified and distributed by RLDU.
- CDU/DFU/DDU coupling RF signal, which are used for antenna VSWR monitoring and forward power detecting.

2) Interface signals between RLDU and BTRM are:

- Main/diversity path receiving RF signals transmitted to BTRM after being amplified and distributed.
- Antenna VSWR, LNA status monitoring alarm signals and forward power detecting voltage signals, which are outputted to BRCU by RLDU through a DB15 interface on the front side of the module and transferred to BIFU for processing.

3) The +27V DC power is necessary for RLDU. It is provided directly by the secondary power supply module in the BTS through a MOLEX power connector on the front side of the module.

IV. Index

- Supported frequency band: 450MHz band, 800MHz band, 1900MHz band
- Power supply: +27VDC
- Power consumption <50W
- Module size: L×W×H= 450mm×180mm×50mm

2.3.9 BTS RF Fan Module (BRFM)

BRFM mainly consists of BBFM, BBFL and fans. The following is the introduction to BBFM and BBFL.

I. BTS BTRM FAN Monitor (BBFM)

1) Overview

BBFM collects and analyzes the temperature information of BHPA module and adjust the fan speed in real time to lower the system noise, so as to prolong equipment service life and improve the external performance of the overall system on the premise that the system works in a safe thermal status. The Pulse Wide Modulation (PWM) control signal regarding the fan speed can be generated by the MCU of the local board or configured by the control unit of BTRM module. At the same time, BBFM reports to BCKM the gain decrease, over-temperature, over-excited alarm and fan failure alarm of BHPA, to ensure the reliability of BHPA module. Specifically, it functions to:

- Control fan speed, monitor and report fan alarm.
- Monitor and report BHPA alarm.
- Drive fan monitor indicator module.
- Collect temperature information of BHPA module.
- Communicate with BTRM module.

2) Structure and principle

The position of BBFM in BHPA module is as shown in Figure 2-21.

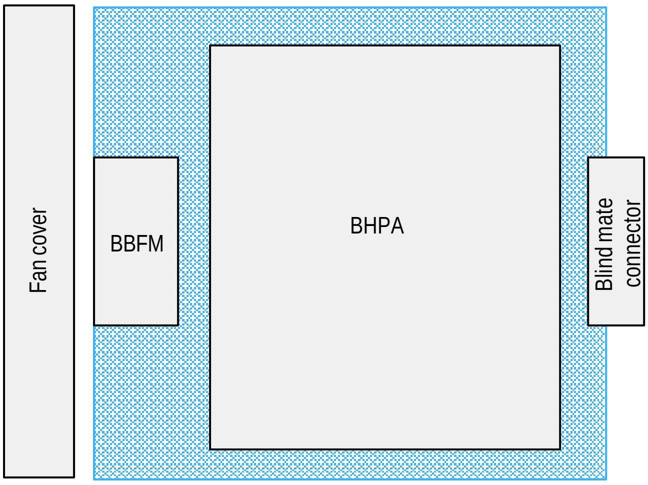


Figure 2-21 Position of BBFM in BHPA module

The structure of BBFM is shown in Figure 2-22.

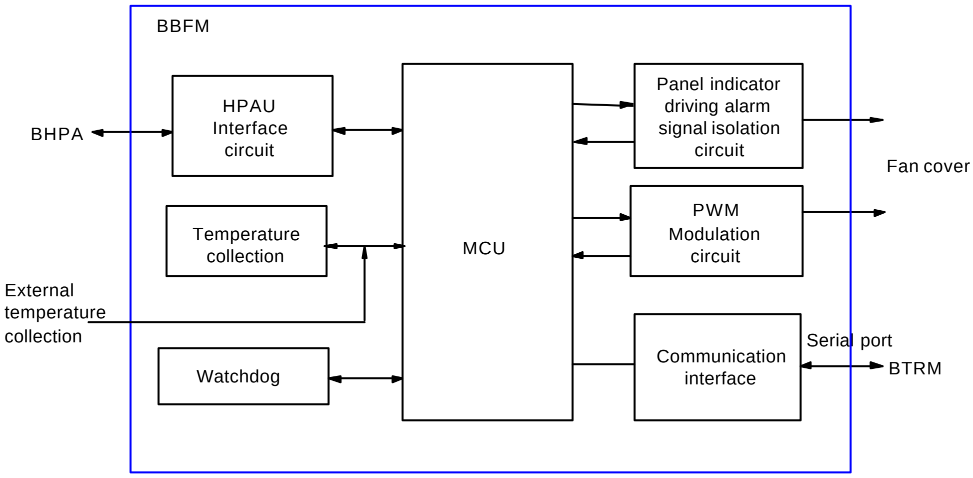


Figure 2-22 Structure of BBFM module

- MCU module

The MCU module collects and analyzes the temperature information to generate PWM signal for controlling the fan speed, receives alarm signals generated by BHPA module and fan alarm signals and reports to BTRM module, generates panel indicator signal and communicates with BTRM module.

- BHPA interface module

This moduloe isolates and drives the interface with BHPA.

- Temperature information collection module

This module collects the temperature information of BHPA module in real time, which is implemented by MCU in query operation.

- Panel indicator driving and alarm signal isolation module

It is used to drive the panel indicator and isolate fan alarm signals.

- Communication module

The module performs serial communication with BTRM module.

- Power supply module

The input power of BFMM is +27V, power consumption is 3.5W (including power for the fans).

3) Interface

- BHPA interface

Interface with BHPA module, used for BHPA alarm monitoring.

- Serial communication interface

Interface used to report the alarm of the fans and BHPA module.

- Interface with the fan cover

Including fan alarm signal, panel indicator, and fan power interface.

4) Index

Size of BBFM: 200.0mm×55.0mm.

II. BTS BTRM FAN Lamp Module (BBFL)

1) Overview

BBFL has three RUN indicators to indicate the running status of BTRM module, fans and BHPA module. The board is connected with BBFM via the fan cover interface. It is an auxiliary board.

2) Structure and principle

The structure of BBFL is shown in Figure 2-23.

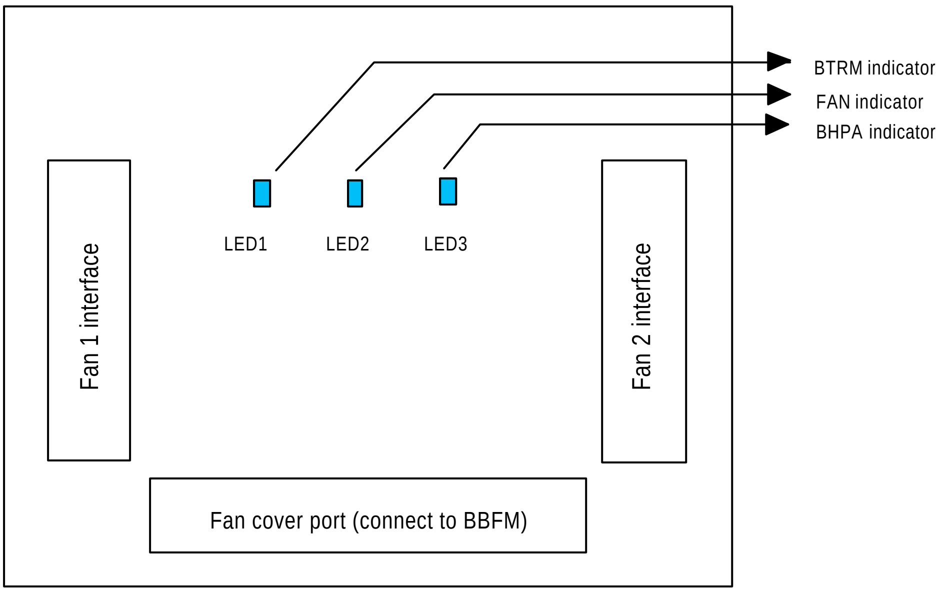


Figure 2-23 Structure of BBFL module

BBFL consists of the following parts:

- Fan 1 interface module

It is a 4pin ordinary socket connector connected with Fan 1, including power supply input port and fan alarm output port.

- Fan 2 interface module

It is a 4pin ordinary socket connector connected with Fan 2, including power supply input port and fan alarm output port,

- Fan cover port interface module

It is connected with the fan cover of BBFM.

3) Panel indicator

LED1: BTRM operating signal

LED2: Fan operating signal

LED3: BHPA operating signal

4) Index

Size of BBFL: 55.0mm×25.0mm.

2.4 Antenna & Feeder Subsystem

2.4.1 Overview

BTS antenna & feeder subsystem consists of two parts: RF antenna & feeder, and dual-satellite synchronization antenna & feeder. The former transmits the modulated RF signals and receives MS signals, while the latter provides precise synchronization for CDMA system.

2.4.2 RF Antenna & Feeder

RF antenna & feeder of the BTS is composed of outdoor antenna, jumper from antenna to feeder, feeder, and the jumper from feeder to cabinet-top, as shown in Figure 2-24.

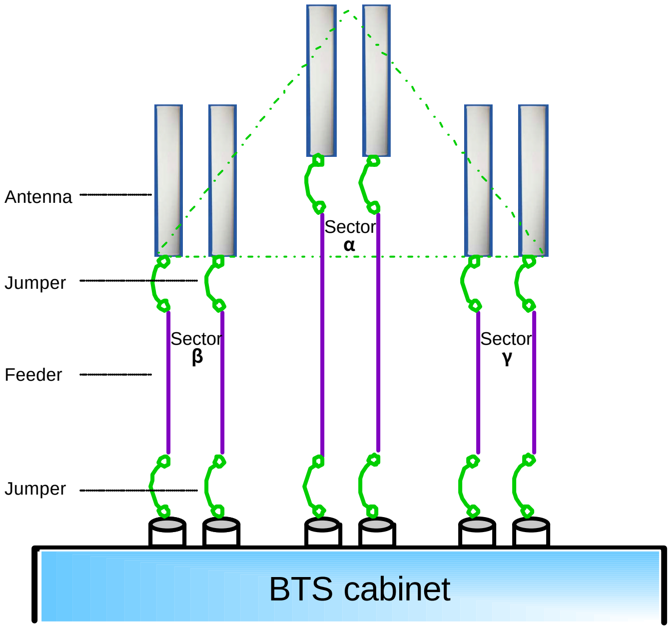


Figure 2-24 Structure of RF antenna & feeder

I. Antenna

Antenna is the end point of transmitting and start point of receiving. Type, gain, coverage pattern and front-to-rear ratio of the antenna can affect the system performance. The network designer should choose antenna properly based on the subscriber number and system coverage.

1) Antenna gain

Antenna gain is the capability of the antenna to radiate the input power in specific directions. Normally, the higher gain, the larger coverage. But there may be blind area in the vicinity.

2) Antenna pattern

Antenna pattern describes the radiation intensity of the antenna in all directions. In the field of telecommunication, it usually means a horizontal pattern. BTS antenna is available in two types: 360° omni antenna and directional antenna. The directional antenna includes the following types: 120°, 90°, 65° and 33°.

3) Polarization

Polarization is used to describe the direction of the electrical field. The mobile communication system often uses uni-polarization antennas. Bi-polarization antennae have been used recently to reduce the quantity of antennae. The two polarization directions are perpendicular to each other.

Normally Bi-polarization directional antenna is used in directional cell. Comparing with the uni-polarization directional antenna, the bi-polarization directional antenna is cost-effective, space saving and easy to install. However, uni-polarization omni antenna is still adopted in omni cell.

4) Diversity technology

Electrical wave propagation in urban area has the following features:

- Field intensity value changes slowly with places and times. It changes in the rule of logarithmic normal distribution, which is called slow attenuation.
- Field intensity transient value attenuates selectively since it is multi-path transmission. The attenuation rules falls in Rayleigh distribution, which is called fast attenuation.

Either fast attenuation or slow attenuation impairs the quality of communication or even interrupts the conversation. Diversity technology is one of the most effective technologies to tackle the attenuation problem. Diversity receiving and combining technology can be used to minimize the attenuation when there is little correlation between the two attenuated signals. There are polarized diversity and space diversity. In the present mobile communication system, horizontal space diversity and polarized diversity are both supported. Theoretical conclusion shows that space diversity is effective when the distance between two antennae is over 10 wavelengths. Polarized diversity facilitates antenna installation and saves space, therefore it is used more and more extensively.

5) Antenna isolation

The receiving/transmitting antenna must be installed with sufficient isolation to minimize the effect on the receiver. The isolation space is subject to the out-band noise of the transmitter and the sensitivity of the receiver. Please refer to *cBTS3612 Installation Manual* for details.

II. Feeder

Normally, the standard 7/8 inch or 5/4 inch feeders are used to connect the outdoor antenna and indoor cabinet. In the site installation, 7/16 DIN connectors are needed based on the actual length of feeders. Three grounding cable clips for lightning protection should be applied at the tower top (or building roof), feeder middle, and the wall hole where feeder enter indoors. If the feeder is excessively long, additional cable clips are needed.

Since 7/8 inch feeder should not be bent, the tower top (or building roof) antenna and the feeder, indoor cabinet and the feeder should be connected via jumpers. The specifications of Huawei standard jumpers are 1/2 inch, 3.5m long, with 7/16DIN connectors.

III. Lightning arrester (Optional)

When the cBTS3612 is configured for 1900MHz band, the lightning arrester is necessary, but for the other bands, it is not necessary.

The lightning arrester is used to prevent damage of lightning current to the antenna and feeder system. Usually, there are two kinds of lightning arresters. The first type uses the microwave principle to conduct the low frequency lightning current to the ground so as to sink the current. The second one is a discharging tube, when the voltages at both ends of the discharging tube reach a certain value, the tube conducts to sink the large current. The second technique is used in cBTS3612. Lightning arrester should be installed close to the BTS cabinet, for details, please refer to cBTS3612 Installation Manual.

IV. Tower-top Amplifier (Optional)

When the cBTS3612 is configured for 1900MHz band, the tower-top amplifier is optional, for the other bands, it is not necessary.

Tower-top amplifier is used to further improve the signal quality. Normally it is installed close to the antennas, consisting of triplex filter and low noise amplifier. The triplex filter is actually a device composed of two duplex filters.

Signals from the antennas first pass through the triplex filter to filter out the out-band interference, then the low noise amplifier amplifies the weak signals. Finally the amplified signals are sent over the low loss cable to the BTS.

The purpose of the tower top amplifier is to enhance the receiving sensitivity of the base station. So the tower-top amplifier is required to have a low noise coefficient.

The power of the signals received on the antenna varies greatly with the distance between the MS and the base station. This requires that the tower- top amplifier have a greater dynamic range.

Besides, the tower-top amplifier also has the by-pass function in case of DC power failure.

The DC power supply of tower-top amplifier is fed through the center conductor of the receiving feeder by DDU. Since it is an outdoor device, so a reliable waterproof sealing is required.

The tower-top amplifier can operate under $-40^{o}C \sim 60^{o}C$.

2.4.3 Dual-Satellite Synchronization Antenna & Feeder

I. Overview

Many important features of CDMA system are closely related with global satellite navigation system and are much dependent on it. If global satellite navigation system does not work for a long time, the whole network will collapse. In consideration of the system security and reliability, BTS receives the signals of GPS system or of GLONASS system through the dual-satellite synchronization antenna & feeder, to implement radio synchronization. In this way, the whole network can operate normally without any adverse effect when GPS or GLONASS system is not available. The following describes the application of GPS and GLONASS in CDMA system.

1) GPS

CDMA network can be synchronized with GPS. GPS is a high precision global positioning system set up by American Navy Observatory. It is a all-weather satellite navigation system based on high frequency radio. It provides 3D-position information, so users can attain high precision information about position, speed and time. The 3D-position is accurate to less than 10 yard (approx. 9.1m) in space and less than 100ns in time. The received signal is processed and used as the master reference frequency.

The whole system consists of three parts: space part, land control part and user part.

Space part is a group of satellites 20,183 kilometers high, orbiting the earth at a speed of 12 hours/circle. There are 24 satellites together, running on 6 orbits. The plane of each orbit is at a 55° angle with the equator.

The land control part consists of a main control center and some widely distributed stations. The land control network tracks the satellites and controls their orbits accurately. It also corrects astronomical data and other system data from time to time and transmits to users through the satellites.

The user part includes the GPS receivers and their supporting equipment. The CDMA system is actually a GPS user utilizing the timing function of GPS. GPS satellites are synchronized with a cesium atom clock group on the land. Therefore, GPS timing signal is steady and reliable. The frequency is in a long-term stability of cesium atom clock level. BTS provides a highly stable crystal clock, which is stable on a short-term base. The crystal clock together with GPS signals ensures the clock absolute stability and reliability of CDMA system.

2) GLONASS

GLONASS is a global satellite navigation system developed by the former Soviet Union and inherited by Russia. It is of a similar structure to GPS. There are 24 satellites distributed on 3 orbits. The inclination of the orbit is 64.8° and the height is 18840~19940 km. The satellites go around the earth one circle every 11 hours 15 minutes and 44 seconds. Satellites are identified with frequency division multi-address, i.e. different satellites use different frequencies. Since the inclination of the orbits is greater than that of GPS, the visibility at high latitude area (over 50°) is better than that of GPS. The design service life of the present satellites is 3~4 years. The service life of the new generation GLONASS will be 5 years, with enhanced functions of inter-satellite data communication and autonomous running. At present, only 19 satellites are working in the constellation and some of them are not working well. The coverage is not as large as GPS system.

The user equipment receives C/A code, P code and two carrier signals modulated from the navigation data L1: 1602MHz +△fL1, L2: 1 246 MHz+△fL2 (△fL1, △fL2 are frequency increments of different satellites), to identify the position of the satellite and measure the distance between the user and the satellite. In this way, the position of the user can be figured out. The algorithm used is similar to that of GPS.

Huawei BTS system uses intelligent software phase-locking and holdover technology to minimize the interference such as signal wander and jitter due to ionosphere error and troposphere error of GPS satellites. BTS system can not only provide accurate timing signal, but also provide accurate calendar clock (hour, minute, second). Huawei BTS supports GPS/GLONASS dual-satellite system synchronization mode, providing two synchronization solutions (GPS or GPS/GLONASS) as required by the user.

II. Antenna

- GPS antenna

The antenna is an active antenna. The L1 band GPS signals received by GPS antenna are filtered by a narrow-band filter and amplified by a preamplifier. Then they are sent to a GPS receive card. GPS antenna supports all kinds of GPS receivers. Performance indices are as follows:

Frequency: 1.575GHz

Bandwidth: 20MHz

Voltage: +5.0 ± 0.25VDC

Current: 35mA

Impedance: 50Ù

Polarity: RHCP

- GPS/GLONASS dual-satellite receiving antenna

This antenna receives L1 GPS signals (1.575GHz) and GLONASS signals (1.611GHz). The power voltage is 5~18V.

III. Feeder

The feeder is the physically foamed polyethylene insulation RF coaxial cable, with the impedance of 50-ohm and specification of 10-FB. Nominal indices are:

70dB/km (400MHz)

113dB/km (900MHz)

The loss at 1.575GHz frequency is 13.78dB every 100m.

The coaxial cable is mainly used to transmit the GPS signals received by the GSP antenna to GPS card. At the same time, the coaxial cable also provides power for the antenna module to make pre-amplification.

This kind of cable is used when dual-satellite solution is adopted.

IV. Lightning arrester of antenna and feeder

The lightning arrester of antenna and feeder used in BTS features clamp voltage of -1~+7VDC, standing wave ratio of less than 1.1:1, and signal attenuation of less than 0.1dB (1.2~2GHz).

V. Receiver

GPS receiver has 8 parallel paths, capable of tracking 8 satellites concurrently. The receiver receives GPS signal of band L1 (1575.42MHz) and tracks C/A code. The receiver must be powered with regulated 5V DC. Inside the receiver, the RF signal processor makes frequency down-conversion to the GPS signal received by the antenna to get Intermediate Frequency (IF) signal. The IF signal is then converted to digital signal and sent to 8-path code and carrier correlator, where signal detection, code correlation, carrier tracking and filtering are performed. The processed signal is synchronized and sent to positioning MPU. This part of circuit controls the operational mode and decoding of GPS receiver, processes satellite data, measures pseudo-distance and pseudo-distance increment so as to figure out the position, speed and time. The sensitivity of the receive card is -137dBm.

The dual-satellite receive card has 20 receiving paths. GPS L1 can be upgraded to GPS/GLONASS L1+L2 or other solutions. The timing accuracy of the card is up to 25ns.

2.5 Power Supply Subsystem

2.5.1 Overview

BTS built-in power supply module converts -48V DC into +27V for the BTS, forming the power supply subsystem together with power distribution, lightning protection and power monitoring.

According to the requirement of BTS overall design, each site can be configured with multiple cabinets as required. Different cabinets are interconnected so that different network configurations can be implemented with flexibility, convenience and reliability. Therefore the power supply subsystem also needs flexible, convenient and reliable distribution monitoring solution such as centralized lightning protection, distributed DC power (i.e. the power supply subsystem of each cabinet is an integrated system and each power supply module has its own built-in monitoring unit). These units are connected on the backplane, and information is report to BTRM through the universal monitoring bus to implement power management and monitoring.

The -48V power input is filtered by EMI filter and connected to the wiring terminal on the cabinet top, and then connected to the power backplane input bus bar in the secondary power supply subrack. The +27V power is output to the output bus bar of power subrack backplane, then led out from the bus bar, the power cable goes up along the wiring trough to the distribution copper bar in the DC switchbox on top of the cabinet. The distribution copper bars in the switchbox distribute +27V DC power to different modules (the power passes the over-current protection devices for each power consumption unit and is connected to the output terminals at the back of the distribution box). In this way, it is ensured that when the power supply to a unit fails due to over-current, other units will not be affected.

The structure of the whole power supply subsystem is shown in Figure 2-25.

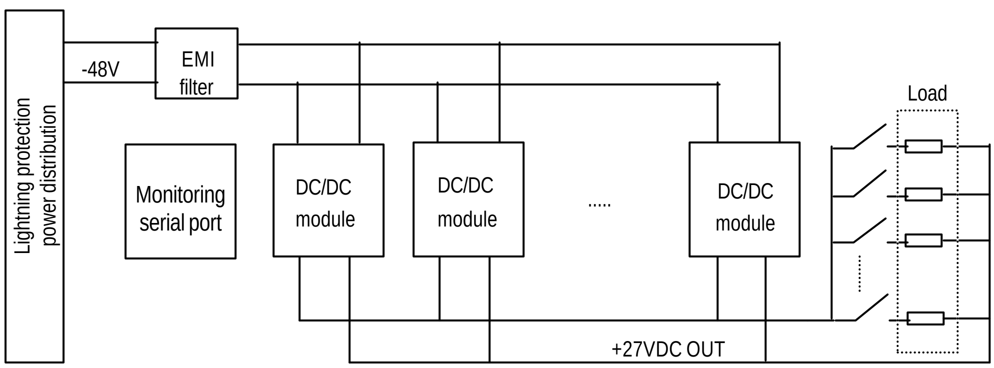


Figure 2-25 BTS power supply subsystem

2.5.2 General Structure

The -48V power is filtered by the EMI filter on top of the cabinet, and then goes down along the wiring trough, and finally connected to the input bus bar of the power subrack backplane. The power supply subsystem uses five +27V/65A DC/DC power supply units (PSU) in full configuration. These five PSUs operation in 4+1 redundancy to ensure an output of at least 7200W. The size of PSU is L×W×H = 400mm×121.9mm×177.8mm.

The overall structure of the power supply system is shown in Figure 2-26.

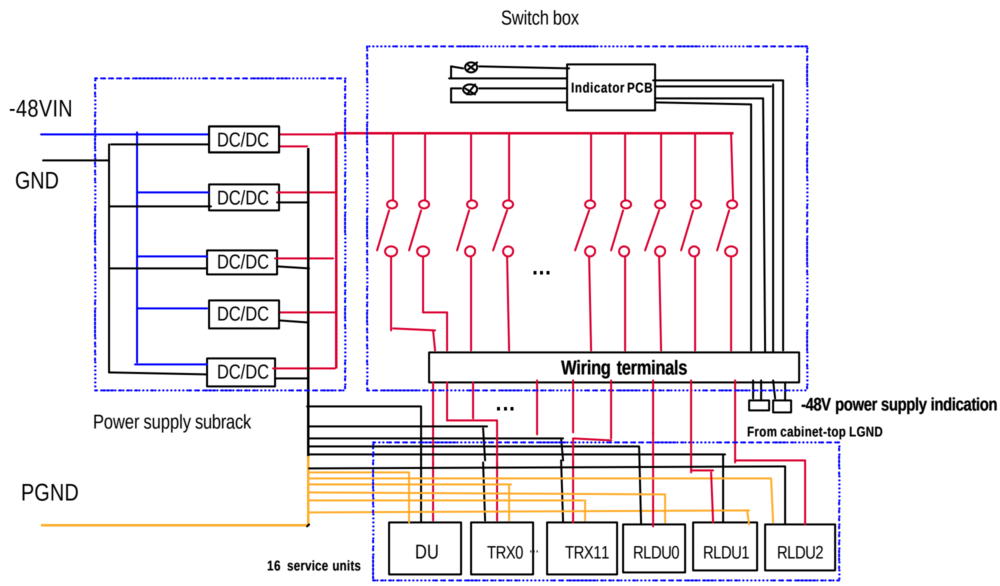


Figure 2-26 Structure of power supply system

2.5.3 Technical Indices

I. DC input lightning protection

DC input lightning protection part is an external cabinet-top lightning arrester. It mainly features:

- Temperature-controlled fusing technology and built-in over-current protection circuit to prevent fire.
- Multiple autonomous current equalization technology used to withstand successive lightning attack.
- Common mode and differential mode protection, and low residual voltage.
- Dual-color working status indication, with remote alarm node.
- Small in size and easy installation.

1) Input indices

Input mode: -48VDC

Operating voltage range: -40VDC~-60VDC

Maximum input current: 30kA

2) Wiring mode

The positive and negative poles of the power cord are connected with V+ and V- terminals of the lightning arrester.

The PE end is connected to the grounding copper bar for lightning protection.

3) Lightning protection indices

Maximum through-flow: 30kA, once, 8/20μs surge current wave.

Rated through-flow: 5kA, 5 times for positive and negative each, 8/20μs surge current wave.

Residual voltage: 250V.

4) Indicator and alarm node indices

When the green indicator is on and the red is off, it means the power input is normal, and the lightning arrester is working normally.

If the green indicator is off and the red indicator is on, it means the power input is abnormal, components in the lightning arrester are damaged, protection effect is deteriorated and the device must be replaced immediately.

The alarm node is a constantly-closed contact. It is closed when the lightning arrester is normal and it is open when arrester fails. Regulated current is ⩽1A.

5) Size of the lightning arrester: L×W×H= 41mm×95mm×59mm

II. DC/DC power supply module

Power supply module provides perfect protection function. The safety specifications comply with UL, TUV and CCEE standards. EMC is compliant with EN55022 and IEC61000-4 standards.

- Operating temperature: -10~50°C
- Storage temperature: -40~70°C
- Atmospheric pressure: 70~106kpa
- Relative humidity: 5%~90%
- Input voltage: -40~ -60VDC
- Input under-voltage current-limiting protection point: -36±1VDC
- Input under-voltage recovery point: -38±1VDC

- Output voltage: +27±0.5V
- Output voltage range: +25~+29VDC
- Output over-voltage protection point: +30.5±0.5VDC
- DC output rated current: 65A
- Output current-limiting point: 68.5~71.5A
- Regulated voltage precision: ⩽±1%

  Load regulation: ⩽±0.5%

  Voltage regulation: ⩽±0.2%

- Output noise voltage

  Balanced noise of phone: ⩽2.0mV (300~3400Hz)

  Broadband noise voltage: ⩽30mV (3.4k~30MHz)

  Peak-peak value noise voltage: ⩽100mV (0~20MHz)

  Discrete noise voltage: ⩽5mV (3.4kHz~150kHz)

  ⩽3mV (150kHz~200kHz)

  ⩽2mV (200kHz~500kHz)

  ⩽1mV (500kHz~30MHz)

- Power efficiency: ⩾85% (in full load)
- Dynamic performance

  Load effect recovery time: ⩽200µs 25%~50%~25% load variance

  50%~75%~50% load variance

  Output overshoot: ⩽5% output voltage setting value

- Equipment delay: ⩽5s
- Safety requirement

  Insulation resistance of input-case, input-output, output-case: ⩾2MÙ

  Test conditions: ambient temperature: 20±5˚C

  Relative humidity: 90%

  Test voltage: DC 500V

- Insulation strength

  Input-output: AC 1000V/1min/30mA

  Input-ground: AC 500V/1min/30mA

  Output-ground: AC 500V/1min/30mA

- EMI requirement

Conducted interference:

At frequency 150kHz~30MHz, the conducted interference level in the power cord of the tested equipment conforms to class "A" standard in EN55022 Table 1.

Radiated interference:

At frequency 150kHz~1000MHz, the radiated interference level of the power cord of the tested equipment conforms to class "A" standard in EN55022 Table 1.

- Reliability

The MTBF value (which is the main representative of system reliability) of the power supply subsystem is greater than 15×10^4h.

- Burn-in test

The power supply subsystem works in full load for 4 hours continuously at an ambient temperature of 55±2°C and all its technical indices can still meet the standard.

2.5.4 Power Supply Monitoring

The monitoring information of the whole power supply subsystem and each power supply module is provided via the RS485 serial port on the backplane. Monitored contents include:

1) Control value

- Power supply module total shutdown control
- Power supply module auto startup/shutdown control

2) Boolean value

- Fan alarm signal
- Overheat alarm signal
- Output over-voltage alarm signal
- Input under-voltage alarm signal

3) Current/voltage analog signal

- Output voltage (V)
- Output current (A)

4) Interface

Power supply subsystem provides an RS485 port on the backplane, used to report monitoring information to BCKM.

2.5.5 BTS Direct Current Switchbox (BDCS)

BDCS is used to distribute power to the system. After t he +27V power is outputted from the power subrack, it is connected to the distribution copper bar in the switchbox via the bus bar installed on the back pole. The power is distributed by the copper bar and connected to terminals. with the power is finally supplyed to the power consumption units from these terminals. There are also lightning protection alarm indicators and -48V power status indicators on the switchbox.

There is one set of +27 power sockets on the panel of the DC switchbox, used to supply power for RF module in maintenance or voltage measurement.

2.6 Environment Monitoring

BTS equipment rooms are usually unattended and widely distributed. In comparison with switch equipment rooms, BTS equipment rooms have fewer and simpler facilities, and the system operates in a harsher environment. To ensure the normal operation of BTS, intensive environment monitoring system is provided to handle any accidents.

The environment monitoring system of the BTS consists of the environment monitoring devices and BCKM. The environment monitoring devices collect environment information and report the information to OMC.

The environment monitoring devices consist of environment alarm collection box and the sensors.

The environment alarm collection box collects external environment parameter through the sensors. The parameters are processed in the box. If alarm condition is met, an alarm will be sent to BCKM as a switch value, via the alarm transmission signal line, asynchronous serial port and optical fiber. BCKM collects the alarm signals, makes corresponding processing and reports them to OMC.

The alarm box in the system can in real time monitor the temperature, humidity, smoke and illegal entry in the environment. It can also automatically detect the environment conditions based on the specified value, automatically give alarm and drive related protection apparatus such as fire extinguisher, humidifier, dehumidifier and burglar proof device. The alarm box can also receive instruction from the control center to modify parameters and activate protection apparatus.

The alarm box features:

- Real-time indication of temperature and humidity.
- Time indication.
- Fire, smoke, humiture, water and three types of burglar alarms.
- Providing panel control key pad.

- Providing 10 switch value inputs (optical/electrical isolation).
- Providing 6 relays (max. 5A/220V) to drive external actuators.
- Providing 2 PWM outputs (8bit resolution, basic clock no greater than 500kHz).
- Driving of 7 independent collector open-circuit gates (absorption current 300mA).
- Communication with BCKM through RS485 interface.

2.6.1 Alarm Box Input

- Monitoring temperature: frequency type hygrothermograph.
- Monitoring humidity: frequency type hygrothermograph.
- Monitoring smoke: ionic smoke sensor or optical/electrical smoke sensor.
- Monitoring naked flame (optional): flame detector or hyper-thermo detector.
- Burglar proof monitoring: infrared monitor, optical/electrical monitor, door magnetic monitor.
- Other sensor inputs: Maximally 10 sensor inputs of the same type (except the temperature and humidity sensors) can be supported.

2.6.2 Alarm Indicator

The 10 red indicator on the alarm box panel correspond to the following alarm values:

- Fire alarm: alarm generated due to over heat or by smoke detector.
- Smoke alarm: overtime alarm generated by the smoke sensor.
- Temperature upper limit: alarm generated when the ambient temperature exceeds the upper limit.
- Temperature lower limit: alarm generated when the ambient temperature exceeds the lower limit.
- Humidity alarm: alarm generated when the relative humidity is not in the specified range.
- Soaking: alarm generated when the soaking detector is triggered.
- Air-conditioner status: alarm generated when a fault occurs to the air-conditioner.
- Optical/electrical: burglar alarm generated when the optical/electrical switch is triggered.
- Infrared: burglar alarm generated when the infrared sensor is triggered.
- Door magnetic: generated burglar alarm generated when the door magnetic switch is triggered.

When there are more than one input signals from the same type of sensors, they will be regarded an alarm event. Maximally 10 sensors of the same type (except the temperature and humidity sensors) can be equipped.

2.6.3 Interface for Actuators

The environment monitoring function of BTS also includes the following interfaces for actuators.

1) Six (A~F) constantly open/closed optional relays for controlling the protection devices. The usage of the relays (1A/220V) can be defined by users. By default,

- A starts the freezer. The relay is activated when the temperature exceeds the upper limit of the specified range.
- B starts the heater. The relay is activated when the temperature exceeds the lower limit of the specified range.
- C starts the dehumidifier. The relay is activated when the humidity exceeds the upper limit of the specified range.
- D starts the humidifier. The relay is activated when the humidity exceeds the lower limit of the specified range.
- F starts the burglar alarm device. The relay is activated when a burglar alarm occurs.

2) Two PWM outputs, driven by the collector open-circuit gate. The driving current is 300mA and the period (1 second by default) can be defined by users. The resolution is 8 bits (0~255).

3) Seven collector open-circuit gate outputs (driving current 300mA) for controlling the specified actuator.

2.6.4 Communication

There is two-way link between the alarm box and BCKM. The alarm box reports alarm status and monitored data to BCKM through the link. BCKM can send commands to control the alarm box to activate the protection devices and configure alarm parameters.

2.7 Lightning Protection System

2.7.1 Overview

Lightning may do great harm to telecommunication equipment. The damage is related to the external environment (weather, lightning protection and grounding) where the equipment is located and the protection condition of the equipment.

The lightning protection of telecommunication equipment should observe the following principles:

Systematic protection: Since information equipments are extensively connected and lightning surge is everywhere, protection only on equipment and board level is not enough. A systematic protection should be considered, including the equipment office (site) where the BTS is located.

Probability protection: Lightning is random and lightning protection devices cannot suppress all over-voltage and over-current. Although there is small probability of destructive lightning, the cost of protection is considerable.

Multi-level protection: IEC 61312 divides the equipment premises area into several lightning protection zones: LPZ0A, LPZ0B, LPZ1 and LPZ2, as shown in Figure 2-26.

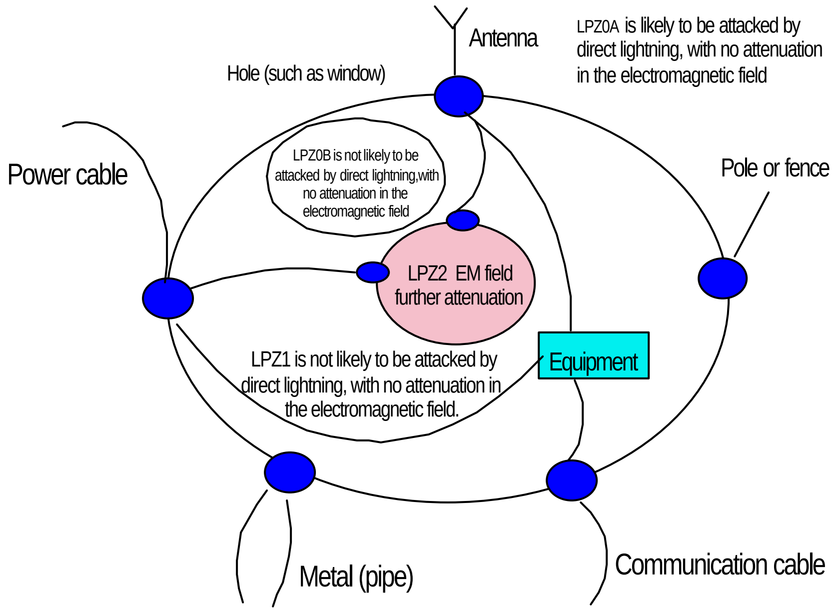


Figure 2-27 IEC 61312 division of lightning protection zone

BTS equipment is usually in LPZ1, and communication cables, power cables and antennae are usually in LPZ0A. Different protection measures are taken for different zones. The multi-level protection requires equipotential connection (equipotential connection means the connection of lightning apparatus, metal devices, foreign conductor, electrical appliances and telecommunication equipment located in the area with conductors or surge protectors) to minimize potential difference between metal parts and the systems.

Generally, to lower the probability of lightning attack to the BTS, the following three aspects should be considered: protection system of the room (site) where BTS is located, BTS internal lightning protection system, and their interoperation.

2.7.2 Lightning Protection for DC

I. Multi-level protection of power supply

The BTS power supply subsystem is normally in 5-level protection, as shown in Figure 2-28.

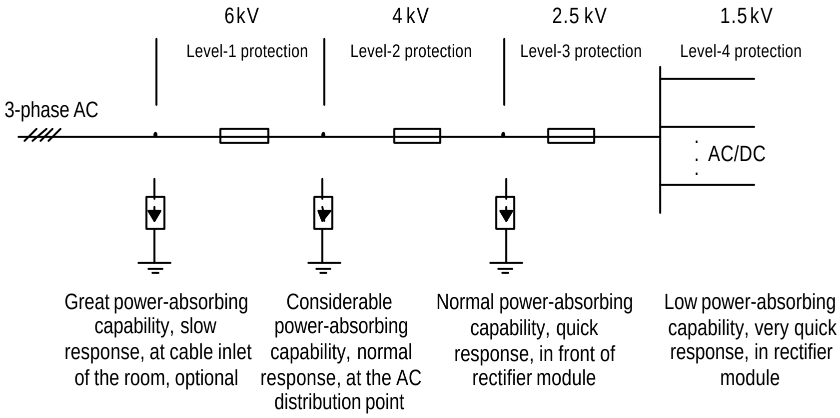


Figure 2-28 Illustration of lightning protection of BTS power

II. Principle of DC lightning arrester

Level-5 protection is a built-in integrated lightning arrester on the cabinet-top box. The operation principle is as shown in Figure 2-29.

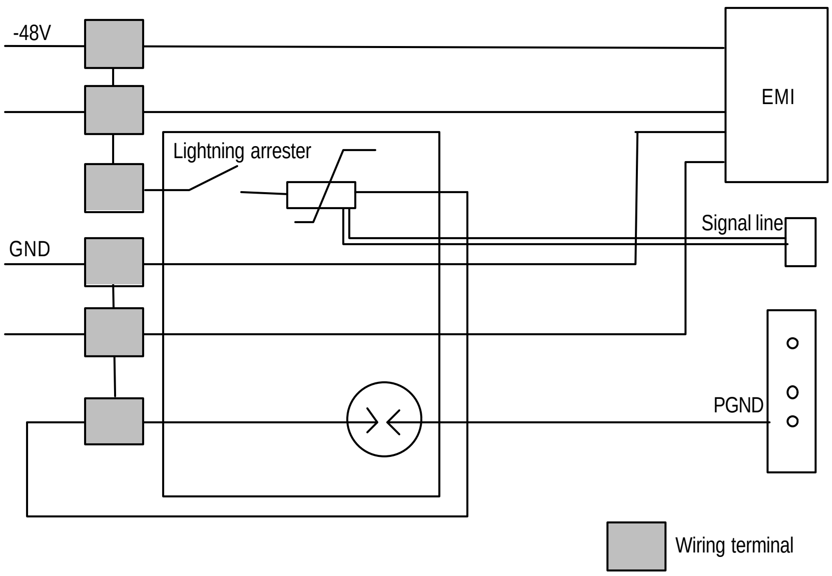


Figure 2-29 Illustration of lightning protection of BTS power

2.7.3 Lightning Protection for Trunk Line

I. Overview

Three kinds of trunk lines are supported in BTS: 75Ù coaxial cable (E1), 120Ù twisted pair (E1) and optical fiber. Lightning protection is out of question if optical fiber is used as the BTS is connected with fiber tail. For E1 trunk line, the BTS E1 surge protector (BESP) on top of the cabinet provides lightning protection.

II. Connection to BTS via E1 trunk line

The connection is shown in Figure 2-30.

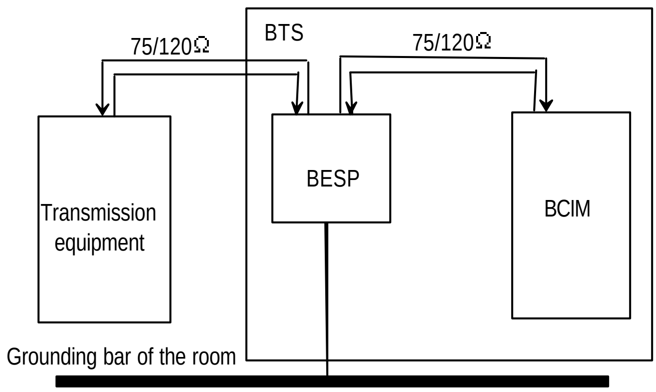


Figure 2-30 Connection to BTS via trunk lines

III. BESP introduction

E1 interface protection of BTS is implemented through a BESP on top of the cabinet. In consideration of the limited cabinet-top space or the convenience of installation, two identical BESPs are used, each with 8 pairs (16 PCS) of E1 lightning protection units, 1 DB37 connector and 2 DB25 connectors, as shown in Figure 2-31.

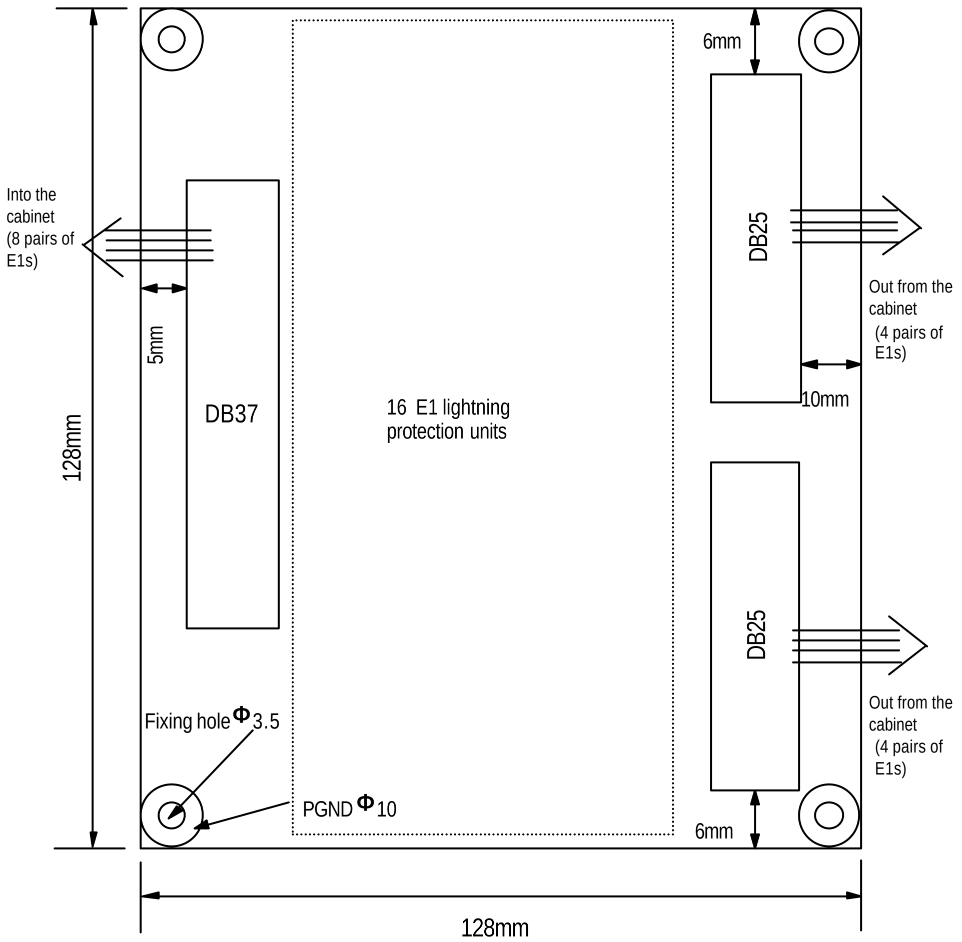


Figure 2-31 Physical appearance of BESP

E1 lightning protection unit has two inbound lines connected with DB25, two outbound lines connected with DB37, and one PGND. Here PGNDs of all lightning protection units can be interconnected. DB37 is male connector and DB25 is female connector, with 8 pairs of shielded E1 cables connected. 75Ù and 120Ù impedance match is provided with the cables. The principle of lightning protection units is as shown in Figure 2-32.

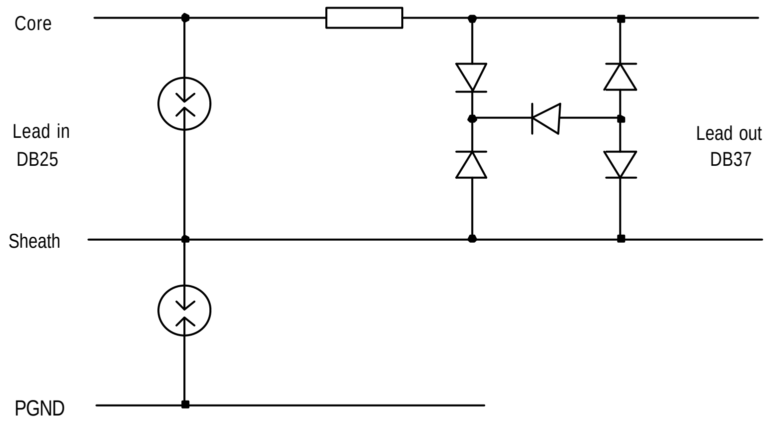


Figure 2-32 Principle of E1 lightning protection units

2.7.4 Lightning Protection for Antenna & Feeder Port

I. Lightning protection for RF antenna & feeder port

Antenna & feeder lightning protection is to protect against secondary lightning attack, i.e. inductive lightning. Inductive lightning means that the feeder receives inductive current at the moment of lightning attack, which may cause damage to the equipment.

Inductive lightning can be prevented effectively in three ways:

- The feeder is grounded at three points.
- Antenna DC is grounded. The inductive current on the conductor of the feeder can be discharged through the antenna.
- CDU/DFU's DC is grounded. The inductive current on the conductor of the feeder can be discharged through CDU/DFU.
- When DDU is configured, lightning arrester should be used between the feeder and indoor jumper.

With the above measures taken, up to 8kA lightning current can be endured.

II. Lighting protection for dual-satellite synchronization antenna & feeder

GPS/GLONASS antenna & feeder is protected with an additional lightning arrester to prevent the damage caused by the lightning current induced on the core of the antenna & feeder.

Lightning protection can be active or passive:

- Passive lightning protection: The low frequency lightning current is grounded based on microwave principle to provide protection.

- Active lightning protection: A discharge tube is used as the lightning arrester. When the voltage at both ends of the discharge tube comes to a specified value, the two ends will be connected, hence the lightning protection is realized.

The dual-satellite synchronization antenna & feeder adopts passive lightning protection. Its equivalent circuit is shown in Figure 2-33.

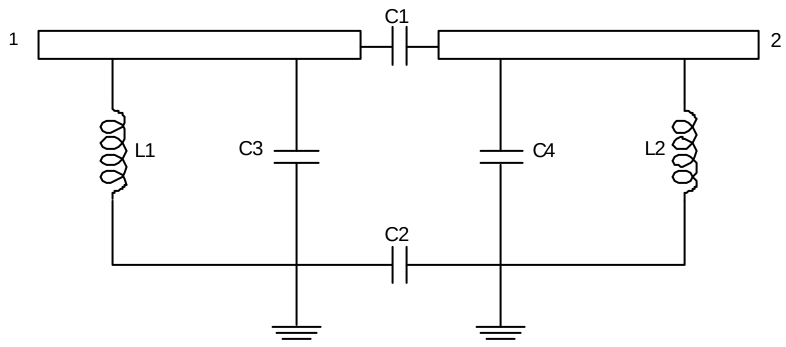


Figure 2-33 Lightning protection for BTS antenna & feeder port

3 Software Architecture

3.1 Overall Architecture

cBTS3612 software consists of applications and bottom layer software in terms of layer. And in terms of functional unit, there are main control software, O&M software, clock software, BCIM software, BCPM software, BRDM software and BTRM software.

Main control software, O&M software and clock software are compiled together, running on BCKM. Other software runs on their corresponding boards.

cBTS3612 software architecture is as shown in Figure 3-1.

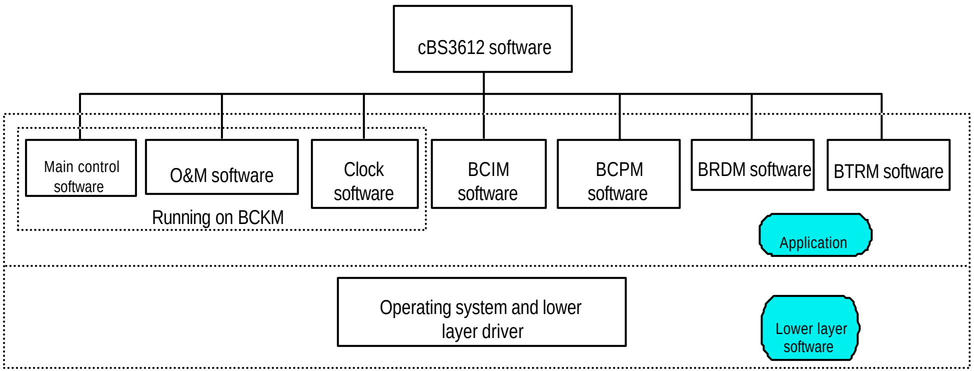


Figure 3-1 cBTS3612 software architecture

I. cBTS3612 applications

This part mainly realizes layered protocol of radio links and Abis interface protocol, exercises real-time management over radio resources and transmission equipment, as well as performs operation & maintenance to BTS equipment. The function of each software module will be detailed in "3.2 Module Description".

II. cBTS3612 bottom layer software

This part operates on a unified software platform. Bottom layer software includes operating system and bottom layer drivers. The operating system is a well-developed real-time multi-task imbedded operating system, which provides highly effective and reliable operations such as task dispatching, message management, timer management and memory management. The bottom layer drivers provide basic functions for the upper layer to operate the physical devices and for the calling by applications.

3.2 Module Description

3.2.1 Main Control Software

I. Function

The main control software is primarily used for the control of traffic flow. It communicates with BSC through Abis interface, and with BCPM, BTRM, OMU (operation & maintenance software) interfaces inside the BTS. BTS is connected with BSC through the main control software, jointly performing radio resources management on air interface.

II. Structure

The structure of the main control software is shown in Figure 3-2.

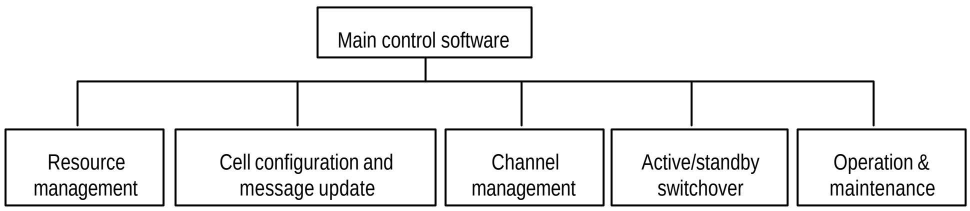


Figure 3-2 Structure of main control software

III. Software units

1) Resource management

This unit consists of four sub-modules:

- Resource status management: When BTS resource status changes, the main control software reports to BSC the current status of BTS resource, which will trigger BSC to perform logic configuration operation to BTS. At the same time, BTS regularly reports its resource status to BSC so that the logic resource status of BTS and BSC are consistent. Logic resources include cells, carriers, forward channels and reverse channels in the channel resource pool.
- Resource measurement report: Main control software submits the cell public parameter measurement report received from BTRM to BSC. Specific parameters include RSSI, carrier transmit power, etc.

- Resource blocking function: cells, carriers or channel elements can be blocked or unblocked.
- Resource checking function: Main control software checks the resources of BCPM regularly, such as dedicated channels and common channels, to make sure the resources allocated on both sides are identical.

2) Cell configuration and message update

This unit comprises three sub-modules:

- Cell configuration function: BSC makes logic configuration to the cell according to the availability status of the logic resource reported by BTS. Specifically, they are carrier attribute configuration of BTRM and cell common channel attribute configuration of BCPM. Carrier attribute configuration parameters include carrier band, carrier absolute frequency point number and carrier transmit gain. Cell common channel attribute configuration parameters include BASE_ID, cell ID, pilot PN sequence offset, cell gain, common channel number and attribute (including pilot type, pilot gain, SCH gain, QPCH quantity, QPCH gain, QPCH rate, PCH quantity, PCH gain, PCH rate, and ACH quantity).
- Overhead message update: after cell configuration, when the cell logic resource changes, it is necessary to update the overhead message of the cell. Overhead message includes system parameter message, access parameter message and synchronization channel message.
- Cell breath control: when the traffic load of adjacent cells is not balanced, BSC activates the cell breath control. The main control software reconfigures the cell attribute parameters as required by BSC, to perform cell breath function.

3) Channel management

This unit comprises 6 sub-modules:

- Paging channel message processing: transmit the paging channel message to corresponding BCPM according the parameters such as cell ID, absolute frequency point number and PCN.
- Access channel message processing: Main control software sends the access channel message received from BCPM access channel to BSC.
- Channel allocation and release: when a dedicated channel is to be set up, the main control software will first check information such as the carrier absolute band of the dedicated channel, channel type, RC, rate, frame length, and whether it is a branch of the existing channel for a softer handoff, then distribute channel resources in the corresponding channel resource pool and send message instruction to BCPM to set up the channel. Similarly, when a channel is to be released, the main control software first sends message instruction to BCPM to release the channel, then returns the released channel to corresponding channel resource pool. When a dedicated channel is to be set up

or released, main control software needs to distribute or release the AAL2 traffic link of the corresponding Abis interface.

- Physical channel modification function: in the process of a communication over a dedicated channel, BSC can modify some parameters of this channel on the physical layer. The parameters include: long code mask, reverse pilot gate control rate, forward power control mode and MS pilot gain. After receiving the message from BSC, the main control software identifies the BCPM number of the dedicated channel, and sends message to the BCPM board, instructing the modification of physical parameters.
- Common channel mutual-aid function: when part of channel elements in a channel resource pool are damaged, and part of or all of common channels in this resource pool are unavailable, the main control software will attempt to move the affected common channels onto some available channels. At the same time, BCKM will send message to BCPM, requesting it to re-establish these channels.
- Transmission delay report function: when the BTS seizes a reverse dedicated channel, or after the acquisition the air interface delay from the MS to the BTS changes over 1 chip, BCPM will report to main control software about the air interface delay of this dedicated channel. Then main control software forwards the channel delay information to BSC.

4) Active/standby switchover

To improve the system reliability, main control software works in active/standby mode. The active main control software backs up call data to the standby in real time. When the active equipment gets faulty, active/standby switchover will be conducted. Therefore the communication can continue on the channel without any interruption.

5) Operation & maintenance

The O&M functions include data configuration, status report, interface tracing, fault alarm, restart control, switchover control, log transfer and process reporting.

3.2.2 O&M Software

I. Function

Operation & maintenance software unit (OMU) is the maintenance control part of cBTS3612. Other software modules in the BTS have their own interfaces to the OMU.

OMU monitors the operation of BTS. It is the bridge between the O&M center (OMC) and all devices of cBTS3612. OMU is connected upward with OMC and downward with the function units of BTS. On one hand, OMU receives instructions from OMC, converts them into control unit instructions and sends them to the function units. On the other hand, OMU receives status report and alarm report from the function units, make proper processing and report to OMC.

II. Structure

The structure of the operation & maintenance software is shown in Figure 3-3.

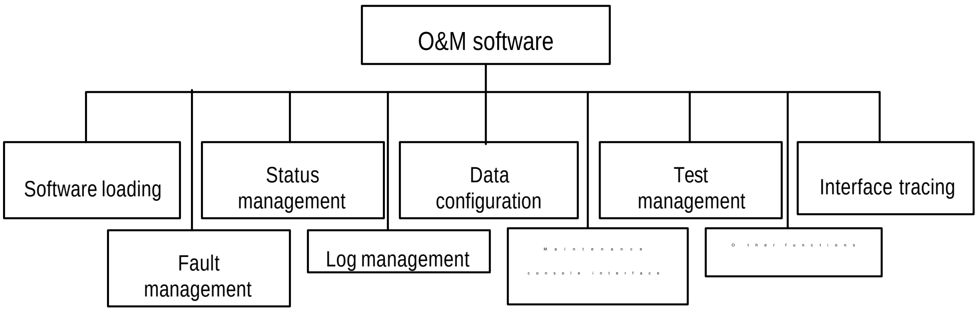


Figure 3-3 Structure of O&M software

III. Introduction to software units

1) Software downloading

Software of all parts of BTS (including O&M software) can be downloaded remotely. So it is not necessary to upgrade the software on the site of BTS.

2) Status management

This unit monitors the operation status of BTS boards, and perform block/unblock opertions for the channels.

3) Data configuration

This part configures the operation parameters of BTS boards, including BTS attributes, BTRM attributes and BCPM attributes, and manages Abis interface circuit.

4) Test management

It is responsible for vairous tests of BTS equipment, including functional test of the boards, pre-warning of faults and location of faults.

5) Interface tracing

This part traces the air interface messages, or other interface messages inside BTS, to help locate faults.

6) Fault management

This part monitors BTS internal alarms (such as board alarms) and environmental alarms (such as temperature, humidity, fire alarm). For serious alarms, the OMU can take protective measures such as shutting down the equipment to avoid further damage.

7) Log management

Equipment operations and abnormal information are recorded to help locate faults.

8) Maintenance console interface

With the local MMI, the user can perform operation & maintenance locally to the BTS via the Ethernet.

9) Other functions

Other functions include active/standby switchover, debugging, etc.

3.2.3 Clock Software

I. Funciton

The primary function of the clock software is to follow the standard 1PPS pulse signal output by the clock reference source module and GPS/GLONASS time information output from the serial port, and generate various clock signals synchronous with GPS/GLONASS system with the software phase-locking algorithm.

II. Structure

Structure of clock software is shown in Figure 3-4.

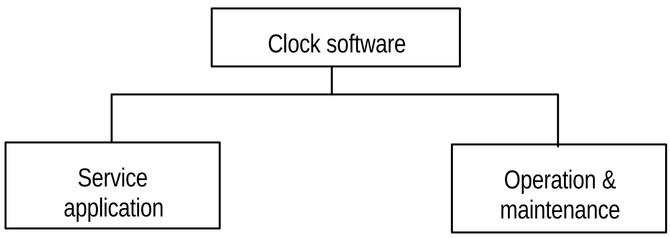


Figure 3-4 Structure of clock software

III. Introduction to software units

1) Service application

This unit consists of three functional sub-modules:

- Reference clock source serial port communication processing sub-module: the clock software supports three reference clock sources inputs: GPS, GLONASS and external input. The sub-module gets GPS time information from the serial port of the clock source (the present system uses GPS clock source), and distributes to the system via OMU.

- Software phase-locking sub-module: it combines the methods of hardware counting and software phase-locking to provide GPS/GLONASS synchronization clock signal for the system.
- Hardware phase-locking control sub-module: this sub-moduloe performs initialization settings for the devices of hardware phase-locked loop (PLL).

2) Operation & maintenance

- Public part: process messages related to OMU interface, such as public query, board self-check and related functions.
- Private part: impletement clock module operation parameter configuration, status management, alarm collection, alarm processing and reporting.

3.2.4 BCIM Software

I. Function

The primary function of BCIM software is to set up ATM transmission link on Abis interface between BTS and BSC, and perform transmission of signaling, traffic and O&M information between the two through related protocol stack. Specifically, it

- Receives OMU configuration command and configures ATM transmission link on Abis interface.
- In a frame of 128 cells, supports the maximum 8×1904kbit/s bandwidth of one ATM transmission link.
- Supports up to 7 ATM transmission links between BTS and BSC, with the bandwidth of each link being 1904kbit/s.

II. Structure

The structure of BCIM software is shown in Figure 3-5.

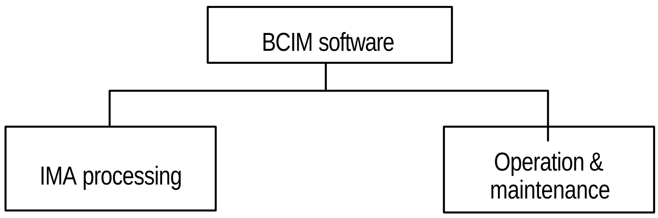


Figure 3-5 Structure of BCIM software

III. Introduction to software units

1) IMA processing

IMA (Inverse Multiplexing on ATM) processing includes: add or delete IMA link sets and IMA links dynamically, add or delete UNI links.

2) Operation & maintenance

- Public part: process messages related to OMU interface, such as log management, board self-check, public query, interface tracing, board software loading, link test, and related functions.
- Private maintenance: perform management of E1/SDH interface, IMA state machine and IMA configuration, BCIM board status management, alarm collection, alarm processing and reporting.

3.2.5 BCPM Software

I. Function

The function of BCPM software is to make operation and control to channel processors, specifically:

- Working with main control software to manage the traffic layer of BCPM.
- Common channel processing.
- Traffic channel processing.

II. Structure

The structure of BCPM software is shown in Figure 3-6.

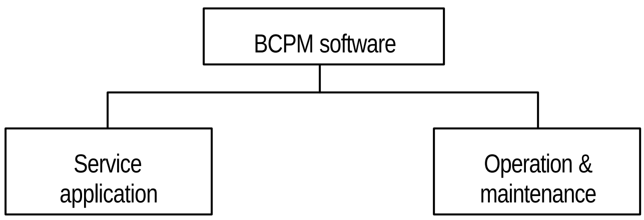


Figure 3-6 Structure of BCPM software

III. Introduction to software units

1) Service application

This unit consists of 3 functional sub-modules:

- Control & management sub-module: the sub-module sets up or release specified channels according to the control command sent from main control software. At the same, it exercises management over cell configuration and radio link.
- Common channel sub-module: under the control of the control & management sub-module, this sub-module sets up or releases common channel. For forward common channel, it dispatches messages and controls the corresponding driver to send messages on the air at correct time. For the reverse common

channel, it receives reverse messages on the air, and forwards them to BSC through the main control software.

- Dedicated channel sub-module: under the control of the control & management sub-module, it sets up or releases traffic channel. For the forward dedicated channel it receives data frames from BSC and sends them on the air at correct time according to the power set in BSC. For reverse dedicated channel, it receives reverse frame on the air interface, adds some information and sends them to BSC.

2) Operation & maintenance

- Public part: process messages related to OMU interface, such as log management, board self-check, public query, interface tracing, board software loading, link test, and related functions.
- Private part: perform channel processing parameter configuration, status management, alarm collection, alarm processing and reporting.

3.2.6 BRDM Software

I. Function

BRDM software is used to relay BTRM signaling and control baseband data. The main functions are:

- Relay of signaling for up to 36 BTRMs (including main control signaling and operation & maintenance signaling).
- Receiving OMU configuration command, controlling the relay of forward & reverse baseband data.

II. Structure

The structure of BRDM software is shown in Figure 3-7.

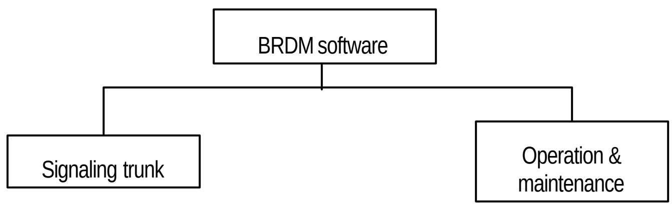


Figure 3-7 Structure of BRDM software

III. Introduction to software units

1) Signaling relay

This part performs BTRM signaling relay function, including two parts: BTRM signaling relay and relay interface matching. According to the format and protocol negotiated with BTRM software, it adapts signaling from OMU or BCKM and sends them to BTRM, or adapts signaling from BTRM and sends them to OMU or BCKM.

2) Operation & maintenance

- Public part: process messages related to OMU interface, such as log management, board self-checking, public query, interface tracing, board software loading, link test, and related functions.
- Private part: perform functions such as baseband trunk link configuration, BTRM signaling trunk link configuration, link quality monitoring, board status management, alarm collection, alarm processing and reporting.

3.2.7 BTRM Software

I. Function

BTRM software exercises management over BTRM. The main functions include:

- Cell carrier configuration, carrier parameter measurement and transmit gain compensation.
- Operation & maintenance over BTRM module.
- Ensuring the precision of BTRM clock through software phase-locking.
- Board device configuration, BFMM & environment monitor box management, and optical link delay measurement.

II. Structure

The structure of BTRM software is shown in Figure 3-8.

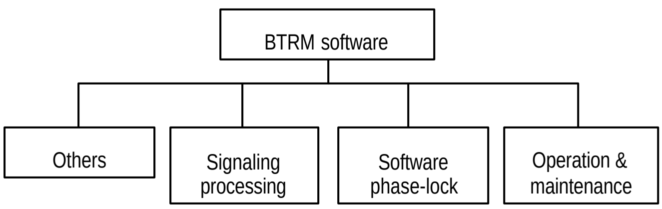


Figure 3-8 Structure of BTRM software

III. Introduction to software units

1) Signaling processing

This unit consists of 4 functional sub-modules:

- Carrier setting: BTRM software receives carrier configuration command from main control software, and configures the frequency and power class of the sector carrier.

- Public parameter measurement: BTRM makes a regular measurement of the forward transmit power and Received Signal Strength Indication (RSSI), and reports the measurement result to BCKM.
- Loopback test: BTRM software receives loopback test command from the main control software and returns the test data. This function is used for testing the logic link between BTRM and BCKM.
- Transmit path gain compensation: BTRM software modifies the gain of the transmit path according to the change of ambient temperature and the present working frequency, to ensure the stability of transmit power at antenna & feeder port.

2) Software phase-lock

BTRM software phase-lock unit controls the thermostatic crystal oscillator with software phase-locking algorithm so that the crystal oscillator can provide a clock with satisfactory frequency and precision to the system.

3) Others

This part consists of 2 functional sub-modules:

- Optical fiber delay calculation: when the optical fiber is long, the delay of optical link becomes significant. BTRM software can calculate the delay of the optical link and reports the result to OMU so that OMU can make necessary phase compensation.
- BFMM and environment monitor box management: BTRM software exercises management over the BFMM and environment monitor box, including storing & sending alarm information, sending control command and acquiring real-time status.

4) Operation & maintenance

- Public part: process messages related to OMU interface such as log management, board self-check, public query, interface tracing, board software loading, link test, and related functions.
- Private part: control the parameter configuration and operation status of RF system, monitor RF PLL status, and perform functions such as alarm collection, alarm processing and reporting.

4 System Function

This chapter describes the main functions of cBTS3612, including transmission networking, call procedure, signaling processing, baseband processing, RF functions, and operation & maintenance function.

4.1 Transmission Networking

cBTS3612 supports star networking, chain networking and tree networking.

Different networking modes are realized through the flexible configuration of BCIMs. Each BCIM provides 8 E1 interfaces and each cabinet can be configured with 2 BCIMs, so total 16 E1s can be configured.

I. Star networking

Star networking is the widely used, especially in the densely populated urban area. Start networking is as shown in Figure 4-1.

In this mode, each BTS is directly connected with BSC with an E1 trunk line. The networking is simple and maintenance is easy. Signals go through less links and the line is more reliable. Future expansion is easier. However, this mode requires much more transmission lines than any other mode.

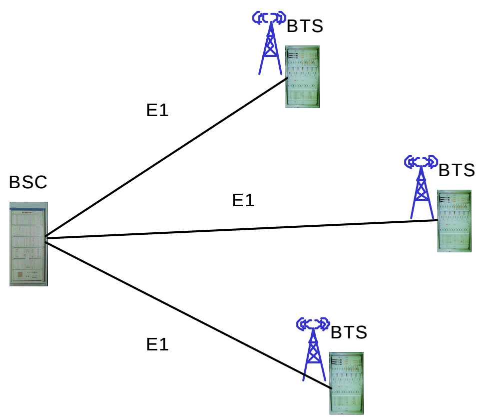


Figure 4-1 BTS star networking

II. Chain networking

Chain networking of the BTS is shown in Figure 4-2. It is applicable to sparsely populated stripe areas, e.g. along the highways and railways.

Chain networking is a perfect solution to certain requirements and can save the transmission resources.

The disadvantage of this mode is that signals should pass quite a few network sections, making the line less reliable. The nodes cascaded should not be more than 3.

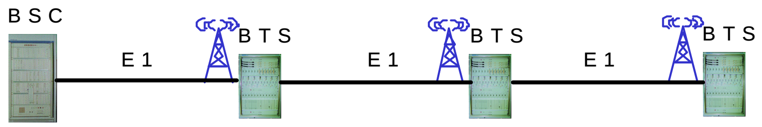


Figure 4-2 BTS chain networking

III. Tree networking

Tree networking mode applies to the area where network structure, site and subscriber distribution are complicated, such as the area where users are not evenly distributed. Tree networking is as shown in Figure 4-3.

In this mode, signals go through many links, so the line reliability is low, and implementation and maintenance are difficult. In addition, the fault in the upper-level BTS may affect the normal operation of the lower-level BTSs. Expansion is not easy and may cause substantial network reconstruction. However, tree networking requires much less transmission lines than star networking. The cascaded BTSs should not be more than 3 levels, i.e. the depth of the tree should not exceed 3 layers.

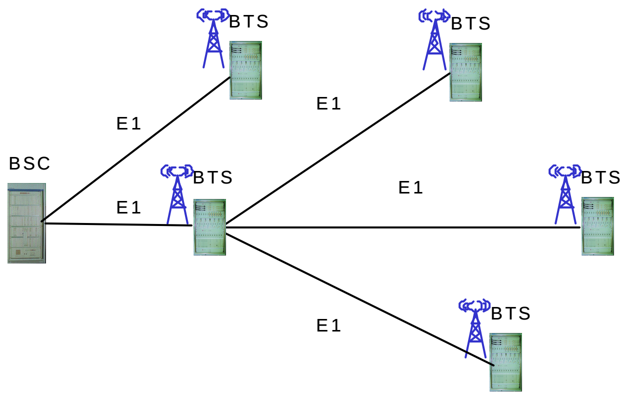


Figure 4-3 BTS tree networking

It is common practice that the above three modes be used together. Proper application of different modes inproves service quality and saves investment on the transmission equipment.

4.2 Call Procedure

Call procedure mainly includes speech service call procedure and data service call procedure. This section gives some typical examples to introduce the MS call procedures.

4.2.1 Speech Service Call Procedure

I. MS-originated call (MOC)

MS-originated call procedure is illustrated in Figure 4-4.

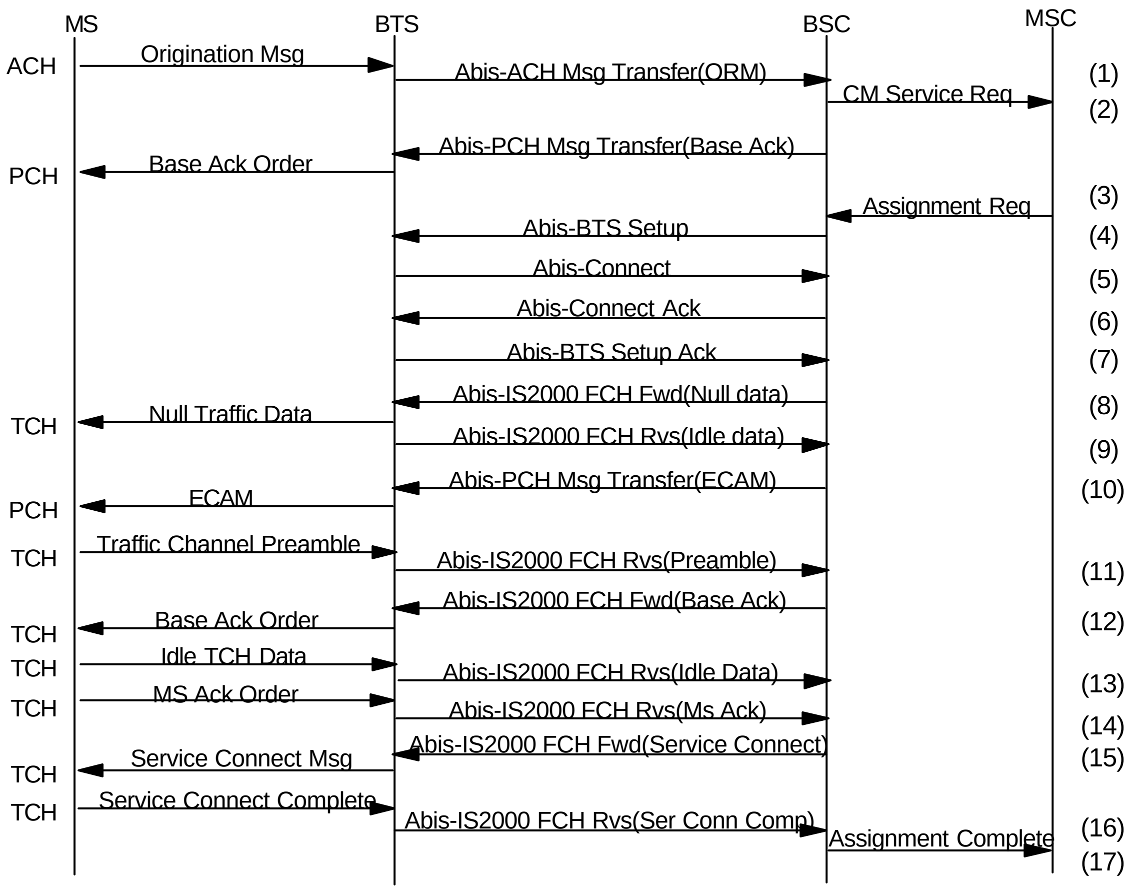


Figure 4-4 MS-originated call procedure

1) MS sends "Origination Message" on access channel. On receiving the message, BTS sends "Abis-ACH Msg Transfer" message to BSC.
2) BSC sends "CM Service Request" message to MSC, to request service assignment. Meanwhile, BSC sends "Base Ack" order to BTS via "Abis-PCH Msg Transfer" message. BTS sends "Base Ack Order" on paging channel to the MS.

3) MSC sends "Assignment Request" message to BSC to request BSS to assign radio resources.
4) BSC sends "Abis-BTS Setup" message to BTS, to request BTS to allocate radio resources for the call.
5) BTS sends "Abis-Connect" message to BSC, to establish Abis service connection.
6) BSC sends "Abis-Connect Ack" to BTS in response to the "Abis-Connect" message.
7) After resources allocation, BTS sends "Abis-BTS Setup Ack" message to BSC.
8) BSC sends "Abis-IS2000 FCH Fwd" message to BTS, and orders BTS to send null frame to MS.
9) After receiving "Abis-IS2000 FCH Fwd" message, BTS sends idle frame to BSC via "Abis-IS2000 FCH Rvs" message, and performs Abis link delay adjustment.
10) BSC sends channel assignment message to BTS via "Abis-PCH Msg Transfer" message. BTS forwards the channel assignment message to MS on paging channel.
11) MS begins to send traffic channel preamble on the assigned reverse traffic channel. After BTS captures the preamble, it sends traffic channel preamble to BSC via "Abis-IS2000 FCH Rvs" message.
12) After BSC receives traffic channel preamble from MS, BSC sends "Base Ack" order to BTS via "Abis-IS2000 FCH Fwd" message; BTS will send "Base Ack Order" to MS on the forward traffic channel.
13) After MS receives "Base Ack Order", it stops sending traffic channel preamble and starts to send data frame.
14) After MS receives "Base Ack Order", it sends "MS Ack Order" to BTS. BTS forwards the message to BSC via " Abis-IS2000 FCH Rvs" message.
15) On receiving "MS Ack" order, BSC sends "Service Connect" message to BTS via "Abis-IS2000 FCH Fwd" message, then BTS forwards the message to MS. MS starts to handle the traffic according to the designated service configuration.
16) To respond to service connection message, MS sends "Service Connect Complete" message.
17) On receiving the "Service Connect Complete" message, BSC sends "Assignment Complete" message to MSC.

II. MS-terminated call (MTC)

MS-terminated call procedure is shown in Figure 4-5.

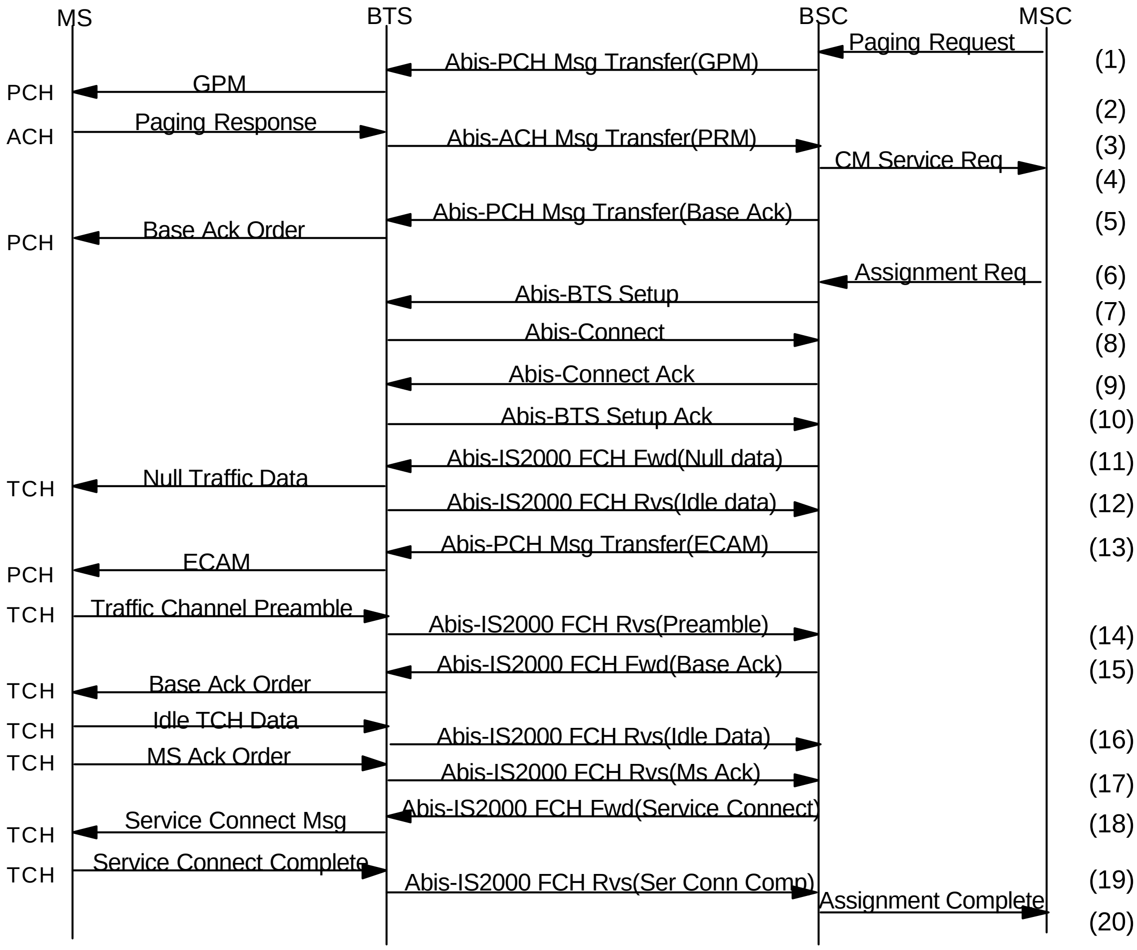


Figure 4-5 MS-terminated call procedure

1) MSC sends "Paging Request" to BSC.
2) BSC constructs General Paging Message (GPM), embeds it into" Abis-PCH Msg Transfer" message, then sends it to BTS. BTS sends the GPM on the paging channel.
3) After MS receives paging message, it sends "Paging Response" message (PRM) to BTS. BTS forwards it to BSC in "Abis-ACH Msg Transfer" message.
4) BSC sends "CM Service Request" message to MSC, to request service assignment.
5) BSC sends "Base Ack" order to BTS via "Abis-PCH Msg Transfer" message. BTS sends the "Base Ack" order on the paging channel.
6) MSC sends assignment request message to BSC, to request BSS to assign radio resources.
7) BSC sends "Abis-BTS Setup" message to BTS, to request BTS to allocate radio resource for the call.
8) BTS sends "Abis-Connect" message to BSC, to establish Abis service connection.

9) BSC sends "Abis-Connect Ack" to BTS in response to "Abis-Connect" message.
10) BTS completes resource allocation, and sends "Abis-BTS Setup Ack" message to BSC.
11) BSC sends "Abis-IS2000 FCH Fwd" message to BTS, to order BTS to send null frame to MS.
12) After receiving "Abis-IS2000 FCH Fwd" message, BTS sends null frame to BSC via "Abis-IS2000 FCH Rvs" message, and performs Abis link delay adjustment.
13) BSC sends channel assignment message to BTS via "Abis-PCH Msg Transfer" message. BTS forwards the message to MS on paging channel.
14) MS begins to send traffic channel preamble on the assigned reverse traffic channel. After capturing the preamble, BTS sends traffic channel preamble to BSC via "Abis-IS2000 FCH Rvs" message.
15) After BSC receives the traffic channel preamble sent from MS, it sends "Base Ack" order to BTS via "Abis-IS2000 FCH Fwd" message. BTS forwards the order to MS over the forward traffic channel.
16) After MS receives "Base Ack" order, it stops sending traffic channel preamble and starts sending data frame.
17) After MS receives "Base Ack" order, it sends "MS Ack" order to BTS. BTS forwards the order to BSC via "Abis-IS2000 FCH Rvs" message.
18) After BSC receives "MS Ack" order, it sends service connection message to BTS via "Abis-IS2000 FCH Fwd" message. BTS forwards the message to MS, and then MS starts to handle the service according to the designated service configuration.
19) To respond to service connection message, MS sends service connection complete message.
20) After BSC receives the service connection complete message, it sends assignment complete message to MSC.

4.2.2 Data Service Call Procedure

I. MS-originated data service

MS-originated data service procedure is shown in Figure 4-6.

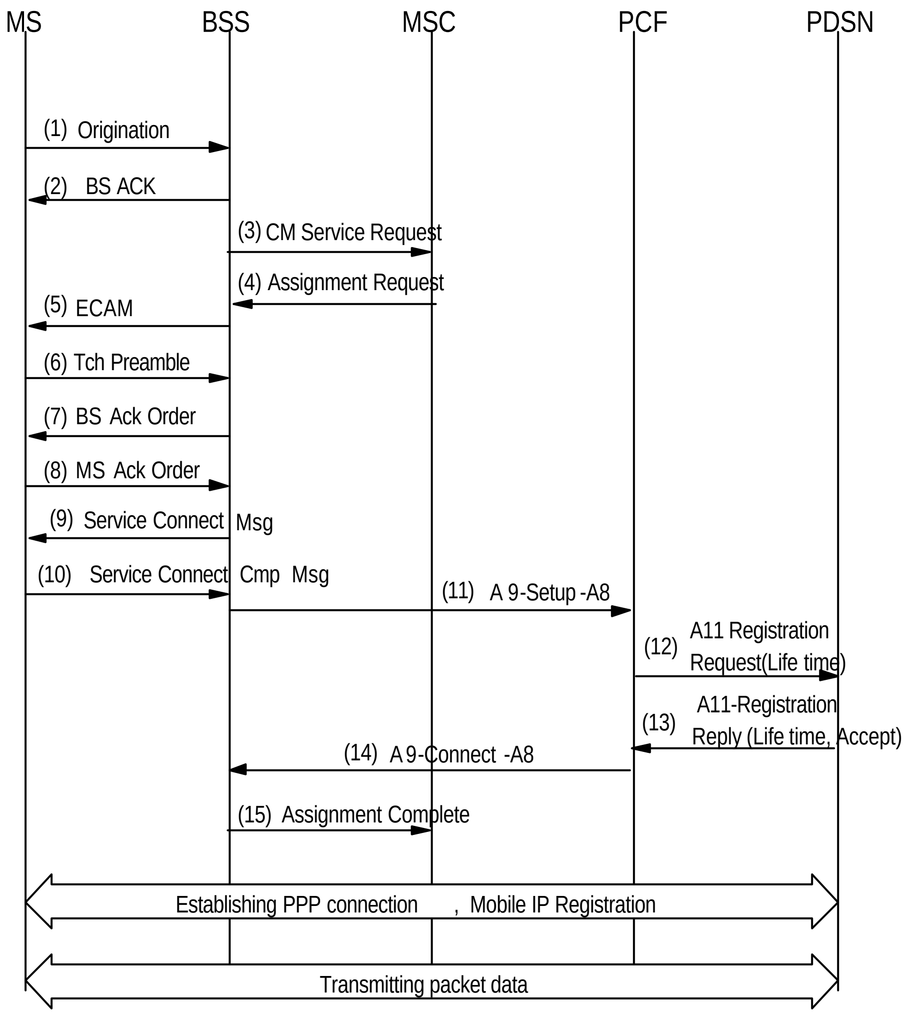


Figure 4-6 MS-originated data service procedure

1) MS sends origination message to BS via the access channel on air interface.
2) After BTS receives origination message, it sends BS acknowledgement to MS.
3) BSC constructs a CM service request message and sends it to MSC.
4) MSC sends assignment request message to BSC, to request BTS to assign radio resources.
5) BTS sends channel assignment message in the paging channel of air interface.
6) MS begins to send preamble in the assigned reverse traffic channel.
7) After acquiring the reverse traffic channel, BTS sends "BS ACK Order" to MS in the forward traffic channel.
8) After receiving "BS ACK Order", MS sends "MS ACK Order", and transmits the null service frame in the reverse traffic channel.
9) BTS sends service connection message/service selection response message to MS, and designates the service configuration used for the call. MS starts to handle the service according to the designated service configuration.

10) After receiving service connection message, MS responds with one service connection complete message.
11) BSC sends "A9-Setup-A8" message to PCF, to request to establish A8 connection.
12) PCF sends "A11-Registration-Request" to PDSN, to request to establish A10 connection.
13) PDSN accepts A10 connection establishment request, and returns "A11-Registration-Reply" message to PCF.
14) PCF returns "A9-Connect-A8" message to BSC; connection between A8 and A10 is established.
15) After both radio traffic channel and terrestrial circuit are established, BSC sends assignment complete message to MSC.
16) MS negotiates with PDSN to establish PPP connection cooperatively. In the case of Mobile IP access, Mobile IP connection will be established. PPP message and Mobile IP message are transmitted in traffic channel, and are transparent to BSC/PCF.
17) After PPP connection is established, the data service will enter connection state.

II. SCH establishment

This section describes MS-originated Supplemental Channel (SCH) establishment procedure, as for BSC-originated SCH establishment procedure, it is similar to MS-originated SCH establishment procedure which differs in the trigger condition. There is no special SCH release procedure when dynamically assigning SCH, instead, BSC will determines SCH rate and duration, once the time is due, SCH will be released. MS-originated SCH establishment procedure is shown in Figure 4-7.

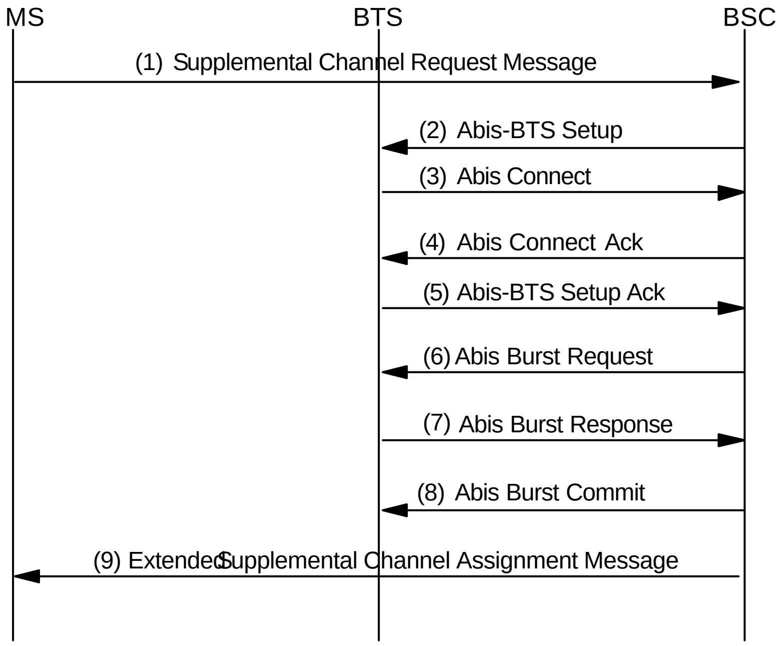


Figure 4-7 Reverse SCH establishment procedure

1) If the packet data call is established, MS may send "Supplemental Channel Request Message" to BSC for establishing SCH channel.
2) BSC sends "Abis-BTS setup" to BTS, to request BTS to allocate radio resource for the call.
3) After BTS establishes the channel, it sends "Abis-connect" to BSC.
4) BSC responds with "Abis-connect ack" to BTS.
5) After BTS establishes all of the channels, it sends "Abis-BTS setup Ack" to BSC, indicating the completion of terrestrial circuit establishment.
6) BSC sends "Abis-Burst Request" to BTS to activate BTS.
7) BSC responds "Abis-Burst Response" message to BTS.
8) BSC sends "Abis-Burst Commit" to BTS, and BTS starts to transmit SCH.
9) BSC sends "Extended Supplemental Channel Assignment Message" and assigns SCH channel for MS, so that the packet data service can be transmitted at high speed in SCH channel.

4.3 Signaling Processing

BTS signaling processing serves two purposes:

- Implement interconnection of MS and BSS/CN on the air interface layer.
- Perform part of radio resource management function under the control of BSC.

Specifically, BTS signaling processing performs the following functions: signaling processing on Abis physical layer and transmission layer, channel resource management, Abis traffic link management, BTS logic operation & maintenance processing, common channel processing, dedicated channel setup and release, traffic bearing and power control.

I. Signaling processing on Abis interface physical layer and transmission layer

Abis interface physical layer utilizes IMA technology. BTS sets up or deletes IMA link sets.

Abis interface data link layer utilizes ATM link. Signaling is adapted with AAL5 and traffic is adapted with AAL2.

II. Channel resource management

BTS organizes channel resource with a resource pool and is responsible for the allocation, release and management of the channel resource.

III. Abis traffic link management

BTS is responsible for assigning traffic link for Abis interface.

IV. BTS logic operation & maintenance

BTS processes the following logic operation & maintenance functions:

- Resource status indication
- Cell configuration function
- General message updating
- Cell breath control function
- Cell block/unblock function
- Radio measurement report function

V. Common channel processing

BTS is responsible for the setup and release of common channels and processing of common channel messages. Common channels include paging channel, access channel, etc.

VI. Setup and release of dedicated channel

BTS is also responsible for setup and release of dedicated channels.

VII. Traffic bearing

BTS processes Abis interface protocol, transmits the traffic channel data received from the air interface to BSC, and transmits the traffic data that received from BSC on the air interface.

VIII. Power control

BTS performs reverse quick power control and performs reverse outer loop power control with the coordination of BSC.

4.4 Baseband Processing

Baseband processing performs physical layer function on Um interface, processing baseband data of all full-duplex channels in CDMA system. In the forward direction (transmitting direction), it fulfills channel encoding, rate adaptation, interleaving, encryption, spreading spectrum and modulation. In the reverse direction (receiving direction), it fulfills multi-path signaling demodulation, de-interleaving, channel decoding and information bit extraction. For different RC, baseband processing is different. But basically it can be summarized as follows:

I. Forward channel baseband processing

In CDMA forward channel, the baseband processing of one traffic channel includes channel encoding, rate adaptation, block interleaving, long code scrambling, power control bit insertion, Walsh code spreading spectrum, signal modulation and baseband filtering, as shown in Figure 4-8.

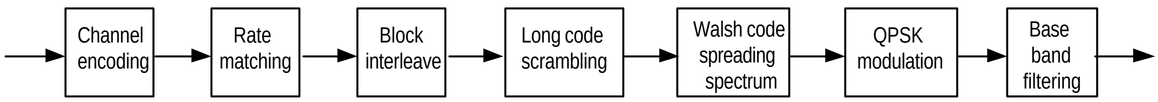


Figure 4-8 Baseband processing in forward channel

- Channel encoding

CDMA system uses convolutional code and Turbo code for channel encoding. Its main function is error correction. Convolutional code is used for ordinary speech service and Turbo code for high-speed data service.

- Rate adaptation

Since the system supports frames of different rates. The frame rates after channel encoding are different. Rates should be adapted to ensure that the rate of frame meets the requirement before entering the interleaver. In CDMA system, rate adaptation is realized by symbol repetition and code puncturing.

- Block interleaving

The purpose of interleaving is to resist fast attenuation in the radio channel environment.

- Long code scrambling

In the forward channel, long code scrambling is used to scramble the user data to provide encryption function.

- Walsh code spreading

In the forward channel, Walsh code is used to identify each user.

- QPSK modulation

Quadrature Phase Shift Keying (QPSK) modulation is used in the forward channel. PN short code is used in the modulation for scrambling and providing cell ID.

- Baseband filtering

This process implements pulse shaping without inter-code interference and suppression of out-band signal.

II. Reverse channel baseband processing

Baseband processing in the reverse channel includes multi-path signal demodulation, signal de-interleaveing, channel decoding, extraction of frame information data, as shown in Figure 4-9.

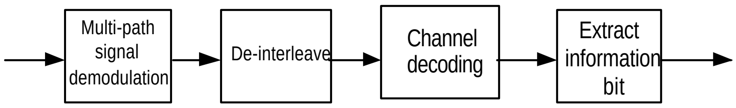


Figure 4-9 Reverse channel processing flow

1) Multi-path demodulation

With Rake technology, BTS can demodulate the radio multi-path signals and effectively combine multi-path energy.

2) De-interleaving

Signals received from an MS have been interleaved, so de-interleaving must be performed by BTS to recover the signals.

3) Channel decoding

MS uses convolutional code or Turbo code for channel encoding before transmission, while BTS decodes with Viterbi decoder or Turbo decoder at the receiving end based on the channel code type of the MS.

4) Extraction of frame information data

When transmission, MS adds Cyclic Redundancy Check (CRC) bits and a number of all-zero tail bits at the end of information bits to compose a transmitting frame. On receiving the frame, BTS performs CRC check and removes the non-information bit

(CRC check bit and end bit) to get the information bits, then sends them to the higher layer for processing.

4.5 RF Functions

cBTS3612 RF functions meet the requirements of TIA/EIA IS-97-D protocol. It features high transmission power, high sensitivity, flexible configuration, easy operation & maintenance, cell breath and diversity receiving.

4.5.1 Power Control

CDMA system is a self-jamming system, in which every subscriber is an interference source to other subscribers. If it is possible to ensure that every MS transmits the minimum power it needs, the whole system capacity can be the largest. Therefore, power control directly affects the system capacity and the service quality.

I. Purpose

The purpose of the power control is to

- Ensure conversation quality, meanwhile restrict the transmitting power on the forward and reverse links, thus minimizing the system interference.
- Overcome the far-near effect caused by the freely distributed mobile stations, so the signals of mobile stations whose distances to the BTS are different can reach the BTS with the same power.
- Realize the system soft capacity control.
- Prolong MS battery life.
- Minimize MS radiation to the human body.

II. Types

Power control can be divided into forward power control and reverse power control. The forward power control is used to control BTS' s transmit power, while the reverse power control aims to control MS' s transmit power.

1) Forward power control

Forward power control has various methods, whose applications are subject to the MS protocol version and the system parameters.

- PMRM (Power Measurement Report Message)

When the MS adopts PMRM power control method, it will determine the method and frequency of reporting PMRM in accordance with the received control message of the system parameter message.

- EIB (Erasure Indicator Bit) method

When the MS adopts EIB power control method, it will detect forward frame quality, and feed back the information to the BTS via EIB. The BTS will adjust the transmit power according to EIB information.

- Forward quick power control

MS will adjust BTS power according to power control bit (the maximum speed can reach 800bit/s). In cdma2000 1X system, large data service is supported. Therefore, the requirement on forward power control is increasingly strict. The forward quick power control method can control forward channel transmit power accurately, so as to reduce interference and improve the capacity.

2) Reverse power control

Reverse power control includes open-loop power control and closed-loop power control. The closed-loop power control can be sub-divided into inner loop power control and outer loop power control.

- Open-loop power control method

The MS will determine transmitting power intensity to access the BTS according to the received pilot signal strength.

- Closed-loop power control method

The BTS issues power control command to the MS, and performs the adjustment according to MS feedback. The principle of closed-loop power control is shown in Figure 4-10.

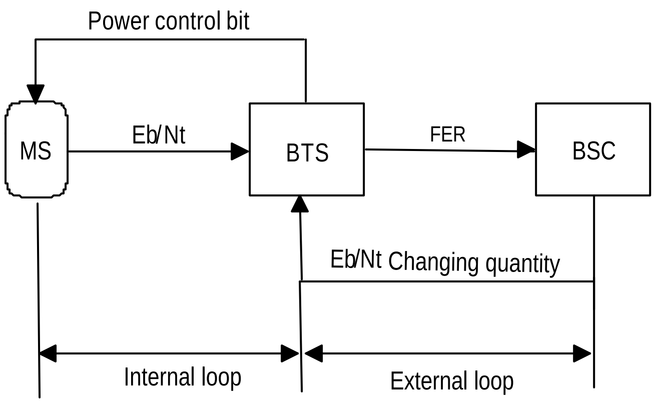


Figure 4-10 Closed-loop power control

Inner loop power control: the BTS will issue power control bit according to the received Eb/Nt.

Outer power control: the BSC will adjust Eb/Nt setting value according to the Frame Error Rate (FER) of the received reverse signal. Then the BTS will use the newly set

Eb/Nt value to issue power control bit, thus the purpose of indirectly controlling the MS is achieved.

4.5.2 Handoff

I. Types

The handoff can be divided into the following three types according to the different processing flow:

- Hard handoff

The MS will firstly interrupt the connection with the previous BTS, then set up the connection with the new BTS.

- Soft handoff

When the MS establishes the communication with a new BTS, it will not release the connection with the previous BTS.

- Softer handoff

It is the soft handoff occurred among different sectors in the same BTS.

II. Purpose

According to the purpose, the handoff can be divided into three types: rescue handoff, better cell handoff and traffic handoff.

- Rescue handoff

When the MS is leaving the cell coverage area and the conversation quality is unbearably poor, the handoff occurs in order to avoid the interruption of the call.

- Better cell handoff

If the rescue handoff condition is not triggered, this handoff may occur if conversation quality or network performance can be improved. The handoff is called better cell handoff because there is better cell for communication.

- Traffic handoff

This kind of handoff occurs when one cell is congested due to its heavy load and the adjacent cell is relatively idle. This mainly results from traffic peak within short time in a limited area due to some special events (such as sports, exhibition, etc).

4.5.3 Flexible Configuration

BTS supports the combination of three cabinets, so the maximum capacity can reach 36 sector-carriers. BTS supports 1~12 carriers for each sector, omni or directional coverage mode, and the configuration of 1~6 sectors. BTS can also control the sensitivity of the receive path and the transmit power to ensure that the forward link and the reverse link are balanced in the system.

4.5.4 Radio Configuration and Channel Support

I. Radio configuration (RC)

Um interface supports cdma2000 1X, and is compatible with IS-95A/B. The spreading rate is 1.2288Mcps.

The cdma2000 1X physical layer supports multiple radio configurations. Each radio configuration supports the frames of the different rate sets, and possesses different channel configuration and spreading spectrum structure. The supported transmission combinations include:

- Forward RC1, and reverse RC1;
- Forward RC2, and reverse RC2;
- Forward RC3 or RC4, and reverse RC3;
- Forward RC5, and reverse RC4.

With the different RC, cdma2000 1X presents different capabilities. RC1 and RC2 are compatible with IS-95A/B.

Each RC supports different traffic channel data rate. The specific data rates are listed in Table 4-1 and Table 4-2.

Table 4-1 Forward channel rates

Channel type		Channel rate (bit/s)
F-SYNCH		9600
F-PCH		9600, or 4800
F-QPCH		4800, or 2400
F-DCCH	RC3 or RC4	9600 (20ms frame)
	RC5	14400 (20ms frame)
F-FCH	RC1	9600, 4800, 2400, or 1200
	RC2	14400, 7200, 3600, or 1800
	RC3 or RC4	9600, 4800, 2700, or 1500 (20ms frame)
	RC5	14400, 7200, 3600, or 1800 (20ms frame)
F-SCCH	RC1	9600
	RC2	14400
F-SCH	RC3	153600, 76800, 38400, 19200, or 9600 (20ms frame)
	RC4	307200, 153600, 76800, 38400, 19200, or 9600(20ms frame)
	RC5	230400, 115200, 57600, 28800, or 14400 (20ms frame)

Table 4-2 Reverse channel rates

Channel type		Channel rate (bit/s)
R-ACH		4800
R-DCCH	RC3	9600(20ms frame)
	RC4	14400(20ms frame)

Channel type		Channel rate (bit/s)
R-FCH	RC1	9600, 4800, 2400, or 1200
	RC2	14400, 7200, 3600, or 1800
	RC3	9600, 4800, 2700, or 1500 (20ms frames)
	RC4	14400, 7200, 3600, or 1800 (20ms frames)
R-SCCH	RC1	9600
	RC2	14400
R-SCH	RC3	153600, 76800, 38400, 19200, or 9600 (20ms frame)
	RC4	307200, 153600, 76800, 38400, 19200, or 9600 (20ms frame)

II. Physical channel configuration

On Um interface is defined series of physical channels, which are divided into different types according to the channel features. Different RCs support different channels.

1) Forward physical channel

The configuration of forward physical channel is shown in Figure 4-11.

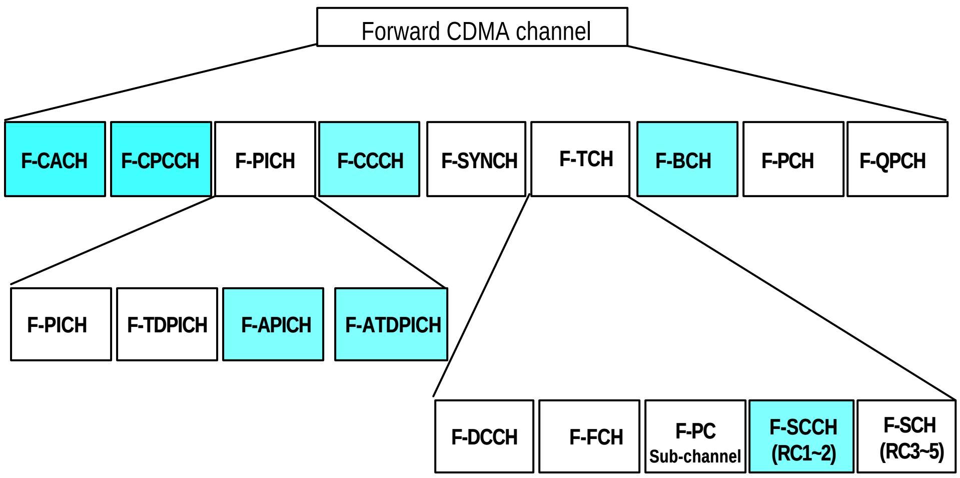


Figure 4-11 Forward physical channels

- F-CACH (Forward Common Assignment Channel)

F-CACH is specially used for transmitting the assignment information in quick response to the reversed channel, and provides the support for random access packet transmission in the reversed link. F-CACH controls R-CCCH (Reverse Common Control Channel) and F-CPCCH in Reservation Access Mode, and provides the quick acknowledgement in power-controlled access mode. In addition, it also provides congestion control function.

- F-CPCCH (Forward Common Power Control Channel)

F-CPCCH is used in the system to support multiple R-CCCH and R-EACH (Reverse Enhanced Access Channel) to perform power control.

- F-PICH (Forward Pilot Channel)

Signals are transmitted on F-PICH all the time. The BTS will transmit a fixed signal in the pilot channel. This signal serves to provide phase reference for the coherent demodulation of MS receiver to ensure coherent detection, and facilites MS to acquire synchronization signals from the synchronization channel and sector identification information.

If the sector supports transmit diversity, it is necessary to configure F-TDPICH (Forward Transmit Diversity Pilot Channel).

Smart antenna or beam shaping formation technology is adopted, the BTS will provide one or more F-APICHs (Forward Assistant Pilot Channel) on the forward channel to improve the system capacity and coverage.

When diversity transmit method is used in CDMA channel with F-APICH, BTS will provide corresponding F-ATDPICH (Forward Transmit Diversity Assistant Pilot Channel).

- F-CCCH (Forward Common Control Channel)

F-CCCH provides encoding interleave spreading and modulation spread spectrum signals, used by the MS in the BTS coverage area. BTS will send the system information and the designated MS information on this channel.

- F-SYNCH (Forward Sync Channel)

The MS in the coverage of BTS gets initial synchronization information from F-SYNCH. The rate of synchronization channel is 1200bit/s and the frame length is 26.667ms. The PN of pilot signal in I channel and Q channel of synchronization channel is the same as the PN in the pilot channel of the same BTS.

- F-TCH (Forward Traffic Channel)

F-TCH is used to send the user information and signaling information to an MS during the call. F-TCH can be sub-divided into:

F-DCCH (Forward Dedicated Control Channel): bears traffic information and signaling information.

F-FCH (Forward Fundamental Channel): bears traffic information.

F-PC sub-channel (Forward Power Control sub-channel): is the signals are sent only in forward fundamental channel or forward dedicated control channel.

F-SCCH (Forward Supplemental Code Channel): bears traffic information, applicable to RC1 and RC2.

F-SCH (Forward Supplemental Channel): bears traffic information, applicable to RC3, RC4 and RC5.

- F-BCH (Forward Broadcast Channel)

F-BCH is used by BTS to send the system information and necessarily broadcast message (such as short message). F-BCH operates in discontinuous mode.

- F-PCH (Forward Paging Channel)

F-PCH is used by BTS to send the system information and MS-specific information to MS.

Paging channel can be used to send the information with the fixed data rate of 9600bit/s or 4800bit/s. In a certain system (with the same system identification number), all paging channels send the information with the same data rate.

The frame length of paging channel is 20ms. Each frequency of the sector can support seven paging channels at most.

- F-QPCH (Forward Quick Paging Channel)

This is used to send paging order and the system configuration changing order to MSs working in sub-timeslot mode, instructing them to receive the paging messages. Thus the MS battery energy can be saved.

Quick paging channel can be divided into some 80ms timeslots. Each timeslot can be divided into paging order and configuration changing order. The data rate that can be supported is 9600bit/s or 4800bit/s.

Note:

In Figure 4-11, the channels in shadow will be supported in subsequent version.

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2) Reverse physical channel configuration

The configuration of reverse physical channel is shown in Figure 4-12.

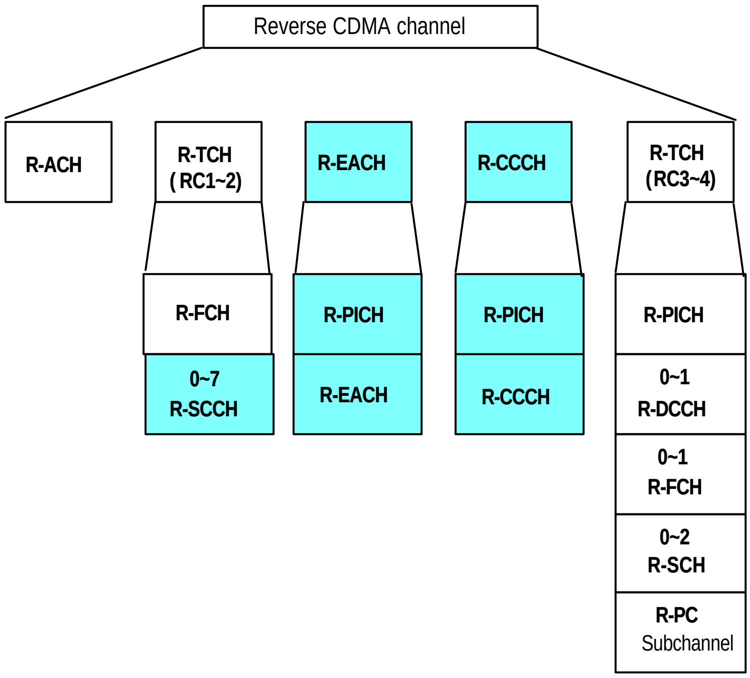

Figure 4-12 Configuration of reverse physical channel

- R-ACH (Reverse Access Channel)

R-ACH is used by MS to originate the communication with BTS, and respond to paging channel message. MS uses random access protocol to originate access procedure. Regarding each of the supported paging channel, Maximum 32 access channels can be supported.

- R-TCH (Reverse Traffic Channel)

R-TCH is used by MS to send the user information and signaling information in the course of the call.

In the configuration of RC1~RC2, R-TCH can be sub-divided into:

R-FCH (Reverse Fundamental Channel), and

R-SCCH (Reverse Supplemental Code Channel).

In the configuration of RC3~RC4, R-TCH can be sub-divided into:

R-PICH (Reverse Pilot Channel) assisting BTS to capture MS and improve receiving performance,

R-DCCH (Reverse Common Control Channel) used to bear traffic information and signaling information,

R-FCH (Reverse Fundamental Channel) used to bear traffic information,

R-SCH (Reverse Supplemental Channel) used to bear the traffic information, and

R-PC subchannel (Reverse Power Control sub-channel), only used to configure RC3 and RC4. The MS shall supporting inner loop power control and outer loop power control on this channel.

- R-EACH (Reverse Enhanced Access Channel)

R-EACH is used by MS to originate the communication with BTS, or respond to the message that is specially sent to MS. R-EACH adopts random access protocol and supports two types of access modes: Basic Access Mode and Reservation Access Mode.

- R-CCCH (Reverse Common Control Channel)

R-CCCH is used to send the user and signaling information to BTS in case of not using reverse traffic channel. Two access modes are supported: Reservation Access Mode and Designated Access Mode.

Notes:

In Figure 4-12, the channel in shadow will be supported in the subsequent version.

For the location and function of the above channels in call procedure, please refer to "4.2 Call Procedure".

4.5.5 Easy Installation and Operation

RF blind mate technology is used in RF part of BTS. During the installation or maintenance, the user just need to insert the modules into corresponding slots of the subrack, and the tedious work of cabling is saved. BTS RF system can be remotely controlled by OMC, transmit power, receiver sensitivity and receive/transmit frequency can be modified easily. Alarm signal generated in RF part is reported to OMC. In this way, the operator can control and monitor the operation of RF part.

4.5.6 Diversity Receiving

BTS supports diversity receiving function, which is realized through two sets of independent receivers (including antenna, feeder, CDU/DFU, RLDU).

The two receivers demodulate the received signals at the same time, and then the baseband processing unit decodes the signals with diversity mergence algorithm to obtain diversity gain. Diversity receiving enhances BTS receivers' capability to resist attenuation, so that the BTS can achieve satisfactory receiving effect even in complicated radio transmission conditions.

4.5.7 Cell Breath

BTS can control the transmit power and receive sensitivity so as to adjust the effective coverage of cells and balance the system load. This feature is especially important to CDMA system. The control range of transmit power and receive sensitivity provided by BTS for cell breath is 24dB. The transmit power is regulated at a step of 0.5dB and receive sensitivity at a step of 1dB.

4.6 Operation and Maintenance

4.6.1 Software Loading

I. Overview

BTS supports remote software loading and local loading from an LMF. The configuration data of BTS can be loaded to OMU through software loading function.

Software loading procedure consists of two steps: Software is downloaded to BCKM through OMC/LMF, and then BCKM transfers the software to other boards.

When BTS is powered on and starts operation, the boards will run the existing software in its Flash Memory. Only when the software is upgraded will download command be sent through OMC, LMF or FTP tool to activate the software downloading process.

II. Software loading from OMC to BCKM

In software upgrading, the software is downloaded from OMC to BCKM memory, and then saved in the Flash Memory of BCKM. BTS configuration data can also be downloaded to OMU with this function.

III. Software loading from BCKM to other boards

Through OMC or LMF, the downloaded software saved in the Flash Memory of BCKM can be loaded to any specified board and activated. In this way, software online upgrading is achieved.

IV. Local/remote software loading from FTP

BTS support local and remote software downloading and activation. If necessary, user can start an FTP Client application and log on to BTS through LMF or RMF, download the software to a specific board of BTS and activate the software.

4.6.2 Interface Management

I. Abis interface management

Abis interface management procedure includes the allocation, setup and management of Abis interface transmission links (including E1/optical link, ATM link and TCP/IP link). The ATM link setup procedure is first originated through a default OML PVC. After the IP address is obtained through BOOTP flow, TCP link setup procedure is activated to complete the setup of OML link. The allocation of PVP, PVC, TCP/IP links (including signaling channel and traffic channel) are allocated through Abis interface management procedure, which is a part of BTS configuration.

Setting up signaling channel is to allocate ATM (bearing AAL5 link) transmission path (i.e. allocate VPI and VCI) and IP address on Abis interface of the signaling channel, and complete the connection of transmission paths.

Setting up traffic channel is to allocate ATM (bearing AAL2 link) transmission path (i.e. distributing VPI, VCI) on Abis interface of the traffic channel and switch the traffic to internal link transmission path to complete the connection of transmission paths. Actually, AAL2 link is set up and released dynamically.

Disconnection of traffic channel is the disconnection of ATM transmission path on Abis interface. When BTS configuration changes, Abis configuration can be changed or this function may be used for maintenance.

II. Air interface management

Main function of the logic part of air interface management is fulfilled by logic operation & maintenance part. The air interface management involves some O&M functions related to implementing radio communication, including configuration of BTS transceiver attributes and channel attributes configuration.

BTS transceiver attributes include parameters such as CSM chip parameter, physical channel transmit format, sector bypass, sector delay, antenna connection status, and transmit diversity (OTD) selection. The configuration of BTS transceiver attributes is activated by OMC through sending configuration message. The result of the operation is that attributes of the corresponding BTS objects are set to specified status.

Channel attributes are the driving parameters of the channel element, including channel type and channel gain. Channel attributes configuration is activated by OMC through sending configuration message. The result of the operation is that attributes of the corresponding BTS objects are set to specified status.

4.6.3 Test Management

Test management is an important function of BTS maintenance. When a BTS fault occurs, test will be conducted to locate the problem. In the process of BTS operation, it is also necessary to make regular tests to some items so as to monitor the performance change of BTS.

BTS provides powerful test functions, including:

1) Self-test

Self-test is to check the software and hardware of boards under the control of board software. During the test, normal service functions may be affected.

- Site self-test: all boards in BTS perform self-test.
- Board self-test: specified boards perform self-test.

2) Loopback test

The control console determines the data and length of loopback. Loopback data are sent from the control console, forwarded by OMU to the high layer of board software, and looped back. Then OMU will make judgment whether the data are correct and return the information to the control console.

4.6.4 Status Management

Board status serves as a base for determing system working status, resource distribution and fault locating. Board status includes the operational status that describes the operation condition of the board, availability status, and additional status that describes active/standby and chip status of the board.

Active/standby status is defined as follows:

Status (active/standby)	Description
Active	Active board, or there is no standby board
Standby	Standby board

Chip status is defined as follows:

Status (chip status)	Description
Not mounted	Not installed
OK	Good
Error	Poor

Operational status describes the operation of the board, which is defined as follows:

Status (Operational status)	Description
Enabled	Permitted
Disabled	Prohibited

Availability status is the explanation of the operational status, which is defined as follows:

Status (availability status)	Description	Cause
Failed	Operation is abnormal due to serious fault (alarm message can still be reported).	Critical alarm occurs.
Power off	Operation is abnormal due to interruption of communication with OMU.	Board is not in position. Board is initialized. Board communication is interrupted. The status is usually caused as OMU can not detect any board.
Offline	Operation is abnormal since data are not configured. .	The status occurs after board software/hardware are installed but configuration data is not received.
Blocked	Operation is abnormal since block command is received, operation is abnormal.	This status occurs after lock command is received and before unlocked command is received.
Dependence	Operation is abnormal due to fault of related resource.	Other resource failure.
Not installed	Operation is abnormal since software or hardware is not installed.	This status occurs between board initialization and the sending of configuration data. In this period, the software may be downloaded or activated.
Degraded	Fault is not serious, performance is lowered and the system operates at a low level.	Minor alarm occurs.
In test	In test status, irrelevant to operation status.	Test status.

Status management maintains the consistency of OMC and BTS status, and provides status query function.

4.6.5 Event Reporting and Processing

Event reporting & processing is very important for BTS operation. Event reporting means a report is generated when there is error or alarm inside BTS. This may indicate that a dangerous event has occurred or will occur very soon.

BTS has two types of alarms: board alarm and environment alarm.

I. Board alarm

When an alarm occurs or disappears on a board, the board reports the message to OMU, which forwards it to OMC in due course. Some measures may be taken as necessary to clear the alarms. The causes of alarms may include the following ones:

1) Transmission and communication alarm

There are E1 port local/remote OFF alarm and loop interruption alarm.

2) Clock alarm

There are various clock source alarms and phase-locked loop failure alarm.

3) Power alarm

There are over-voltage or under-voltage alarm, and power failure alarm.

4) Other alarms

There are board hardware fault, internal bus alarm and software running error.

After receiving the board alarm message, OMU takes measures according to the alarm severity. For critical alarm, the board will be resetted or the carrier powered off immediately to minimize the damage. OMU reports all alarms to OMC, which will be shown on the graphic user interface of OMC.

II. Environment alarm

BTS internal environment alarms are collected by OMU, and external environment alarms are collected by an external environment alarm collection box. External environment alarms include fire, smoke, illegal invasion, soaking, temperature, humidity and other alarms. After receiving the environment alarm, OMU activates external devices through the alarm box, such as air-conditioner, fire-distinguisher, smoke scrubber, dehumidifier or siren. At the same time, OMU reports the alarms to OMC, which will be displayed on graphic user interface of OMC.

4.6.6 Equipment Management

Equipment management here means general management oriented to physical objects (hardware). Management and operation of special equipment may also be involved.

I. General function

1) Operation startup

Equipment operation involves startup procedure and synchronization problem. Operation startup function serves this purpose, i.e. the equipment should be started in correct time. OMC sends operation startup command and the result of execution is the startup and operation of the specified object.

2) Equipment switchover

Important boards are designed with active/standby configuration. When the active board gets faulty, service can be switched to the standby board automatically or under control to reduce the loss. In addition, OMC can also send command to make an object switched. Equipment is be switched over because a fault has occurred or a switchover command is received from OMC (LMF). The result of the operation is that the active is switched to the standby and vice versa.

3) Re-initialization

A managed object may need to be re-initialized for some reasons (usually a fault has occurred to the equipment or a great deal of data need to be re-configured). Then OMC can directly send commands to make it re-initialized. Hierarchical initialization function is provided, i.e. part of or all of boards can be reset.

OMC sends re-initialization command. The result of execution is that the specified object will be re-initialized.

4) Setting site control output

Some additional devices on the site, such as air-conditioner, power switch, fire-fighting equipment and door control, need additional control paths. This function is designed for this purpose.

OMC sends site control output command and the result of this function is that the specified controlled object acts as required.

II. Configuration management for special devices

This function completes the configuration management of some special functional units of BTS, including clock configuration, BCIM configuration and BRDM configuration.

1) Configuration of clock parameters

The function of BTS clock module is to provide radio synchronization clock. CDMA system is a synchronized communication system, which requires strict time synchronization between base stations. The reference time of the public CDMA system is GPS time, but the system can also locks and synchronized to UTC (Universal Coordinated Time). Synchronized with GPS via the local high-precision thermostatic crystal oscillator, CLK module of the board divides the frequency to get the internal clock signals.

To ensure normal operation of the clock module, the following data should be configured:

- Length of antenna & feeder

Delay is compensated according to the length of antenna & feeder and the delay of the unit length.

- Time zone

Default time zone is Beijing time.

- Time reference

GPS time or UTC time may be used. If GPS time is used, there is no leap second correction, which means that the second value is 0~59. If UTC is used, there is leap second correction, i.e. the second value is 0-60. In one network, only one time reference should be used.

The parameter configuration messages of this function are sent by OMC. The result of this function is that clock module outputs satisfactory clock signals.

2) BCIM configuration

BCIM configuration includes:

- IMA link group and link configuration.
- Configuration of various ATM links used locally, including Abis signaling link, OML and traffic link.
- Configuration of trunks of other BTSs when the local BTS is cascaded.

3) BRDM configuration

BRDM configuration includes the connection parameters of BCPM and BTRMs that are connected with this BRDM, such as port number and timeslot number of BCPM and BTRM. The purpose is to generate switching network tables and control parameters of BRDM.

4.6.7 Site Configuration

Site configuration management involves the configuration management of BTS general structure, including site capacity and connection relation. Main functions include board configuration, antenna & feeder connection configuration, power amplifier connection configuration and BTS local cell configuration.

I. BTS hardware configuration

BTS hardware configuration is to add or remove specified physical board for site configuration.

OMC sends hardware configuration message and the result of execution is that BTS board is in the specified configuration status.

II. Antenna & feeder connection configuration

BTS antenna & feeder connection configuration is to configure antenna & feeder connection diagram for BTS, so that BTS can get information about the division of local cells and some alarm related information when a fault occurs.

OMC sends antenna & feeder connection configuration command. The result of execution is that BTS configures antenna & feeder connection diagram according to the command and provides local cell division relation of BTS.

III. BTS local cell configuration

BTS local cell configuration is to provide BTS with information such as distribution relation of BTS equipment defined by the connection relation, including number of carriers and number of channel elements can be configured for each carrier.

OMC sends BTS local cell configuration message and the result of execution is that BTS gets the local cell configuration relation.

4.6.8 Operation Status Tracing

Operation status tracing is an important approach to check when the system is operating normally.

One function is to trace the high-layer interface messages between OMC and BSC, between BSC and BTS, and between the functional units of BTS, including:

- Abis O&M message between OMC and OMU.
- O&M message between OMU and other functional units inside BTS.
- Abis signaling between BSC and BCKM.
- Interface message between BCKM and BCPM/BTRM.
- Communication message between active and standby boards.

This function supports the tracing on multiple interfaces from several control consoles at the same time.

The other function is to trace the board resource information such as CPU availability and temperature.

4.6.9 Other Functions

I. Version management

It refers to the management and query of software/hardware versions.

II. Fan and power management

Maintenance functions for the internal devices of BTS, such as fan and power supply, are available.

5 System Configuration

This chapter introduces cBTS3612 system configuration, based on which some typical configuration examples are given. With this chapter, users can get a basic understanding of cBTS3612 configuration principle.

5.1 Overview

BTS consists of the following parts in physical structure:

- Power distribution box
- Baseband subrack
- Fan subrack
- Power supply subrack
- RF subrack
- RLDU subrack
- CDU/DFU subrack

BTS is designed to accommodate 36 sector-carriers in full configuration, and supports the combination of 3 cabinets (one basic cabinet and two extended cabinets). The difference between a basic cabinet and an extended cabinet is that a basic cabinet needs a baseband subrack and fan subrack The basic cabinet and extended cabinet are connected with optical fibers.

One cabinet supports as many as 12 sector-carriers. Main configuration modes include omni cell, 3-sectors and 6-sectors configurations.

5.1.1 Basic/Extended Cabinet Configuration

Configuration of a basic cabinet is as shown in Figure 5-1.

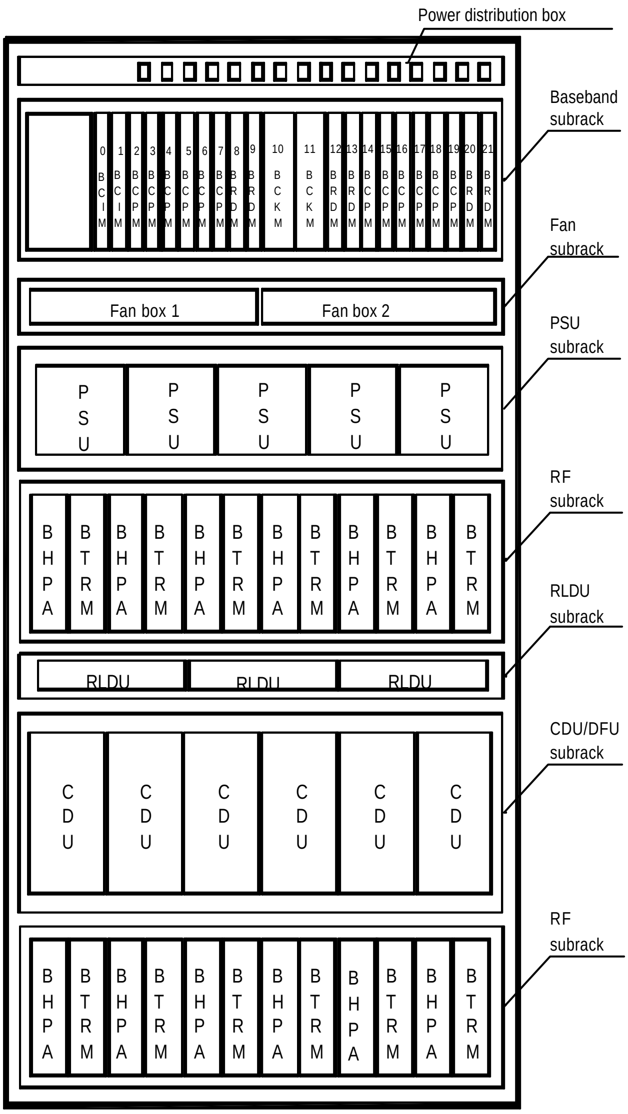

Figure 5-1 Configuration of a basic cabinet

Difference between basic cabinet and extended cabinet: Boards are not necessary in the baseband subrack of the extended cabinet, and the fans also are not necessary in fan subrack.

The front view of a basic cabinet is shown in Figure 5-2.

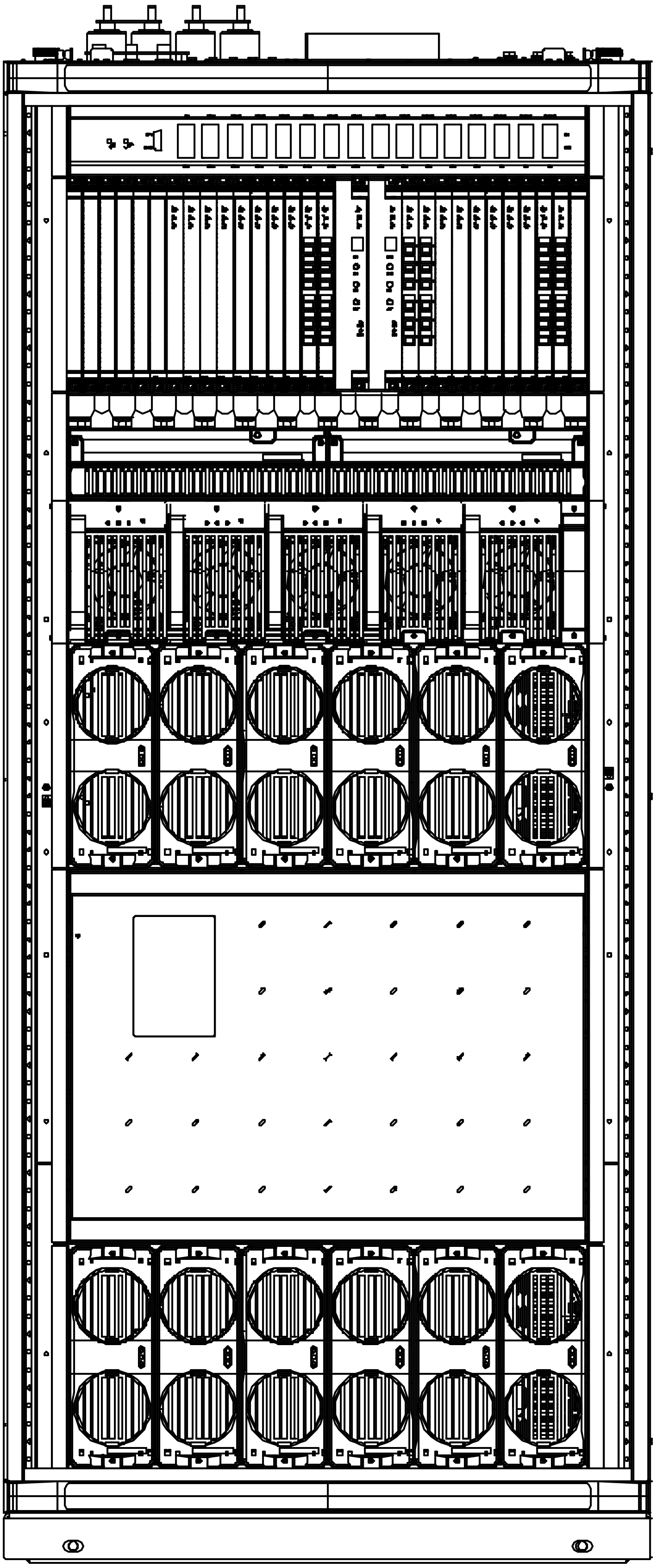

Figure 5-2 Front view of a basic cabinet

5.1.2 Baseband Subrack Configuration

The baseband subrack in full configuration is shown in Figure 5-3.

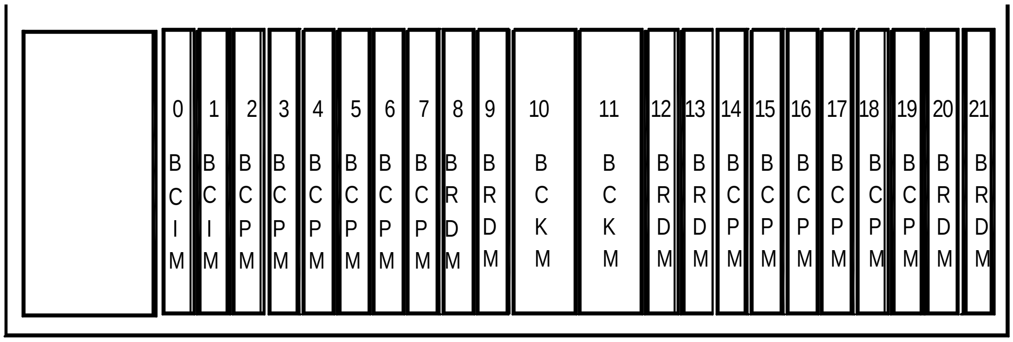

Figure 5-3 The baseband subrack in full configuration

The boards in the baseband subrack include BCIM, BCPM, BRDM, and BCKM. The boards should be configured according to the following rules

I. BCIM

BCIM provides interface to BSC. BCIM is configured according capacity demand and service type. 2 BCIMs are needed in full configuration (in this case they can operation in load sharing mode). Each BCIM boards can support 8 E1 links.

II. BCPM

BCPM board is the channel processing board of BTS. At most 12 BCPMs can be configured in the baseband subrack. There are two types of BCPMs. The processing capability of type-A BCPM is 64 reverse channels and 128 forward channels, while the capability of type-B BCPM is 128 reverse channels and 256 forward channels

BCPMs are configured based on the channel processing capability required by the system, with consideration of BTRM quantity and board types. Typical configurations are listed in Table 5-1.

The board Nos. of BCPMs are not successive. The left six are numbered as No.0 to No.5, while the right six are numbered as No.8 to No.13.

When configuring BCPM, note the difference between the inner half subrack and outer half subrack. BCPMs No.0, No.1, No.2, No.3, No.12 and No.13 belong to the outer half subrack, while BCPMs No.4, No.5, No.8, No.9, No.10 and No.11 belong to the inner half subrack. The BCPMs in different half subracks cannot be configured in the same CE pool.

Table 5-1 Configuration of BCPMs

BTS configuration	Number of type-A BCPM	Number of type-B BCPM
O1	1	Not recommended
O2	2	Not recommended
S111	2	1
S222	4	2
S333	6	3
S444	8	4

The above configurations are for cdma2000 1X system. For 3-sector configuration, type-B BCPMs are recommended. For IS95 configuration, the quantity should be reduced by half.

In normal cases, no redundancy is required. If one board fails, system will automatically shield the faulty board. In this case, the system capacity decreases, but the service is maintained.

III. BRDM

There are two types of BRDM boards, namely multi-mode BRDM and single-mode BRDM. The multi-mode BRDM is used to connect the BTRM in the cabinet, while the single-mode BRDM is used to cascade the SoftSite (ODU3601C).

Providing 6 pairs of ports for leading out optical fibers, the multi-mode BRDM can be connected with 6 BTRMs. For full configuration of 36 BTRMs, 6 BRDMs are needed. In the case BTRMs are less than 6, only 1 BRDM should be configured. For 6-12 BTRMs, 2 BRDMs are needed. The BRDM should be configured from slot No.12 and No.13.

When more than 12 BTRMs are configured, BRDMs are needed in slots No.8, No.9, No.20 and No.21 to increase the number of optical fiber interfaces, as shown in Figure 5-3. The configuration principle is that one more BRDM shall be configured when 6 BTRMs are added.

The single-mode BRDM provides 3 pairs of ports, leading out optical fibers. It can cascade 3 SoftSites (ODU3601C) in star networking.

IV. BCKM

Normally, one BCKM is enough. For redundancy purpose 2 BCKMs can be used (working in active/standby mode). BCKM receives GPS signal from outside and provides 10MHz clock connection tester externally. In addition, it provides some other interfaces.

5.1.3 Power Supply Subrack Configuration

Power supply module provides +27V power for the whole system, 5 modules in full configuration, as shown in Figure 5-4.

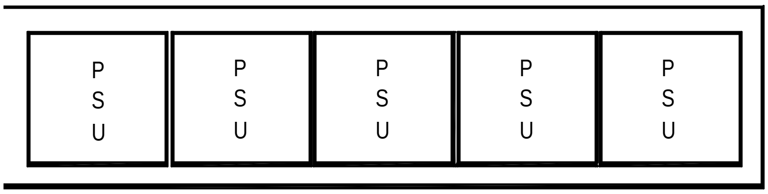

Figure 5-4 Power supply subrack in full configuration

The power supply modules (4+1 redundancy) can ensure at least 7200W output. The number of modules used depends on the number of BTRMs.

Two power supply modules (one standby) should be configured when there are no more than 3 BTRMs. One more power supply module is needed for every 3 new BTRMs added.

Since current equalization output and centralized powering is used, power supply modules can be inserted in any slots of the basic cabinet and extended cabinet.

The configuration of power supply modules in a basic cabinet is as follows.

Configuration unit (BTRM)	Power supply module quantity unit (PCS)
Basic configuration	1
1~3	1+1
4~6	2+1
7~9	3+1
10~12	4+1

The configuration of power supply modules in an extended cabinet is as follows.

Configuration unit (BTRM)	Power supply module quantity unit (PCS)
1~3	1+1
4~6	2+1
7~9	3+1
10~12	4+1

5.1.4 RF Modules Configuration

RF modules in full configuration is shown in Figure 5-5.

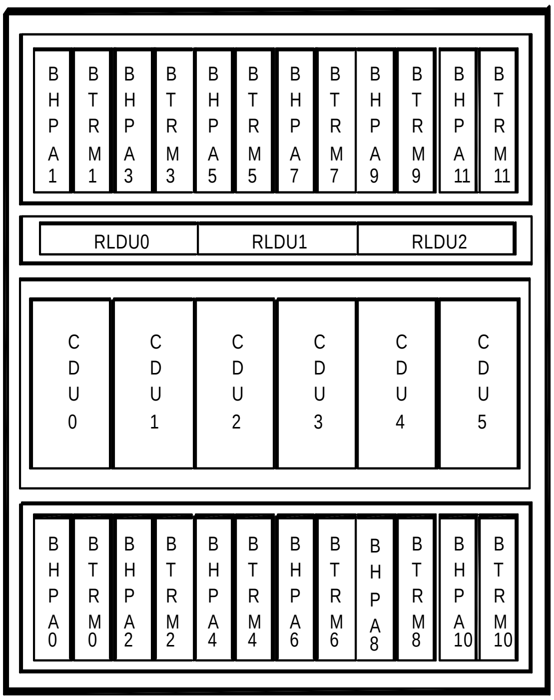

Figure 5-5 RF modules in full configuration (the duplexer in the figure is CDU)

There are 2 RF subracks in BTS, each subrack with 6 BTRM slots and 6 BHPA slots. Empty slots are covered with dummy panels.

There is one RLDU subrack, configured with 1~3 RLDUs according to actual implementation.

There is one CDU/DFU/DDU subrack, configured with 1~6 CDUs or DFUs or DDUs according to needs. Each DFU supports 1 BTRM. Each DDU supports 2 BTRMs (carrier spacing is not necessary), Each CDU supports 2 BTRMs (the BTRMs supported by each CDU should be larger than or equal to 2 carrier spacing).

The configuration of RF devices varies with the quantity of BTRMs.

For CDU and DDU, the corresponding BTRMs and BHPAs are configured from bottom to top and from left to right (as shown in Figure 5-5). For DFU, they are configured from left to right in the RF subrack under the DFU. Based on the specific frequency of CDU, actual implementation conditions should also be considered when configuring the BTRMs and BHPAs, as described in the introduction to typical configurations.

5.1.5 Configuration of Antenna Parts

Two omni antennae should be used for omni cell.

For 3-sectors and 6-sectors configuration, each sector needs one bi-polarization antenna or two uni-polarization antennae.

For operation at 1900MHz, lightning arrester should be equipped for the antenna system, while the tower-top amplifier is optional.

5.2 Typical Configurations

The cBTS3612 support 450MHz band, 800MHz band and 1900MHz band, the typical configurations are listed as below.

I. Typical configuration of cBTS3612 for 450MHz band

- 1 carrier omni cell, i.e. O(1).
- 1 carrier × 3 sectors, i.e. S(1/1/1).
- 2 carriers × 3 sectors, i.e. S(2/2/2).
- 3 carriers × 3 sectors, i.e. S(3/3/3).

II. Typical configuration of cBTS3612 for 800MHz band

- 2 carriers omni cell, i.e. O(2).
- 1 carrier × 3 sectors, i.e. S(1/1/1).
- 4 carriers × 3 sectors, i.e. S(4/4/4).
- 2 carriers × 6 sectors, i.e. S(2/2/2/2/2/2).

5.2.1 Typical Configuration of cBTS3612 for 450MHz Band

The duplex supported currently in this band is CDU and DFU.

I. O(1) Configuration

The configuration of cBTS3612 for O(1) includes:

- 1 BCIM, 1 BRDM, 1-2 BCKMs, and BCPM can be configured according to actual requirement.
- 2 power supply modules.
- 2 unipolarized omni antennas.
- The configuration of the RF modules is shown in Figure 5-6.
- Logic connection of RF modules is shown in Figure 5-7.

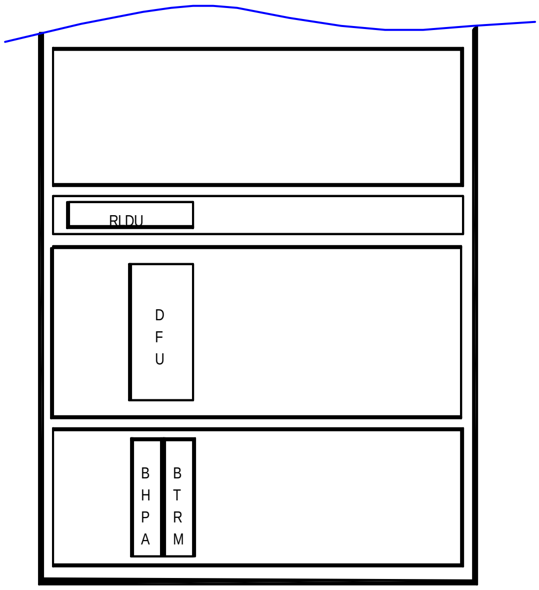

Figure 5-6 O(1) RF configuration

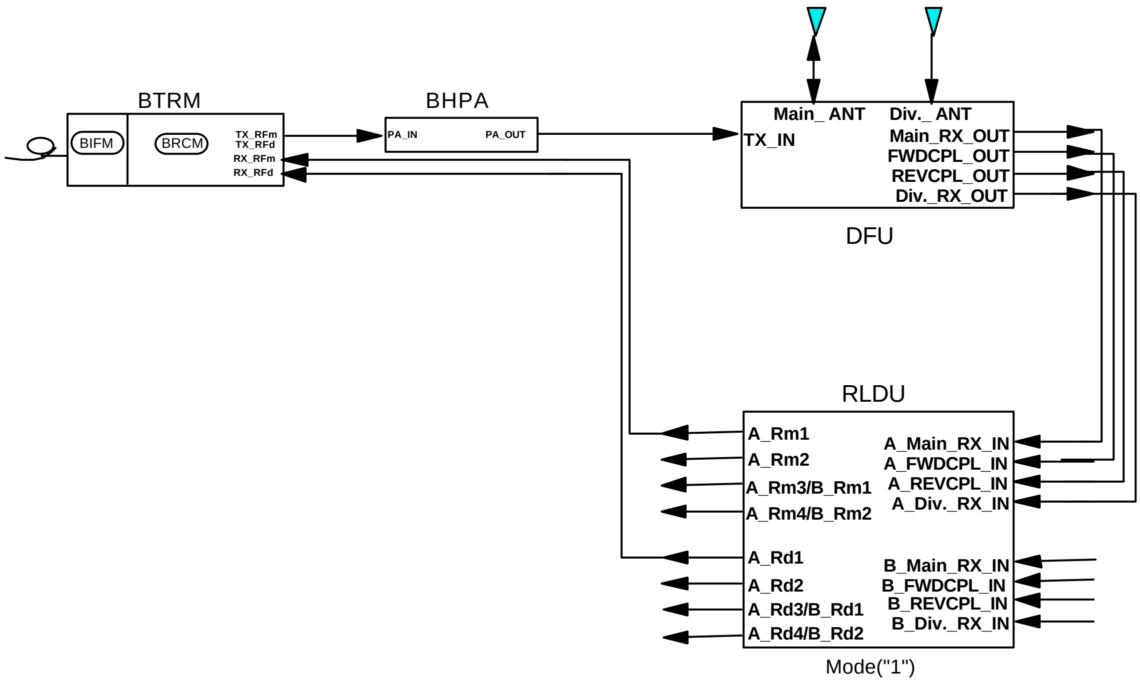

Figure 5-7 Logic connection of RF modules for O(1) configuration

II. S(1/1/1) Configuration

The following is the configuration of cBTS3612 for Type S(1/1/1) (i.e: 1 carrier x 3 sectors):

- 1 BCIM, 1 BRDM, 1-2 BCKMs, and BCPM can be configured according to actual requirement.
- 2 power supply modules.
- 2 unipolarization directional antennas or 1 bipolarization directional antenna for each sector.
- The configuration of the RF modules is shown in Figure 5-8.
- Logic connection of RF modules of one-sector is shown in Figure 5-7.

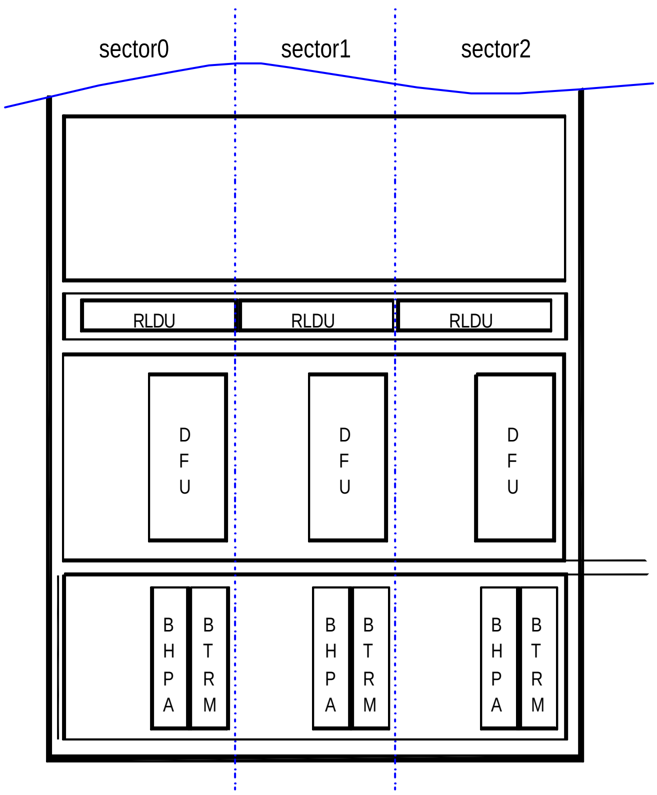

Figure 5-8 S(1/1/1) RF configuration

III. S(2/2/2) Configuration

The following is the configuration of cBTS3612 for Type S(2/2/2) (i.e.: 2 carriers x 3 sectors):

- 1 BCIM, 1 BRDM, 1-2 BCKMs, and BCPM can be configured according to actual requirement.
- 3 power supply modules.

- 2 unipolarization directional antennas or 1 bipolarization directional antenna for each sector.
- The configuration of the RF modules is shown in Figure 5-9.
- Logic connection of RF modules of one-sector is shown in Figure 5-10.

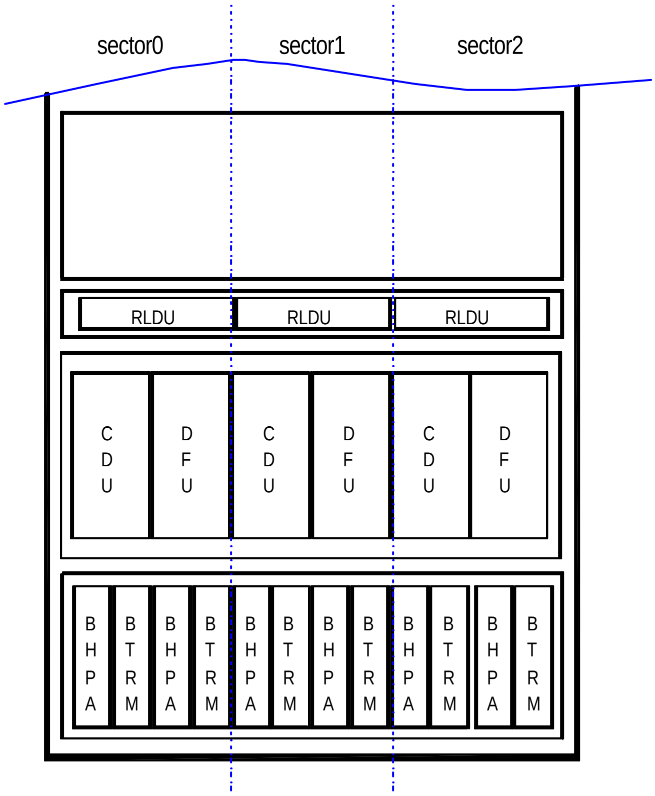

Figure 5-9 S(2/2/2) RF configuration

Note:

The CDU frequency is not adjustable. The carrier channel number of its upper corresponding subrack is higher and the carrier channel number of its lower corresponding subrack is lower. In the actual configuration, the specific carrier module slot should be determined by the specific CDU channel numbers.

For example: When the 160&260-combining CDU is adopted, if the channel number assigned to this CDU is only 260, the carrier module should be configured in the upper subrack. If the channel number assigned to this CDU is only 160, the carrier module should be configured in the lower subrack.

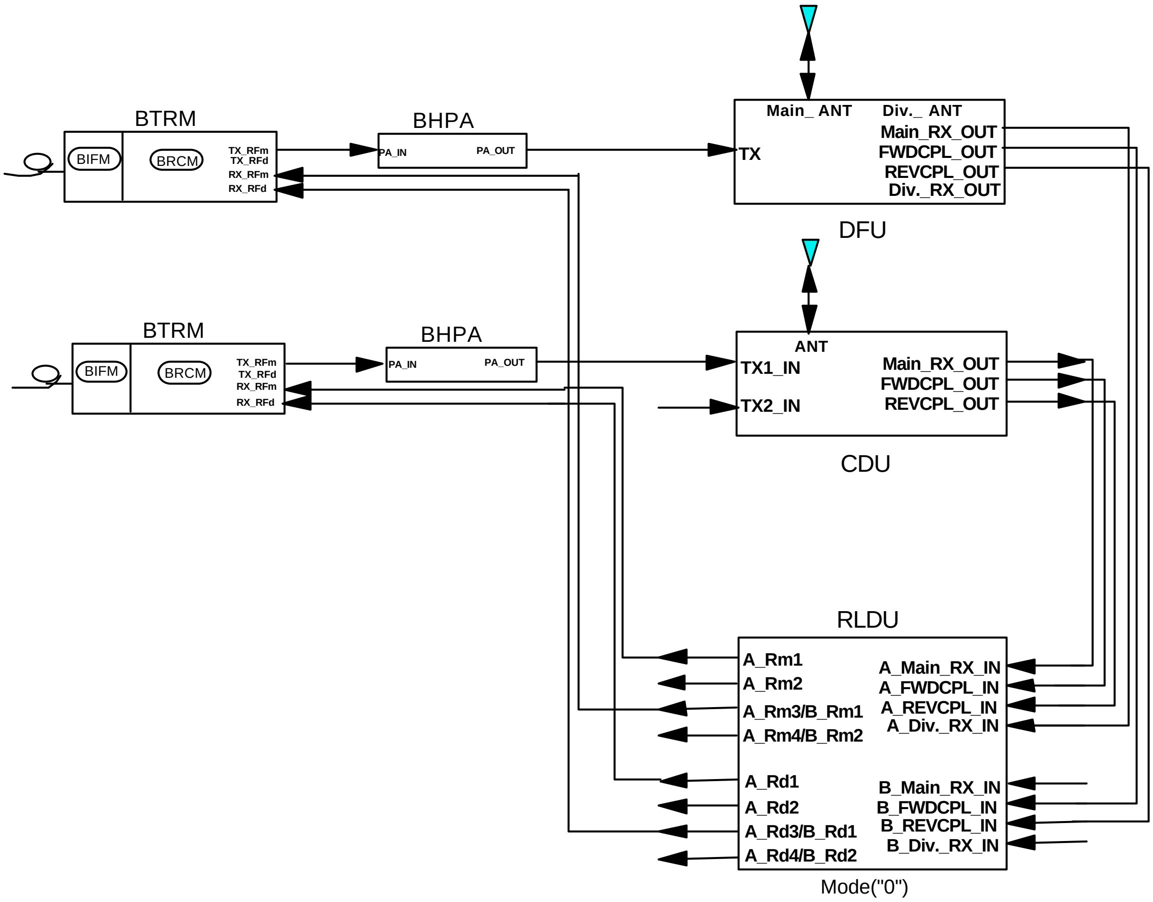

Figure 5-10 Logic connection of one-sector RF modules for S(2/2/2) configuration

IV. S(3/3/3) Configuration

The following is the configuration of Type S(3/3/3) (i.e.: 3 carriers x 3 sectors):

- 1 BCIM, 2 BRDMs, 1-2 BCKMs, and BCPM can be configured according to actual requirement.
- 4 power supply modules.
- 2 unipolarization directional antennas or 1 bipolarization directional antenna for each sector.
- The configuration of the RF modules is shown in Figure 5-11.
- Logic connection of RF modules for one-sector is shown in Figure 5-12

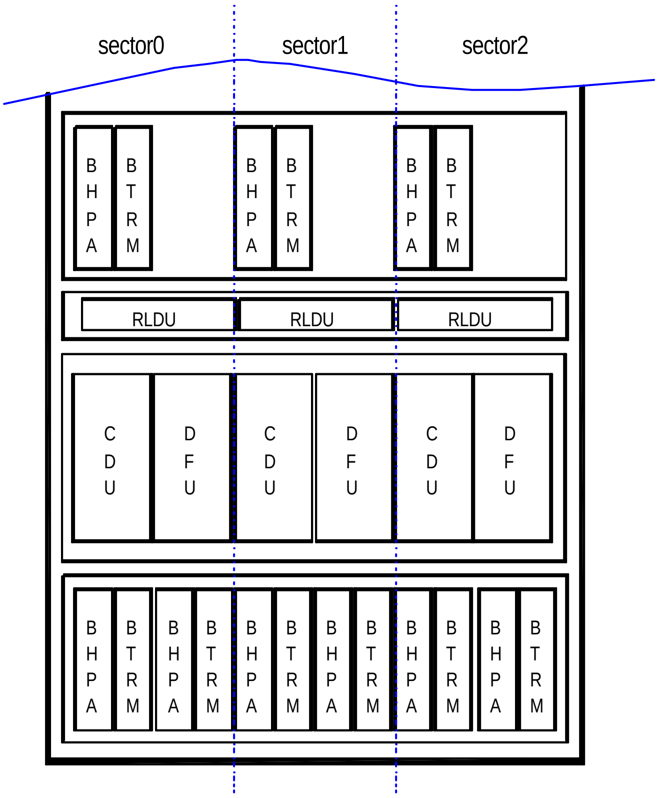

Figure 5-11 S(3/3/3) RF configuration

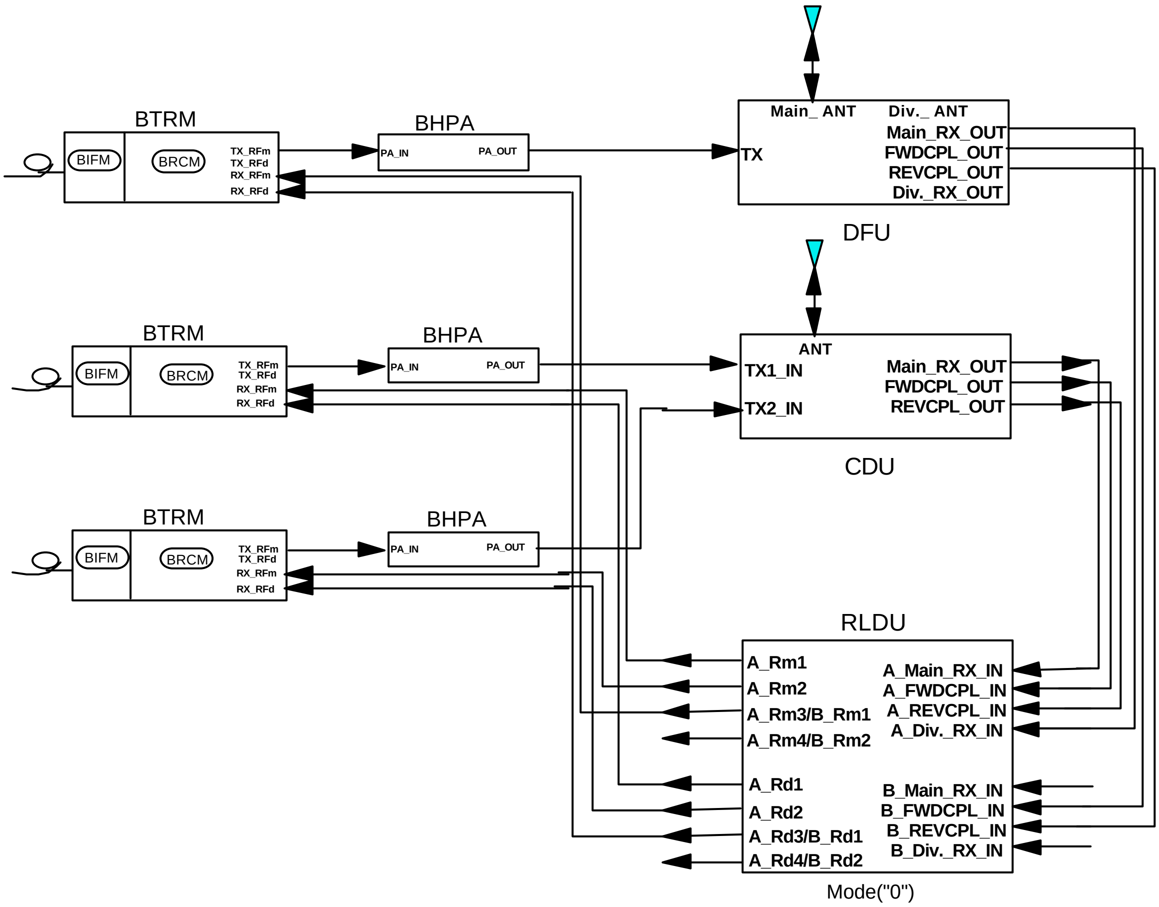

Figure 5-12 Logic connection of one-sector RF modules for S(3/3/3) configuration

5.2.2 Typical Configuration of cBTS3612 for 800MHz Band

The duplex supported currently in this band is CDU.

I. O(2) Configuration

The configuration of cBTS3612 for O(2) includes:

- 1 BCIM, 1 BRDM, 1-2 BCKMs, and BCPM can be configured according to actual requirement.
- 2 power supply modules.
- 2 unipolarized omni antennas.
- The configuration of the RF modules is shown in Figure 5-13.
- Logic connection of RF modules is shown in Figure 5-14.

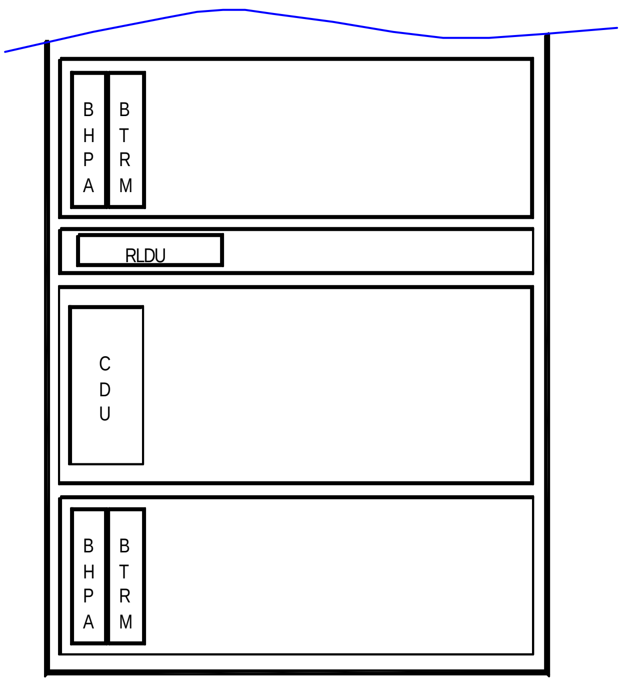

Figure 5-13 O(2) RF configuration

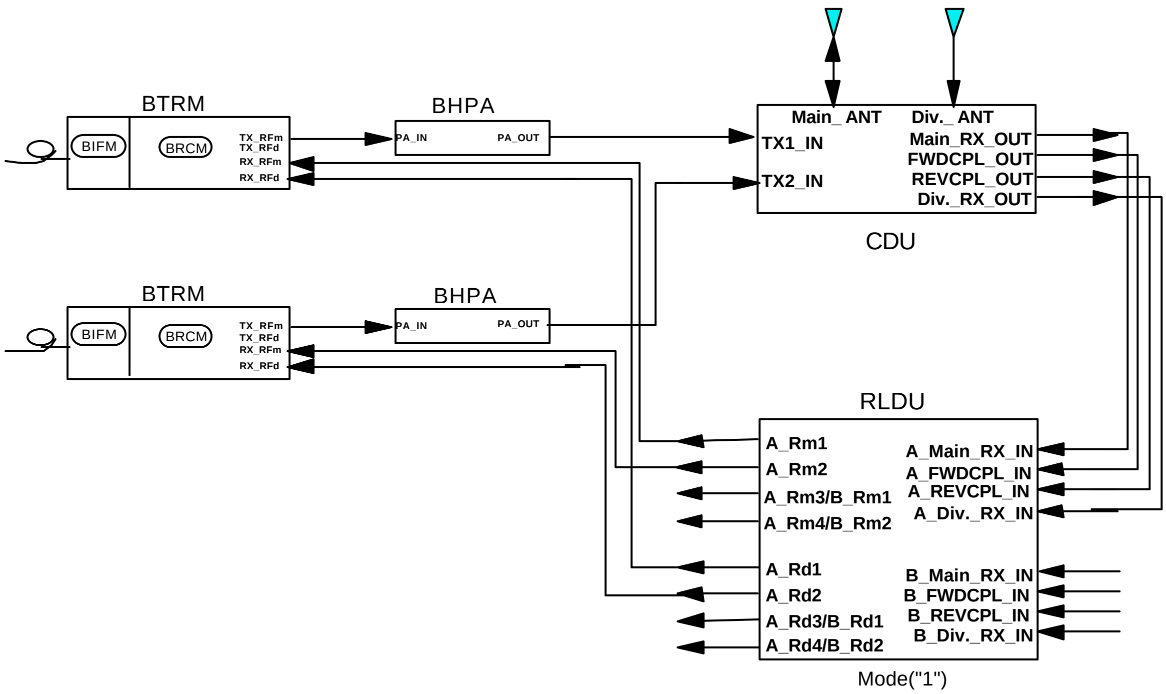

Figure 5-14 Logic connection of RF modules for O(2) configuration

II. S(1/1/1) Configuration

The following is the configuration of cBTS3612 for Type S(1/1/1) (i.e.: 1 carrier x 3 sectors):

- 1 BCIM, 1 BRDM, 1-2 BCKMs, and BCPM can be configured according to actual requirement.
- 2 power supply modules.
- 2 unipolarization directional antennas or 1 bipolarization directional antenna for each sector.
- The configuration of the RF modules is shown in Figure 5-15.
- Logic connection of RF modules of one-sector is shown in Figure 5-16.

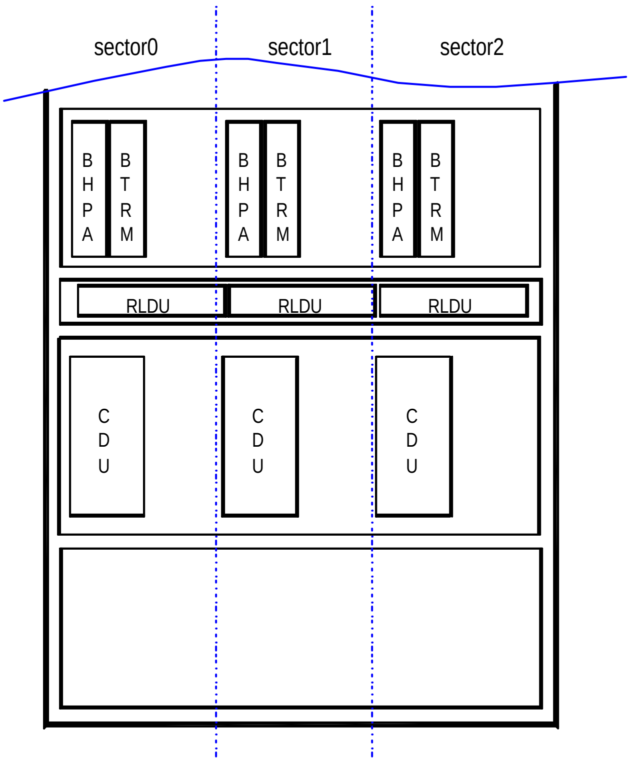

Figure 5-15 S(1/1/1) RF configuration

Note:

The CDU frequency is not adjustable. The carrier channel number of its upper corresponding subrack is higher and the carrier channel number of its lower corresponding subrack is lower. In the actual configuration, the specific carrier module slot should be determined by the specific CDU channel numbers.

For example: When the 201&283-combining CDU is adopted, if the channel number assigned to this CDU is only 283, the carrier modules configured for O(1), S(1/1/1) and S(1/1/1/1/1/1) should be in the upper subrack. If the channel number assigned to this CDU is only 201, these modules should be installed in the lower subrack.

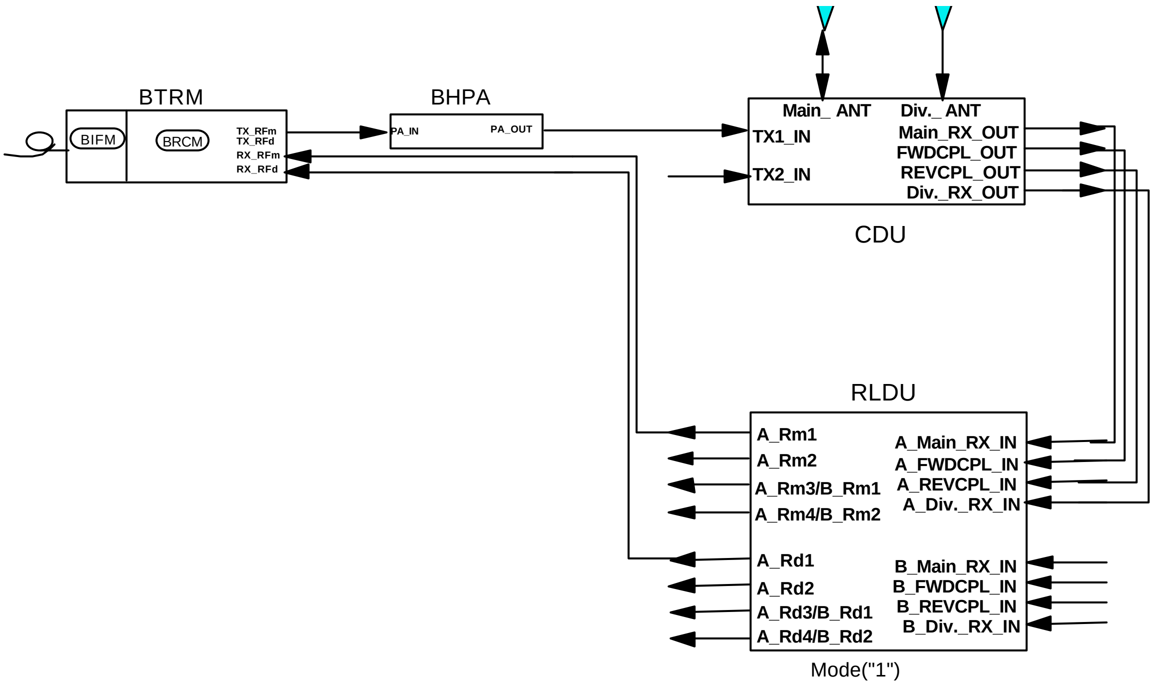

Figure 5-16 Logic connection of one-sector RF modules for S(1/1/1) configuration

III. S(4/4/4) Configuration

The following is the configuration of cBTS3612 for Type S(4/4/4) (i.e.: 4 carriers x 3 sectors):

- 1 BCIM, 2 BRDMs, 1-2 BCKMs, and BCPM can be configured according to actual requirement.
- 5 power supply modules.
- 2 unipolarization directional antennas or 1 bipolarization directional antenna for each sector.
- The configuration of the RF modules is shown in Figure 5-17.

- Logic connection of RF modules of one-sector is shown in Figure 5-18.

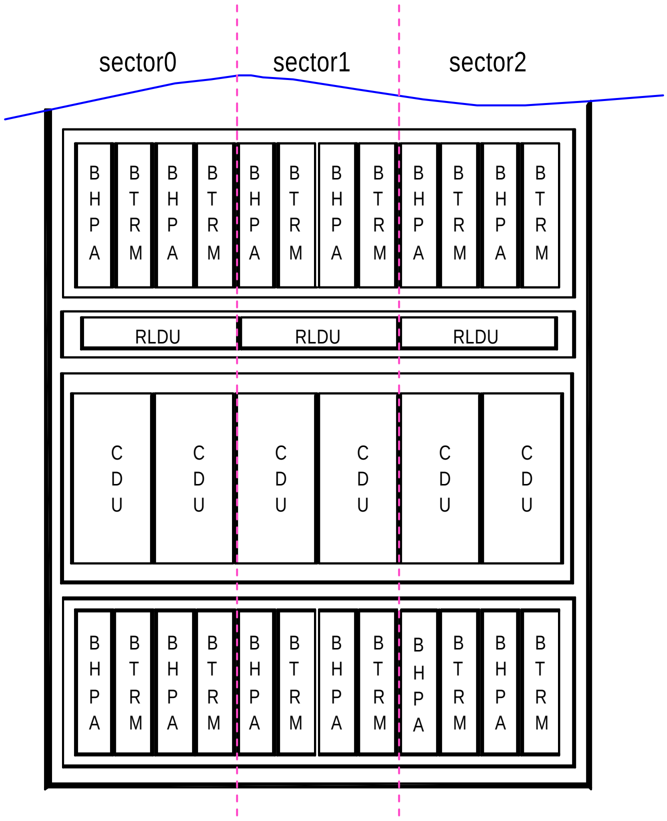

Figure 5-17 S(4/4/4) RF configuration

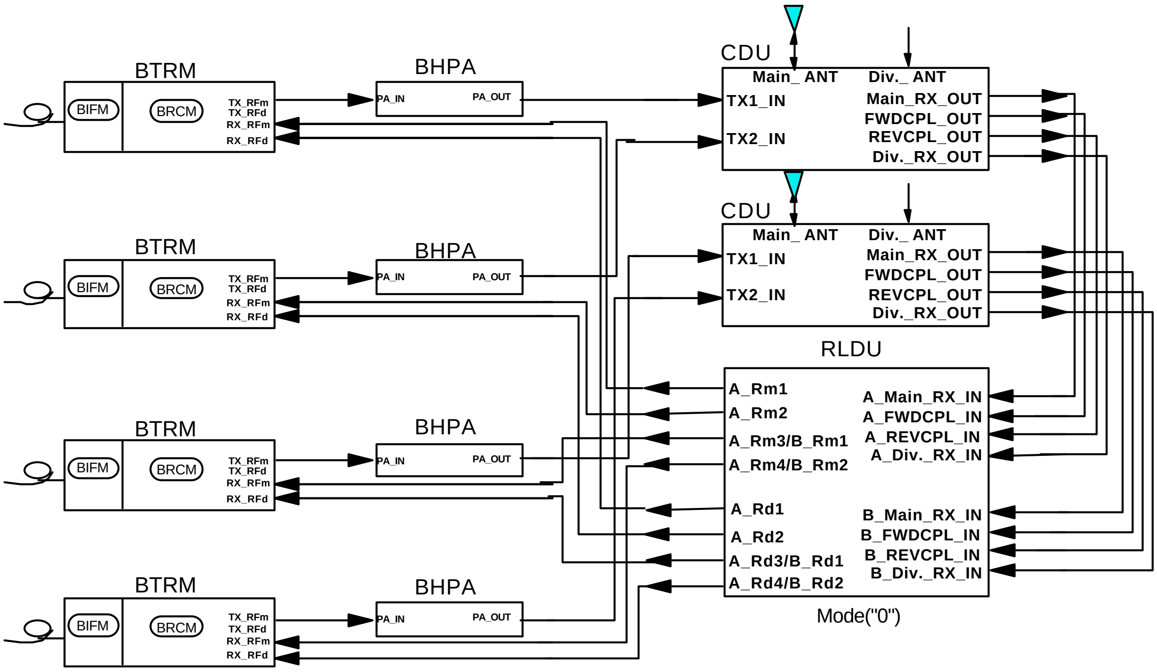

Figure 5-18 Logic connection of one-sector RF modules for S(4/4/4) configuration

IV. S(2/2/2/2/2/2) Configuration

The following is the configuration of Type S(2/2/2/2/2/2) (i.e.: 2 carriers x 6 sectors):

- 1 BCIM, 2 BRDMs, 1-2 BCKMs, and BCPM can be configured according to actual requirement.
- 5 power supply modules.
- 2 unipolarization directional antennas or 1 bipolarization directional antenna for each sector.
- The configuration of the RF modules is shown in Figure 5-19.
- Logic connection of RF modules of two-sector is shown in Figure 5-20.

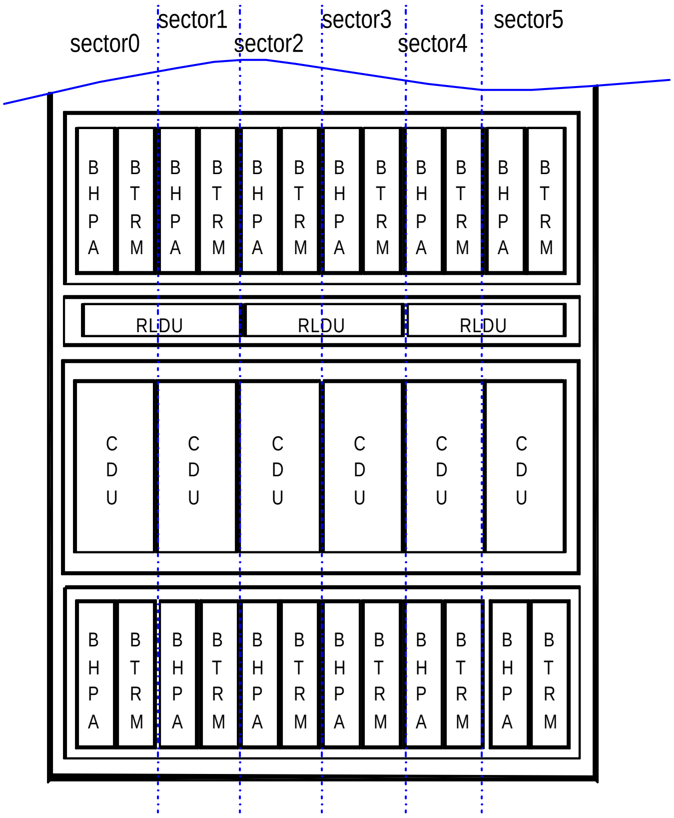

Figure 5-19 S(2/2/2/2/2/2) RF configuration

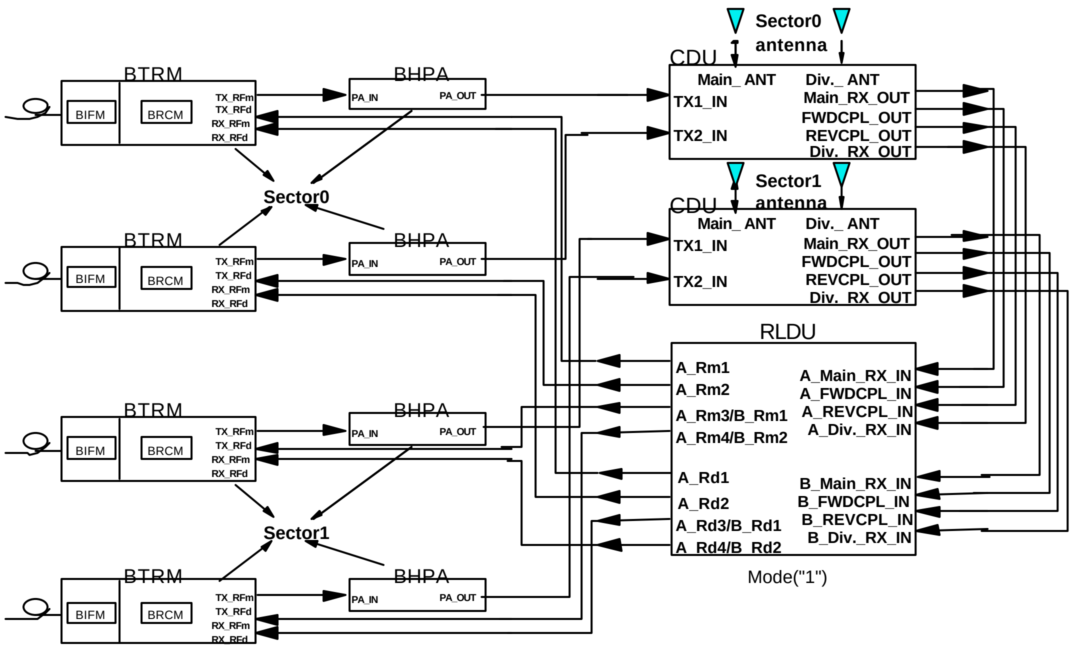

Figure 5-20 Logic connection of two-sector RF modules for S(2/2/2/2/2/2) configuration

5.2.3 Typical Configuration of cBTS3612 in 1900MHz Band

The duplex supported currently in this band is DDU, and it is expected that CDU be supported also in the future with reference to 1900MHz band planning.

I. O(1) Configuration

The configuration of cBTS3612 for O(1) includes:

- 1 BCIM, 1 BRDM, 1-2 BCKMs, and BCPM can be configured according to actual requirement.
- 2 power supply modules.
- 2 unipolarized omni antennas.
- The configuration of the RF modules is shown in Figure 5-21.
- Logic connection of RF modules is shown in Figure 5-22.

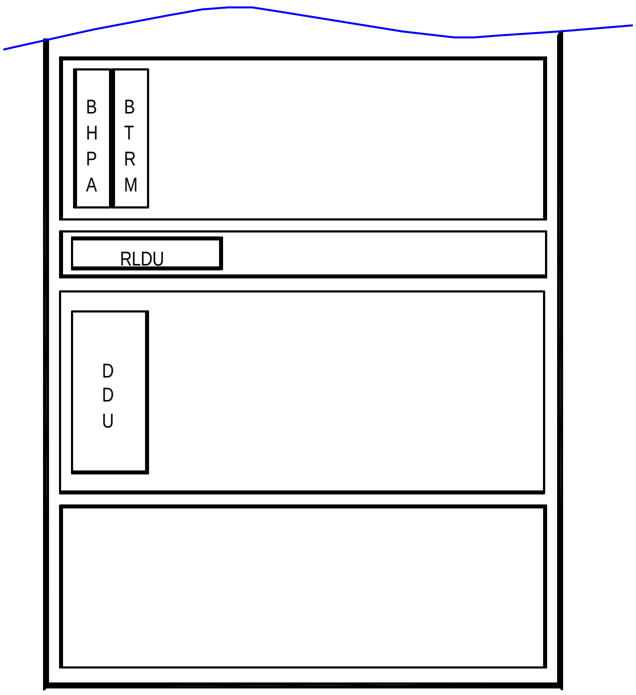

Figure 5-21 O(1) RF configuration

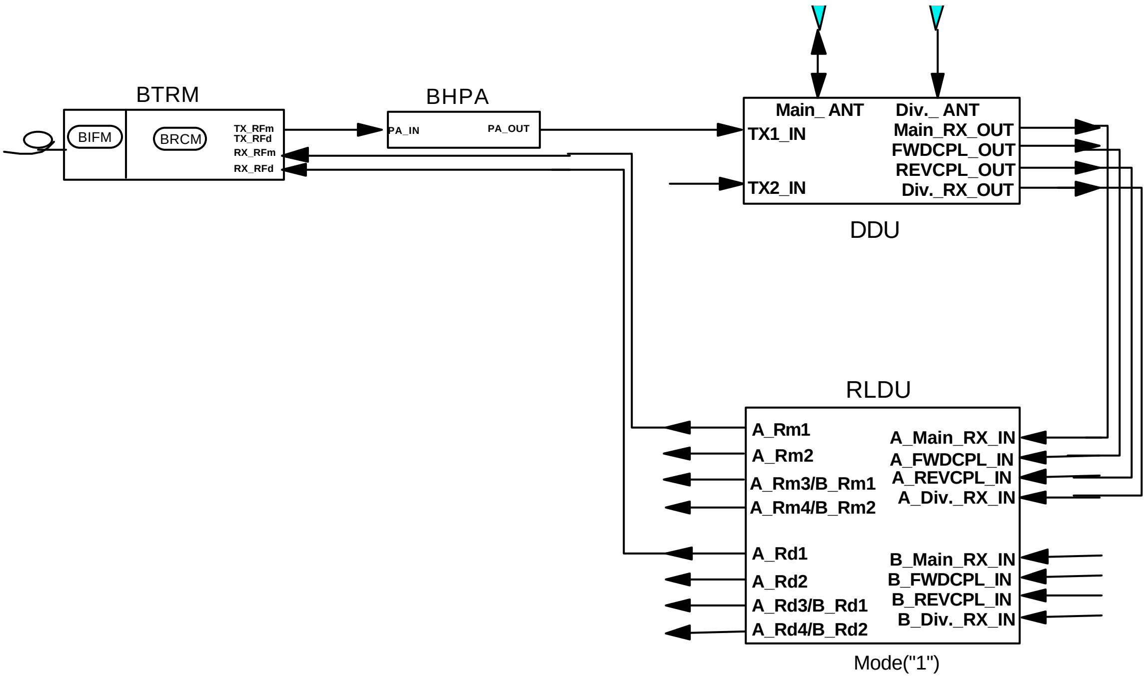

Figure 5-22 Logic connection of RF modules for O(1) configuration

II. S(1/1/1) Configuration

The following is the configuration of cBTS3612 for Type S(1/1/1) (i.e.: 1 carrier x 3 sectors):

- 1 BCIM, 1 BRDM, 1-2 BCKMs, and BCPM can be configured according to actual requirement.
- 2 power supply modules.
- 2 unipolarization directional antennas or 1 bipolarization directional antenna for each sector.
- The configuration of the RF modules is shown in Figure 5-23.
- Logic connection of RF modules of one-sector is shown in Figure 5-22.

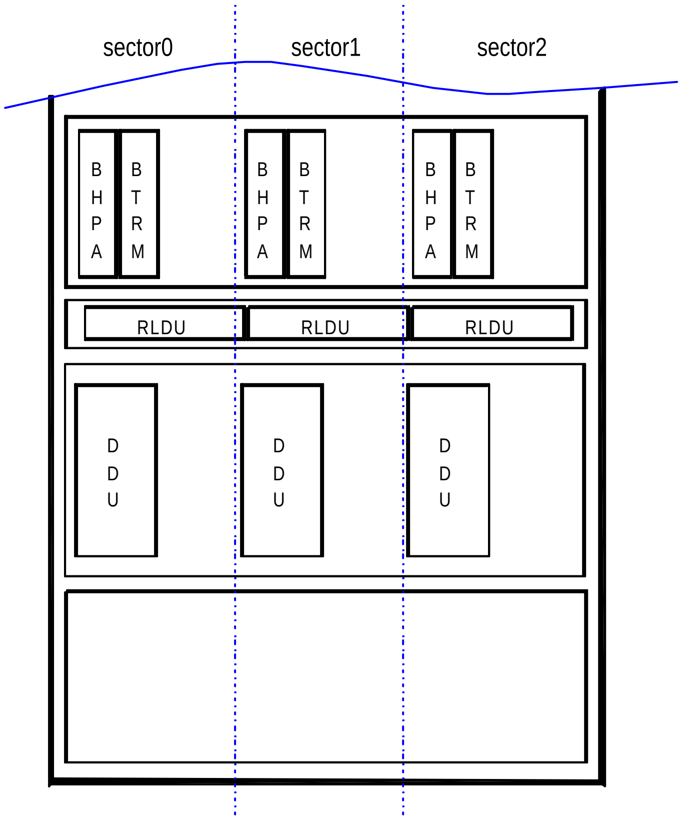

Figure 5-23 S(1/1/1) RF configuration

III. S(2/2/2) Configuration

The following is the configuration of cBTS3612 for Type S(2/2/2) (i.e.: 2 carriers x 3 sectors):

- 1 BCIM, 1 BRDM, 1-2 BCKMs, and BCPM can be configured according to actual requirement.
- 3 power supply modules.
- 2 unipolarization directional antennas or 1 bipolarization directional antenna for each sector.
- The configuration of the RF modules is shown in Figure 5-24.
- Logic connection of RF modules of one-sector is shown in Figure 5-25.

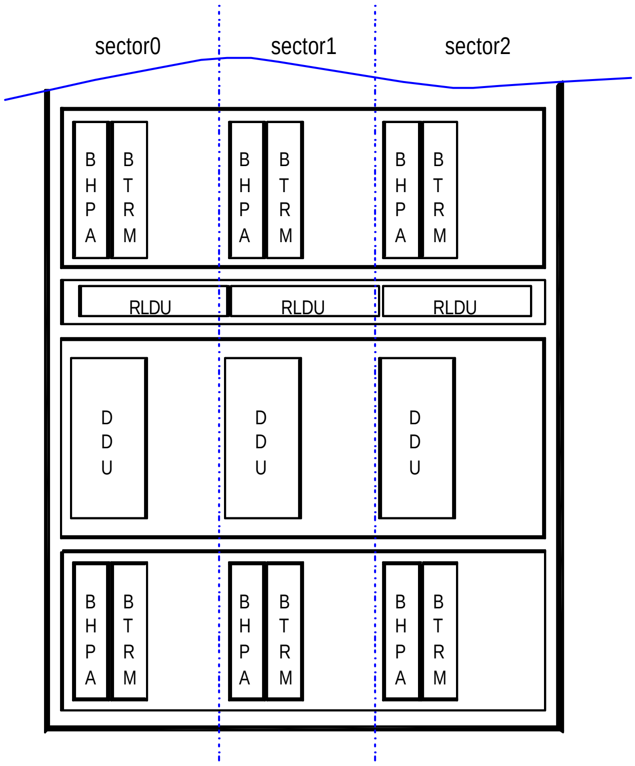

Figure 5-24 S(2/2/2) RF configuration

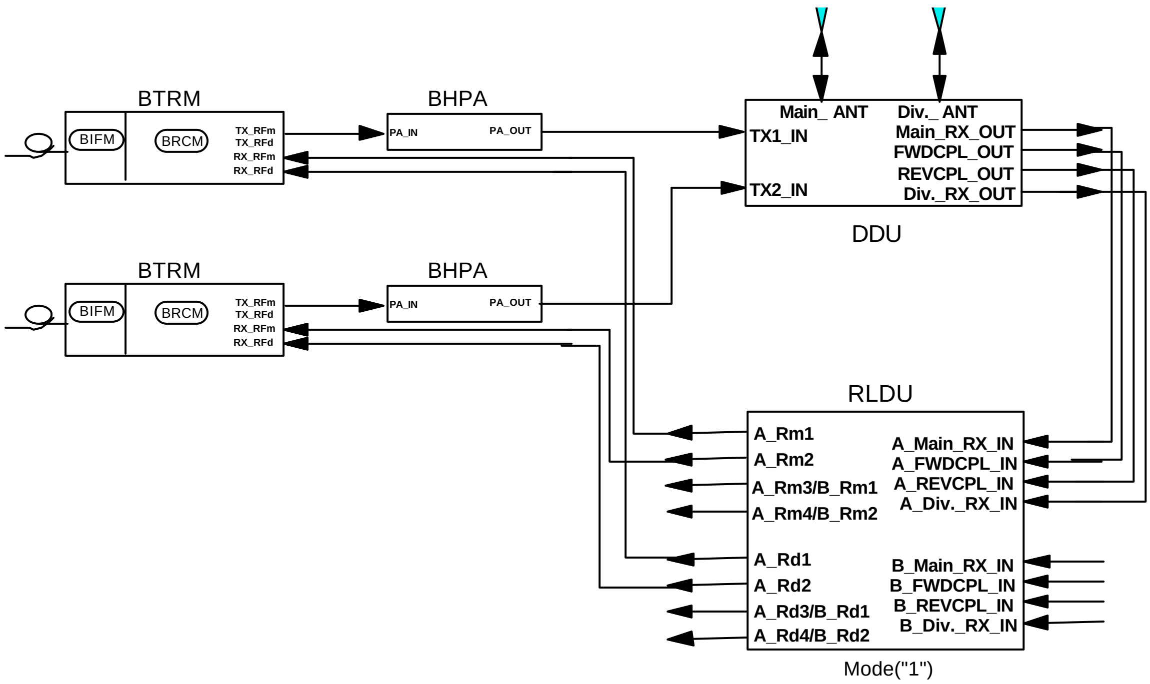

Figure 5-25 Logic connection of one-sector RF modules for S(2/2/2) configuration

IV. S(2/2/2/2/2/2) Configuration

The following is the configuration of Type S(2/2/2/2/2/2) (i.e.: 2 carriers x 6 sectors):

- 1 BCIM, 2 BRDMs, 1-2 BCKMs, and BCPM can be configured according to actual requirement.
- 5 power supply modules.
- 2 unipolarization directional antennas or 1 bipolarization directional antenna for each sector.
- The configuration of the RF modules is shown in Figure 5-26.
- Logic connection of RF modules of two-sector is shown in Figure 5-27.

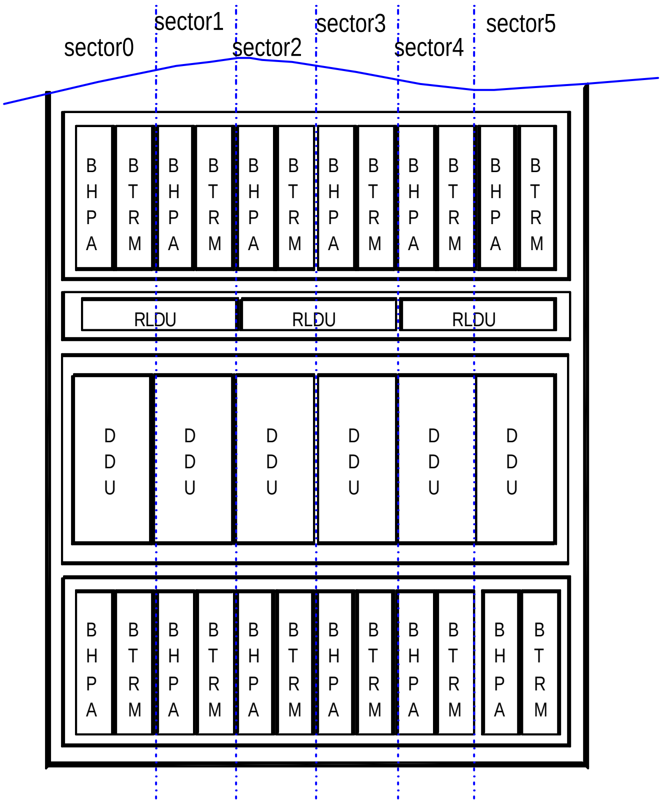

Figure 5-26 S(2/2/2/2/2/2) RF configuration

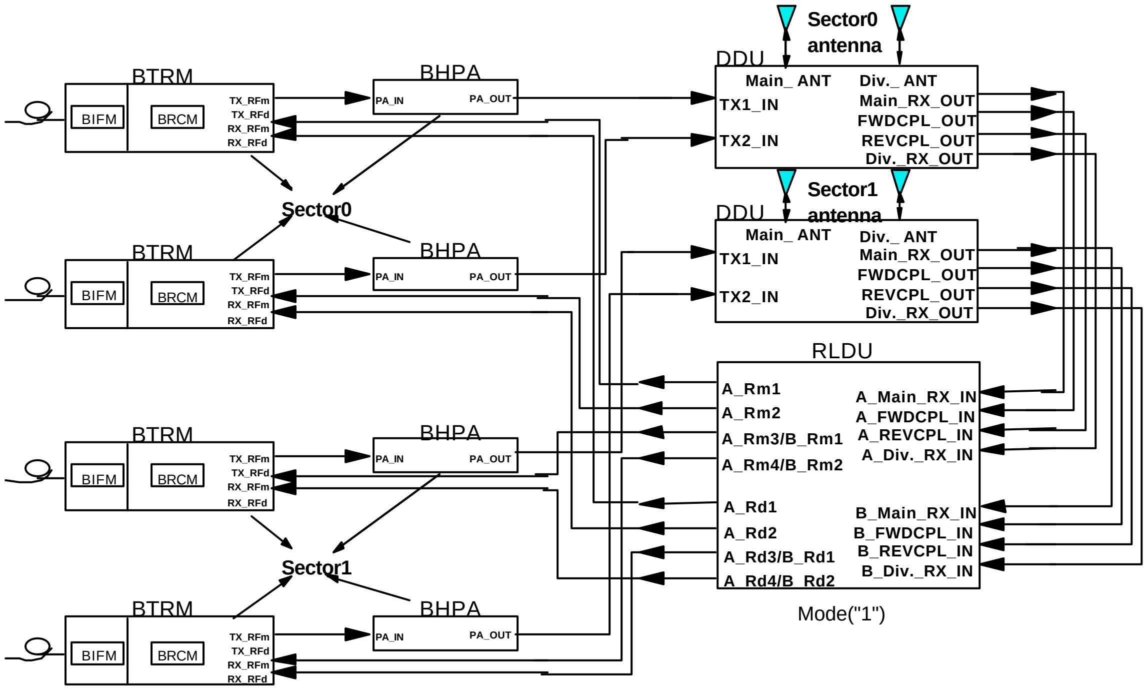

Figure 5-27 Logic connection of two-sector RF modules for S(2/2/2/2/2/2) configuration

Appendix A Technical Performance of Receiver and Transmitter

The technical specifications of BTS receivers and transmitters comply with or surpass all the performance requirements defined in the IS-97-D Recommended Minimum Performance Standards for cdma2000 Spread Spectrum Base Stations.

A.1 Performance of Receiver

A.1.1 Frequency Coverage

450MHz band: 450 - 460MHz

800MHz band: 824 - 849MHz

1900MHz band: 1850 - 1910MHz

A.1.2 Access Probe Acquisition

The access probe failure rates under the reliability of 90% is below the maximum values listed in Table A-1:

Table A-1 Access probe failure rates

Eb/N0 Per RF input point (dB)	Maximum failure rate
5.5	50%
6.5	10%

A.1.3 R-TCH Demodulation Performance

I. Performance of R-TCH in Additive White Gaussian Noise (AWGN)

The demodulation performance of the Reverse Traffic Channel in AWGN (no fading or multipath) environment is determined by the frame error rate (FER) at specified Eb/N0 value. FER of 4 possible data rates should be calculated respectively. With 95% confidence, the FER for each data rate does not exceed the two given FERs in Table A-2 to Table A-9, which adopt the linear interpolation in the form of Log_{10}(FER).

Eb/N0 measurement value is decided by whichever is bigger of the Eb/N0 values in two RF input ports.

Table A-2 Maximum FER of F-FCH or R-DCCH receiver in demodulation performance test under RC1

Data rate (bit/s)	FER limits (%)	
	Lower limit Eb/N0	Upper limit Eb/N0
9600	3.0 @ 4.1dB	0.2 @ 4.7dB
4800	8.0 @ 4.1dB	1.0 @ 4.7dB
2400	23.0 @ 4.1dB	5.0 @ 4.7dB
1200	22.0 @ 4.1dB	6.0 @ 4.7dB

Table A-3 Maximum FER of F-FCH or R-DCCH receiver in demodulation performance test under RC2

Data rate (bit/s)	FER limits (%)	
	Lower limit Eb/N0	Upper limit Eb/N0
14400	5.0 @ 3.2dB	0.2 @ 3.8dB
7200	6.3 @ 3.2dB	0.7 @ 3.2dB
3600	5.8 @ 3.2dB	1.0 @ 3.2dB
1800	3.5 @ 3.2dB	1.0 @ 3.2dB

Table A-4 Maximum FER of F-FCH or R-DCCH receiver in demodulation performance test under RC3

Data rate (bit/s)	FER limit (%)	
	Lower limit Eb/N0	Upper limit Eb/N0
9600	2.3% @ 2.4 dB	0.3% @ 3.0 dB
4800	2.3% @ 3.8 dB	0.4% @ 4.4 dB
2700	2.5% @ 5.0 dB	0.5% @ 5.6 dB
1500	1.7% @ 7.0 dB	0.4% @ 7.6 dB

Table A-5 Maximum FER of R-SCH receiver in demodulation performance test under RC3

Data rate (bit/s)	FER limit (%)	
	Lower limit Eb/N0	Lower limit Eb/N0
19200	9% @ 1.7 dB	1.7% @ 2.3 dB
38400	13% @ 1.4 dB	2.1% @ 2.0 dB
76800	14% @ 1.3 dB	2.4% @ 1.9 dB
153600	14% @ 1.3 dB	2.4% @ 1.9 dB
307200	14% @ 1.8 dB	2.0% @ 2.4 dB

Table A-6 Maximum FER of R-SCH (Turbo Code) receiver in demodulation performance test under RC3

Data rate (bit/s)	FER limit (%)	
	Lower limit Eb/N0	Lower limit Eb/N0
19200	20% @ 0.6 dB	0.9% @ 1.2 dB
38400	24% @ -0.1 dB	0.3% @ 0.5 dB
76800	30% @ -0.5 dB	0.2% @ 0.1 dB
153600	60% @ -0.9 dB	0.1% @ -0.3 dB
307200	90% @ -0.3 dB	0.1% @ 0.3 dB

Table A-7 Maximum FER of F-FCH or R-DCCH receiver in demodulation performance test under RC4

Data rate (bit/s)	FER limit (%)	
	Lower limit Eb/N0	Lower limit Eb/N0
14400	2.4% @ 0.8 dB	0.3% @ 1.4 dB
7200	2.4% @ 3.1 dB	0.4% @ 3.7 dB
3600	1.7% @ 4.6 dB	0.3% @ 5.2 dB
1800	1.6% @ 6.6 dB	0.5% @ 7.2 dB

Table A-8 Maximum FER of R-SCH receiver of demodulation performance test under RC4

Data rate (bit/s)	FER limit (%)	
	Lower limit Eb/N0	Lower limit Eb/N0
28800	10% @ 1.7 dB	1.9% @ 2.3 dB
57600	12% @ 1.6 dB	1.7% @ 2.2 dB
115200	14% @ 1.6 dB	2.0% @ 2.2 dB
230400	12% @ 1.7 dB	1.7% @ 2.3 dB

Table A-9 Maximum FER of R-SCH (Turbo Code) receiver of demodulation performance test under RC4

Data rate (bit/s)	FER limit (%)	
	Lower limit Eb/N0	Lower limit Eb/N0
28800	27% @ 0.7 dB	0.5% @ 1.3 dB
57600	28% @ 0.2 dB	0.2% @ 0.8 dB
115200	60% @ -0.2 dB	0.1% @ 0.4 dB
230400	33% @ -0.5 dB	0.1% @ 0.1 dB

II. R-TCH performance in multipath fading without Closed-Loop power control

The performance of the demodulation of the Reverse Traffic Channel in a multipath fading environment is determined by the frame error rate (FER) at specified Eb/N0 value. FER of 4 possible data rates should be calculated respectively. With 95% confidence, the FER for each data rate shall not exceed that given by linear interpolation on a log10 (FER) scale between the two values given in Table A-13 and Table A-14. And the test value of Eb/N0 assumes the average value of Eb/N0 in two RF input ports. During the test, the reverse service channel Eb/N0 of each RF input port adopted is within the limits specified in Table A-12.

The configurations of standard channel simulator are given in Table A-10; and the channel models of the R-TCH receiving performance test in multipath environment are listed in Table A-11.

Table A-10 Standard channel simulator configuration

Standard channel Simulator configuration	Speed	Number of Paths	Path 2 power (corresponds to path 1)	Path 3 power (corresponds to path 1)	Deferring path 1 input	Deferring path 2 input	Deferring path 3 input
B	8km/h	2	0dB	N/A	0μs	2.0 μs	N/A
C	25km/h	1	N/A	N/A	0μs	N/A	N/A
D	100km/h	3	0dB	-3dB	0μs	2.0 μs	14.5 μs

Table A-11 Channel models for the R-TCH receiving performance test

Case	Channel Simulator configurations
B	2 (8 km/h, 2 paths)
C	3 (30 km/h, 1 path)
D	4 (100 km/h, 3 paths)
D2	4 (100 km/h, 3 paths)

Table A-12 Eb/N0 limits of R-TCH without closed-loop power control

Rate aggregation	Condition	Eb/N0 Limits (dB)	
		Lower limit	Upper limit
RC1	B	11.1	11.7
	C	11.2	11.8
	D	8.8	9.4
	D2	9.2	9.8
RC2	B	10.7	11.3
	D	8.5	9.1
	D2	8.9	9.5

Table A-13 Maximum FER of demodulation performance test of R-FCH or R-DCCH receiver under RC1

Case	Data rate (bit/s)	FER limits (%)	
		Lower limit Eb/N0	Upper limit Eb/N0
B	9600	1.3	0.8
	4800	1.4	0.9
	2400	1.6	1.2
	1200	1.3	0.9
C	9600	1.2	0.7
	4800	1.4	0.9
	2400	2.5	1.7
	1200	2.0	1.4
D	9600	1.6	0.6
	4800	2.6	1.2
	2400	6.4	3.4
	1200	5.6	3.5
D2	9600	0.9	0.3
	4800	1.6	0.7
	2400	4.2	2.3
	1200	4.1	2.6

Table A-14 Maximum FER of demodulation performance test of R-FCH or R-DCCH receiver under RC2

Case	Data rate (bit/s)	FER limits (%)	
		Lower limit Eb/N0	Upper limit Eb/N0
B	14400	1.3	0.8
	7200	1.0	0.5
	3600	0.7	0.4
	1800	0.6	0.5
D	14400	1.7	0.6
	7200	1.6	0.6
	3600	1.5	0.9
	1800	2.2	1.2
D2	14400	0.9	0.3
	7200	0.9	0.4
	3600	1.1	0.6
	1800	1.5	0.9

III. Performance in multipath fading with Closed-Loop power control

The performance of the demodulation of the Reverse Traffic Channel in a multipath fading environment is determined by the frame error rate (FER) at specified Eb/N0 value. FER of 4 possible data rates needs to be calculated respectively. With 95% confidence, the FER for each data rate shall not exceed that given by linear interpolation on a $\log_{10}$ scale between the two values given in Table A-16 and Table A-23. And the test value of Eb/N0 assumes the average value of Eb/N0 tested on the two RF input ports.

Table A-15 Channel models for the R-TCH receiving performance test

Condition	Number of Channel Simulator configurations
A	1 (3 km/h, 1 path)
B	2 (8 km/h, 2 paths)
C	3 (30 km/h, 1 path)
D	4 (100 km/h, 3 path)

Table A-16 Maximum FER of demodulation performance test of R-FCH receiver under RC1

Condition	Data rate (bit/s)	FER limits (%)	
		Lower limit Eb/N0	Upper limit Eb/N0
B	9600	2.8% @ 5.9 dB	0.3 @ 6.5 dB
	4800	7.6 @ 5.9 dB	2.2 @ 6.5 dB
	2400	23.0 @ 5.9 dB	12.0 @ 6.5 dB
	1200	22.0 @ 5.9 dB	14.0 @ 6.5 dB
C	9600	1.5 @ 7.1 dB	0.7 @ 7.7 dB
	4800	8.0 @ 7.1 dB	4.8 @ 7.7 dB
	2400	18.0 @ 7.1 dB	13.0 @ 7.7 dB
	1200	16.0 @ 7.1 dB	12.0 @ 7.7 dB

Table A-17 Maximum FER of demodulation performance test of R-FCH receiver under RC2

Case	Data rate (bit/s)	FER limits (%)	
		Lower limit Eb/N0	Upper limit Eb/N0
B	14400	2.8 @ 5.2 dB	0.4 @ 5.8 dB
	7200	4.7 @ 5.2 dB	1.3 @ 5.8 dB
	3600	8.7 @ 5.2 dB	4.6 @ 5.8 dB
	1800	15.0 @ 5.2 dB	9.8 @ 5.8 dB
C	14400	1.3 @ 7.7 dB	0.7 @ 8.3 dB
	7200	3.2 @ 7.7 dB	1.8 @ 8.3 dB
	3600	4.7 @ 7.7 dB	3.5 @ 8.3 dB
	1800	5.2 @ 7.7 dB	3.9 @ 8.3 dB

Table A-18 Maximum FER of demodulation performance test of R-FCH or R-DCCH receiver under RC3

Case	Data rate (bit/s)	FER limits (%)	
		Lower limit Eb/N0	Upper limit Eb/N0
A	9600 (20 ms)	2.4% @ 3.4 dB	0.5% @ 4.0 dB
	4800	2.0% @ 4.4 dB	0.5% @ 5.0 dB
	2700	1.8% @ 5.6 dB	0.5% @ 6.2 dB
	1500	1.8% @ 7.2 dB	0.6% @ 7.8 dB
B	9600 (20 ms)	2.0% @ 3.9 dB	0.5% @ 4.5 dB
	4800	2.0% @ 4.9 dB	0.5% @ 5.5 dB
	2700	1.8% @ 6.1 dB	0.5% @ 6.7 dB
	1500	1.7% @ 7.8 dB	0.5% @ 8.4 dB
C	9600 (20 ms)	1.5% @ 5.2 dB	0.6% @ 5.8 dB
	4800	1.5% @ 6.1 dB	0.6% @ 6.7 dB
	2700	1.4% @ 7.2 dB	0.6% @ 7.8 dB
	1500	1.4% @ 8.8 dB	0.6% @ 9.4 dB
D	9600 (20 ms)	2.0% @ 4.7 dB	0.5% @ 5.3 dB
	4800	2.0% @ 5.7 dB	0.5% @ 6.3 dB
	2700	1.8% @ 6.9 dB	0.5% @ 7.5 dB
	1500	1.7% @ 8.5 dB	0.5% @ 9.1 dB

Table A-19 Maximum FER of demodulation performance test of R-SCH (Turbo Code) receiver under RC3

Case	Data rate (bit/s)	FER limits (%)	
		Lower limit Eb/N0	Upper limit Eb/N0
B	307200	10% @ 2.6 dB	2.0% @ 3.2 dB
	153600	10% @ 2.6 dB	2.0% @ 3.2 dB
	76800	10% @ 2.1 dB	2.4% @ 2.7 dB
	38400	9.0% @ 2.4 dB	2.4% @ 3.0 dB
	19200	9.0% @ 2.8 dB	2.5% @ 3.4 dB

Table A-20 Maximum FER of demodulation performance test of R-SCH (Turbo Code) receiver under RC3

Case	Data rate (bit/s)	FER limits (%)	
		Lower limit Eb/N0	Upper limit Eb/N0
B	307200	15% @ 0.8 dB	1.8% @ 1.4 dB
	153600	12% @ 0.2 dB	2.0% @ 0.8 dB
	76800	10% @ 0.7 dB	2.0% @ 1.3 dB
	38400	10% @ 1.3 dB	2.0% @ 1.9 dB
	19200	10% @ 2.1 dB	2.5% @ 2.7 dB

Table A-21 Maximum FER of demodulation performance test of R-FCH or R-DCCH receiver under RC4

Case	Data rate (bit/s)	FER limits (%)	
		Lower limit Eb/N0	Upper limit Eb/N0
A	14400	2.2% @ 3.2 dB	0.4% @ 3.8 dB
	7200	1.9% @ 3.9 dB	0.4% @ 4.5 dB
	3600	1.9% @ 5.1 dB	0.5% @ 5.7 dB
	1800	1.8% @ 7.0 dB	0.5% @ 7.6 dB
B	14400	2.0% @ 3.8 dB	0.4% @ 4.4 dB
	7200	2.0% @ 4.3 dB	0.5% @ 4.9 dB
	3600	1.8% @ 5.6 dB	0.5% @ 6.2 dB
	1800	1.8% @ 7.5 dB	0.5% @ 8.1 dB
C	14400	1.6% @ 5.1 dB	0.6% @ 5.7 dB
	7200	1.7% @ 5.6 dB	0.7% @ 6.2 dB
	3600	1.5% @ 6.7 dB	0.6% @ 7.3 dB
	1800	1.6% @ 8.4 dB	0.7% @ 9 dB
D	14400	2.0% @ 4.6 dB	0.5% @ 5.2 dB
	7200	2.0% @ 5.1 dB	0.5% @ 5.7 dB
	3600	1.9% @ 6.3 dB	0.5% @ 6.9 dB
	1800	1.8% @ 8.1 dB	0.6% @ 8.7 dB

Table A-22 Maximum FER of demodulation performance test of R-SCH(Turbo Code) receiver under RC4

Case	Data rate (bit/s)	FER limits (%)	
		Lower limit Eb/N0	Upper limit Eb/N0
B	230400	10% @ 2.4 dB	1.4% @ 3.0 dB
	115200	9.0% @ 2.5 dB	2.3% @ 3.1 dB
	57600	9.0% @ 2.6 dB	2.2% @ 3.2 dB
	28800	7.5% @ 2.8 dB	2.5% @ 3.4 dB

Table A-23 Maximum FER of demodulation performance test of R-SCH (Turbo Code) receiver under RC4

Case	Data rate (bit/s)	FER limits (%)	
		Lower limit Eb/N0	Lower limit Eb/N0
B	230400	10% @ 1.1 dB	2.0% @ 1.7 dB
	115200	10% @ 1.0 dB	1.5% @ 1.7 dB
	57600	11% @ 1.5 dB	1.8% @ 2.1 dB
	28800	10% @ 2.1 dB	2.0% @ 2.7 dB

A.1.4 Receiving Performance

I. Sensitivity

450MHz band and 1900MHz band:

The R-TCH FER shall be <1.0% with 95% confidence when -126dBm/1.23MHz CDMA RC3 signal level is inputted at BTS RF main and diversity input ports.

800MHz band:

The R-TCH FER shall be <1.0% with 95% confidence when -127dBm/1.23MHz CDMA RC3 signal level is inputted at BTS RF main and diversity input ports.

II. Receiver dynamic range

450MHz band and 1900MHz band:

The R-TCH FER shall be 1.0% or less with 95% confidence when -126dBm/1.23MHz~-65dBm/1.23MHz CDMA signal level is inputted at BTS RF main and diversity input ports.

800MHz band:

The R-TCH FER shall be 1.0% or less with 95% confidence when -127dBm/1.23MHz~-65dBm/1.23MHz CDMA signal level is inputted at BTS RF main and diversity input ports.

III. Single-tone desensitization

450MHz band:

Input the single-tone interference deviated from the center frequency at the BTS RF input port: when the single-tone interference deviates from the center frequency +900kHz and -900kHz, the input single-tone interference power is 87dB higher than the output power of the mobile station simulator. When R-TCH FER maintains <1.5%, the output power of mobile station simulator changes less than 3dB whether there is single-tone interference or not.

800MHz band:

Input the single-tone interference deviated from the center frequency at the BTS RF input port: when the single-tone interference deviates from the center frequency about +750kHz and -750kHz, the input single-tone interference power is 50dB higher than the output power of the mobile station simulator; when the single-tone interference deviates from the center frequency +900kHz and -900kHz, the input single-tone interference power is 87dB higher than the output power of the mobile station simulator. When R-TCH FER maintains <1.5%, the output power of mobile station simulator changes less than 3dB whether there is single-tone interference or not.

1900MHz band:

Input the single-tone interference deviated from the center frequency at the BTS RF input port: when the single-tone interference deviates from the center frequency +1.25MHz and -1.25MHz, the input single-tone interference power is 80dB higher than the output power of the mobile station simulator. When R-TCH FER maintains <1.5%, the output power of mobile station simulator changes less than 3dB whether there is single-tone interference or not.

IV. Intermodulation spurious response attenuation

450MHz band and 800MHz band:

Input two single-tone interference of center frequency at the BTS RF input port: both deviate from the center frequency +900kHz and +1700kHz respectively, and -900kHz and -1700kHz respectively, the input single-tone interference power is 72dB higher than the output power of the mobile station simulator. When R-TCH FER keeps <1.5%, the output power of the mobile station simulator changes less than 3dB whether there are two single-tone interference or no interference.

1900MHz band:

Input two single-tone interference of center frequency at the BTS RF input port: both deviate from the center frequency +1.25MHz and +2.05MHz respectively, and -1.25MHz and -2.05MHz respectively. When R-TCH FER keeps <1.5%, the output power of the mobile station simulator changes less than 3dB whether there are two single-tone interference or no interference.

V. Adjacent channel selectivity

The output power of the mobile station simulator shall increase by no more than 3 dB and the FER shall be less than 1.5% with 95% confidence.

A.1.5 Limitations on Emissions

I. Conducted spurious emissions

- At BTS RF input port, the conducted spurious emissions within the BTS receiving frequency range is <-80dBm/30kHz.
- At BTS RF input port, the conducted spurious emissions within the transmitting frequency range is <-60dBm/30kHz.

- At BTS RF input port, the conducted spurious emissions within other frequency range of 0~6GHz is <-47dBm/30kHz.

II. Radiated spurious emissions

In compliant with local radio specifications.

A.1.6 Received Signal Quality Indicator (RSQI)

RSQI is defined as the signal-to-noise ratio Eb/N0, where Eb is the energy per bit including the pilot and power control overhead and N0 is the total received noise-pulse-interference power in the CDMA bandwidth including the interference from other subscribers. The RSQI report values are list in Table A-24.

Table A-24 RSQI range

Eb/N0 (dB) per input port	Minimum Acceptable Report Value	Maximum Acceptable Report Value
4	10	18
5	12	20
6	14	22
7	16	24
8	18	26
9	20	28
10	22	30
11	24	32
12	26	34
13	28	36
14	30	38

A.2 Performance of Transmitter

A.2.1 Frequency Requirements

I. Frequency coverage

450MHz band: 460 - 470MHz

800MHz band: 869 - 894MHz

1900MHz band: 1930 - 1990MHz

II. Frequency tolerance

Within the working temperature range, the average difference between the actual carrier frequency of CDMA transmit sector and the carrier frequency of the dedicated transmit sector is less than $\pm 5\times 10^{-8}$($\pm$0.05ppm)of the designated frequency.

A.2.2 Modulation Requirements

I. Synchronization & timing

Time tolerance for pilot frequency: The pilot time alignment error should be less than 3 µs and shall be less than 10 µs.. For base stations supporting multiple simultaneous CDMA Channels, the pilot time tolerance of all CDMA Channels radiated by a base station shall be within ±1 µs of each other.

Time tolerance of pilot channel and other code-division channels: in the same CDMA channel, time error between the pilot channel and other forwarding code-division channels is <±50ns.

The phase differences between the Pilot Channel and all other code channels sharing the same Forward CDMA Channel should not exceed 0.05 radians and shall not exceed 0.15 radians.

II. Waveform quality

The normalized cross correlation coefficient, ρ, shall be greater than 0.912 (excess power < 0.4 dB)..

A.2.3 RF Output Power Requirement

I. Total power

Total power is the mean power delivered to a load with resistance equal to the nominal load impedance of the transmitter.. The total power of this system is +43dBm (20W), the deviation in all kinds of environmental conditions shall not exceed +2dB and -4dB.

II. Pilot power

The Pilot Channel power to total power ratio shall be within ±0.5 dB of the configured value.

III. Code domain power

For RC1and RC2, the code domain power in each inactive W_n^{64} channel shall be 27 dB or more below the total output power.

For RC3 and RC4,the code domain power in each inactive W_n^{128} channel shall be 30 dB or more below the total output power. .

For RC1 and RC2, the code domain power in each inactive W_n^{256} channel shall be 33 dB or more below the total output power of each carrier.

A.2.4 Limitations on Emissions

I. Conducted spurious emissions

The requirements on Conducted Spurious Emissions vary with frequency bands, as shown in Table A-25 and Table A-26. Local radio requirements should also be observed.

Table A-25 Conducted Spurious Emissions Performance (450MHz band and 800MHz band)

Offset from carrier central frequency	Spurious requirement	
750 kHz~1.98 MHz	-45 dBc / 30 kHz	
1.98 MHz~4.00 MHz	-60 dBc / 30 kHz; Pout ≥ 33 dBm -27 dBm / 30 kHz; 28 dBm ≤ Pout < 33 dBm -55 dBc / 30 kHz; Pout < 28 dBm	
> 4.00 MHz (ITU Class A Requirement)	-13 dBm / 1 kHz; -13 dBm / 10 kHz; -13 dBm/100 kHz; -13 dBm / 1 MHz;	9 kHz < f < 150 kHz 150 kHz < f < 30 MHz 30 MHz < f < 1 GHz 1 GHz < f < 5 GHz
> 4.00 MHz (ITU Class B Requirement)	-36 dBm / 1 kHz; -36 dBm / 10 kHz; -36 dBm/100 kHz; -30 dBm / 1 MHz;	9 kHz < f < 150 kHz 150 kHz < f < 30 MHz 30 MHz < f < 1 GHz 1 GHz < f < 12.5 GHz

Table A-26 Conducted Spurious Emissions Performance (1900MHz band)

Offset from carrier central frequency	Spurious requirement	
885 kHz~1.25 MHz	-45 dBc / 30 kHz	
1.25 MHz~1.98 MHz	-60 dBc / 30 kHz; Pout ≥ 33 dBm -27 dBm / 30 kHz; 28 dBm ≤ Pout < 33 dBm -55 dBc / 30 kHz; Pout < 28 dBm	
1.98 MHz~2.25 MHz	-55dBc/30kHz，Pout≥33dBm -22dBm/30kHz，28dBm ≤ Pout < 33dBm -50dBc/30kHz，Pout < 28dBm	
2.25 MHz~4.00 MHz	-13dBm/1MHz	
> 4.00 MHz (ITU Class A Requirement)	-13 dBm / 1 kHz; -13 dBm / 10 kHz; -13 dBm/100 kHz; -13 dBm / 1 MHz;	9 kHz < f < 150 kHz 150 kHz < f < 30 MHz 30 MHz < f < 1 GHz 1 GHz < f < 5 GHz

II. Radiated spurious emissions

In compliant with local radio specifications.

Appendix B EMC Performance

ETSI EN 300 386 Electromagnetic Compatibility and Radio Spectrum Matters (ERM); Telecommunication network Equipment. ElectroMagnetic Compatibility (EMC) Requirements are the EMC standards of telecommunication equipment globally applicable. EMC Performance of BTS comply with ETSI EN 300 386 V1.2.1 (2000-03). They are described in two aspects: EMI (EelectroMagnetic Interference) and EMS (ElectroMagnetic Sensitivity).

B.1 EMI Performance

1) Conductive emission (CE) at DC input/output port

CE performance indices are listed in Table B-1.

Table B-1 CE index at -48V port

Frequency range	Threshold (dB μV)	
	Average	Quasi-peak
0.15 ~ 0.5MHz	56~46	66~56
0.5 ~ 5MHz	46	56
5 ~ 30MHz	50	60

2) Radiated emission (RE)

RE performance indices are listed in Table B-2.

Table B-2 RE performance requirement

Band (MHz)	Threshold of quasi-peak (dB μV/m)
30 ~ 1000	61.5
1000 ~ 12700	67.5

Note:

Test place is arranged according to ITU-R 329-7 [1].

B.2 EMS Performance

1) R-F anti-electromagnetic interference (80 MHz~1000MHz)

Values of RF anti-EMI test are listed in Table B-3.

Table B-3 Values of RF anti-EMI test

Test port	Test level	Performance class
Whole cabinet	3V/m	A

Note:

Test method is the same as IEC1000-4-3 [9].

2) Voltage drop anti-interference

Among all test items of EMS, the requirement for resisting continuous interference test is class A and the requirement for resisting transient interference test is class B. Requirement for power drop and level interruption is shown in Table B-4.

Table B-4 Requirement for power drop and level interruption

Test port	Test level	Performance class
AC port	Drop 30% Last for 10ms	A
	Drop 60% Last for 100ms	When there is backup power, A When there is no backup power, the communication link need not be maintained. It can be re-created and the user data can be lost.
	Drop over95% Last for 5000ms	When there is backup power, A When there is no backup power, the communication link need not be maintained. It can be re-created and the user data can be lost.

Note:

Test method is the same as IEC61000-4-11 [13].

3) Electrostatic discharge (ESD)

Requirement for ESD test level is shown in Table B-5.

Table B-5 Requirement for ESD test level

Discharge mode	Test level	Performance class
Contact	2kV, 4kV	B
Air	2kV, 4kV, 8kV	B

Note:

1. Test method is the same as IEC 61000-4-2 [5].
2. ESD should be performed to all exposed surface of equipment to be tested except those to be protected as required by the user's document.

4) RF conductive anti-interference

In CDMA equipment, the port where a cable of more than 1 meter may be connected to, including control port, DC input/output port and the input/output port of the connection line when cabinets are combined, should satisfy the requirement for RF conductive anti-interference. Voltage level is shown in Table B-6.

Table B-6 Voltage level

Test port	Voltage level	Performance class
DC line port	3V	A
AC line port		
Signal line port and control line port		

Note:

Test method is the same as IEC61000-4-6 [9].

5) Surge

For CDMA equipment, the DC power input port, indoor signal line of more than 3 m, control line (such as E1 trunk line, serial port line) and the cable that may be led out to the outdoor should all satisfy the requirement for surge interference level. The test level is shown in Table B-7.

Table B-7 Test level

Test port	Test level	Performance class
AC port	Line~line, 2kV Line~ground, 4kV	B
Control line, signal line	Line~line, 0.5kV Line~ground, 1kV	B

Test port	Test level	Performance class
Control line, signal line (outdoors)	Line~line, 1kV Line~ground, 2kV	B

Note:

The test method is the same as IEC61000-4-5 [11].

6) Common-mode fast transient pulse

The signal & data line between CDMA cabinets and that connected with other systems (such as E1 trunk line), control line and cable connected to DC input/output port, should be the requirement for fast transient pulse anti-interference level. The threshold value is shown in Table B-8.

Table B-8 Threshold value

Test port	Test level	Performance class
Signal control line port	0.5kV	B
DC line input/output port	1kV	B
AC line input port	2kV	B

Note:

Performance class A: it means that BTS can withstand the test without any damage and it can run normally in the specified range. There is not any change in the software or data (all data in the storage or the data being processed) related to the tested switching equipment. Equipment performance is not lowered.

Performance class B: it means that BTS can withstand the test without any damage. There is no change in the software or the data in storage. Communication performance is lowered a little, but in the tolerance (as defined for different products). The existing communication link is not interrupted. After the test, the equipment can recover to the normal status before the test automatically without any interference of the operator.

Performance class C: some functions of BTS are lost temporarily during the test, but they will recover to normal performance in a specific period after the test (normally the shortest time needed for system reboot). There is no physical damage or system software deterioration.

Performance class R: after the test, there is no physical damage or fault (including software corruption) with BTS. Protection equipment damage caused by external interference signal is acceptable. When the protection equipment is replaced and the running parameters are re-configured, the equipment can operate normally.

Appendix C Environment Performance

In compliance with ETSI, environmental conditions of products include requirements in three aspects: operation environment, transportation environment and storage environment.

C.1 Ambient Temperature and Humidity

1) Operation environment

In compliance with the environmental level specified in IEC60721-3-3 3K3/3Z2/3Z4/3B1/3C2/3S3/3M1 and ETS 300 019-2-3 T3.1. The normal running temperature should be in the range of -5˚C~+50˚C, and that of humidity in the range of 5%~90% .

2) Storage environment

In compliance with IEC60721-3-1 1K4/1Z2/1Z3/1B2/1C2/1S3/M2 and IEC 300 019-2-1 T1.2 "Weather Protection, No Temperature Control" level. Normal storage temperature should be in the range of -25˚C ~+55˚C, and that of humidity in the range of 10%~100%.

3) Transportation environment

In compliance with IEC60721-3-2 2K4/2B2/2C2/2S2/2M2 and IEC 300 019-2-2 T2.3 "Public Transportation" level. Normal transportation temperature should be in the range of -40˚C ~+70˚C, and that of humidity in the range of 5%~100%.

C.2 Cleanness

1) Operation environment

In compliance with IEC60721-3-3 3K3/3Z2/3Z4/3B1/3C2/3S3/3M1 and ETS 300 019-2-3 T3.1 environment level:

Precipitable particle	15	m^2h
Floating particle	0.4	mg/m^3
Gravel	300	mg/m^3

2) Storage environment

In compliance with IEC60721-3-1 1K4/1Z2/1Z3/1B2/1C2/1S3/M2 and IEC 300 019-2-1 T1.2 "Weather protection, no temperature level" level:

Precipitable particle	20	m^2h
Floating particle	5	mg/m^3
Gravel	300	mg/m^3

3) Transportation environment

In compliance with IEC60721-3-2 2K4/2B2/2C2/2S2/2M2 and IEC 300 019-2-2 T2.3 "Public Transportation" level.

Precipitable particle	3	m^2h
Floating particle	No requirement	mg/m^3
Gravel	100	mg/m^3

C.3 Illumination

1) Operation environment

In compliance with IEC60721-3-3 3K3/3Z2/3Z4/3B1/3C2/3S3/3M1 and ETS 300 019-2-3 T3.1 environment level. In normal operation, solar radiation should not exceed 700W/m^2, thermal radiation should not exceed 600W/m^2, and illumination should satisfy the requirement for working visibility and comfort.

2) Storage environment

In compliance with IEC60721-3-1 1K4/1Z2/1Z3/1B2/1C2/1S3/M2 and IEC 300 019-2-1 T1.2 "Weather Protection, No Temperature Control" level. In normal storage place, the solar radiation should not exceed 1120W/m^2, thermal radiation should not exceed 600W/m^2, and illumination should satisfy the requirement for working visibility and comfort.

3) Transportation environment

In compliance with IEC60721-3-2 2K4/2B2/2C2/2S2/2M2 and IEC 300 019-2-2 T2.3 "Public Transportation" level. In normal transportation conditions, the solar radiation should not exceed 1120W/m^2, thermal radiation should not exceed 600W/m^2, and illumination should satisfy the requirement for working visibility and comfort.

C.4 Atmospheric Condition

1) Operation environment

In compliance with IEC60721-3-3 3K3/3Z2/3Z4/3B1/3C2/3S3/3M1 and ETS 300 019-2-3 T3.1 environment level:

Atmospheric pressure	70~106	kPa
Wind speed	5	m/s
SO_2	0.3~1.0	mg/m^3
H_2S	0.1 ~0.5	mg/m^3
Cl_2	0.1 ~0.3	mg/m^3
HCl	0.1 ~0.5	mg/m^3
NO_x	0.5 ~1.0	mg/m^3
NH_3	1.0 ~3.0	mg/m^3
HF	0.01 ~0.03	mg/m^3
O_3	0.05 ~0.1	mg/m^3

2) Storage environment

In compliance with IEC60721-3-1 1K4/1Z2/1Z3/1B2/1C2/1S3/M2 and IEC 300 019-2-1 T1.2 "Weather Protection, No Temperature Control" level:

Atmospheric press	70~106	KPa
Wind speed	30	m/s
SO_2	0.3~1.0	mg/m^3
H_2S	0.1 ~0.5	mg/m^3
Cl_2	0.1 ~0.3	mg/m^3
HCl	0.1 ~0.5	mg/m^3
NO_x	0.5 ~1.0	mg/m^3
NH_3	0.5 ~3.0	mg/m^3
HF	0.01 ~0.03	mg/m^3
O_3	0.05 ~0.1	mg/m^3

3) Transportation environment

In compliance with IEC60721-3-2 2K4/2B2/2C2/2S2/2M2 and IEC 300 019-2-2 T2.3 "Public Transportation" level.

Atmospheric pressure	70~106	kPa
Wind speed	20	m/s
SO_2	1	mg/m^3
H_2S	0.5	mg/m^3
Cl_2	No requirement	mg/m^3
HCl	0.5	mg/m^3
NO_x	1	mg/m^3
NH_3	3	mg/m^3
HF	0.03	mg/m^3
O_3	0.1	mg/m^3

Appendix D Electromagnetic Radiation

D.1 Introduction

Base Transceiver Station (BTS) emit RF radiation (Radiation Hazard). Although there is no scientific evidence of possible health risks to persons living near to base stations some recommendations are giving below for the installation and operation of base station transceivers. Operators of base station transceivers are required to obey the local regulation for erecting base station transceivers.

The Federal Communications Commission (FCC), are imposing MPE (maximum permissible exposure) limits. FCC CFR part 1, subpart I, section 11307 requires operator to perform a Enviromenta Assemessmet (EA). Equipment listed in the table 1 of before mentioned part are subjected to routine environmental evaulation. For facilities and operations licensed under part 22, licensees and manufactuere are required tto ensure that their facility and equipment comply with IEEE C95.1-1991.

The objective of the Environmental Evaluation is to ensure that human exposure to RF energy does not go beyond the maximum permissible levels stated in the standard. Therefore certain sites do not require an evaluation by nature of its design. It could be that the antennas are placed high enough thereby resulting in extremely low RF fields by the time it reaches areas that would be accessible to people. Environmental evaluations are required, for Paging and Cellular Radiotelephone Services, Part 22 Subpart E and H;

- Non-rooftop antennas: height of radiation center < 10m above ground level and total power of all channels > 1000 W ERP (1640 W EIRP)
- Rooftop antennas: total power of all channels > 1000 W ERP (1640 W EIRP)

D.2 Maximum Permissible Exposure (MPE)

Maximum permissible exposure (MPE) refers to the RF energy that is acceptable for human exposure, given the scientific research to date. It is broken down into two categories, Controlled and Uncontrolled. Controlled limits are used for persons such as installers and designers that are in control of the hazard and exposed to energy for limited amounts of time per day. Occupational/controlled limits apply in situations in which are persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

Uncontrolled limits are used for general public. General population/uncontrolled exposure apply in situations is which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure. The exposure levels can be expressed in terms of power density, electric field strength, or magnetic field strength, as averaged over 30 minutes for the general public and 6 minutes for trained personnel. The exposure criteria is frequency dependent, and a chart covering the range from 3 kHz to 100 GHz can be found in NCRP No.86 (references IEEE C95.1-1991). Below are the limits.

Limits for Occupational/Controlled Exposure			
Frequency Range (MHz)	**Electric Field Strength (E) (V/m)**	**Magnetic Field Strength (H) (A/m)**	**Power Density (S) (mW/cm^2)**
0.3-3.0	614	.63	(100)*
3.0-30	1842/f	4.89/f	($900/f^2$)*
30-300	61.4	0.163	1.0
300-1500	--	--	f/300
1500-100,000	--	--	5

Limits for General Population/Uncontrolled Exposure			
Frequency Range (MHz)	**Electric Field Strength (E) (V/m)**	**Magnetic Field Strength (H) (A/m)**	**Power Density (S) (mW/cm^2)**
0.3-3.0	614	1.63	(100)*
3.0-30	842/f	2.19/f	($180/f^2$)*
30-300	27.5	0.073	0.2
300-1500	--	--	f/1500
1500-100,000	--	--	1.0

Power density S [mW/cm^2] for controlled area at 880 MHz

$$S = \frac{f[MHz]}{300} = \frac{880}{300} = 2.9mW/cm^2$$

Power density S [mW/cm²] for uncontrolled area at 880 MHz

$$S = \frac{f[MHz]}{1500} = \frac{880}{1500} = 0.58 mW / cm^2$$

D.3 Estimation of Exposure to Electromagnetic Fields

Below method describes a theoretical approach to calculate possible exposure to electromagnetic radiation around a base station transceiver antenna. Precise statements are basically only possible either with measurements or complex calculations considering the complexity of the environment (e.g. soil conditions, near buildings and other obstacles) which causes reflections, scattering of electromagnetic fields.

The maximum output power (given in EIRP) of a base station is usually limited by license conditions of the network operator.

A rough estimation of the expected exposure in power flux density on a given point can be made with the following equation. The calcualtions are based on FCC OET 65 Appendix B.

$$S = \frac{P(W) * G_{numeric}}{4 * r^2(m) * p}$$

Whereas:

P = Maximum output power in W of the site

$G_{numeric}$ = Numeric gain of the antenna relative to isotropic antenna

R = distance between the antenna and the point of exposure in meters

D.4 Calculation of Safe Distance

Calculations can be made on a site by site basis to ensure the power density is below the limits given above, or guidelines can be done beforehand to ensure the minimum distances from the antenna is maintained through the site planning.

$$r = \sqrt{\frac{1.64 * G_d * Pt}{4pS}}$$

Whereas:

r = distance from the antenna [m]

G_d = Antenna gain relative to half wave dipole

Pt = Power at the antenna terminals [W]

S = power density [W/m^2] see also MPE Limits

Note: 1mW/cm^2 = 10W/m^2

D.5 Location of Base Station Antennas

Base stations antennas, the source of the radiation, are usually mounted on freestanding towers, with a height up to 30 m or on a tower on the top of buildings or in less cases to the side of the building. Generally the height of the antenna position does not fall below 10 m. The power usually is focused into a horizontal main beam and slightly downward tilted. The remaining power goes into the weaker beams on both side of the main beam. The main beam however does not reach ground level until the distance from the antenna position is around 50 – 200 m.

The highest level of emission would be expected in close vicinity of the antenna and in line of sight to the antenna.

D.5.1 Exclusion Zones

1) Antenna location should be designed so that the public cannot access areas where the RF radiation exceeds the levels as described above. .
2) If there are areas accessible to workers that exceed the RF radiation exceeds the levels as described above make sure that workers know where these areas are, and that they can (and do) power-down (or shut down) the transmitters when entering these areas. Such areas may not exist; but if they do, they will be confined to areas within 10 m of the antennas.
3) Each Exclusion zone should be defined by a physical barrier and by a easy recognizable sign warning the public or workers that inside the exclusion zone the RF radiation might exceed national limits.

D.5.2 Guidelines on Arranging Antenna Locations

1) For roof-mounted antennas, elevate the transmitting antennas above the height of people who may have to be on the roof.
2) For roof-mounted antennas, keep the transmitting antennas away from the areas where people are most likely to be (e.g., roof access points, telephone service points, HVAC equipment).
3) For roof-mounted directional antennas, place the antennas near the periphery and point them away from the building.

4) Consider the trade off between large aperture antennas (lower maximum RF) and small aperture antennas (lower visual impact).
5) Take special precautions to keep higher-power antennas away from accessible areas.
6) Keep antennas at a site as for apart as possible; although this may run contrary to local zoning requirements.
7) Take special precautions when designing "co-location" sites, where multiple antennas owned by different companies are on the same structure. This applies particularly to sites that include high-power broadcast (FM/TV) antennas. Local zoning often favors co-location, but co-location can provide "challenging" RF safety problems.
8) For roof-mounted antennas, elevate the transmitting antennas above the height of people who may have to be on the roof.
9) For roof-mounted antennas, keep the transmitting antennas away from the areas where people are most likely to be (e.g., roof access points, telephone service points, HVAC equipment).
10) Take special precautions for antenna sites near hospital and schools.

Appendix E Standard Compliance

E.1 Um Interface

I. Physical layer

TIA/EIA IS-2000-2-A: Physical Layer Standard for cdma2000 Spread Spectrum Systems

II. MAC layer

TIA/EIA IS-2000-3-A: Medium Access Control (MAC) Standard for cdma2000 Spread Spectrum Systems

III. Service capability

TSB2000: Capabilities Requirements Mapping for cdma2000 standards

IV. System performance

TIA/EIA-97-D: Recommended Minimum Performance Specification for cdma2000 Spread Spectrum Base Station

E.2 Abis Interface

I. Physical layer

1) E1 interface

E1 Physical Interface Specification, September 1996

2) SDH STM-1

ANSI T1.101: Synchronization Interface Standard

ITU-T G.707: (3/96) Network node interface for the synchronous digital hierarchy (SDH)

ITU-T G.703: (10/98) Physical/electrical characteristics of hierarchical digital interfaces

ITU-T G.957: Optical interface for equipment and systems relating to the synchronous digital hierarchy

ITU-T G.958: Digital line systems based on the synchronous digital hierarchy for use on optical fiber cables

3) ATM

AF-PHY-0086.001: Inverse Multiplexing for ATM(IMA) Specification Version 1.1

ATM Forum af-phy-0064.000

ATM Forum af-phy-0130.000

ATM on Fractional E1/T1, October 1999

II. ATM layer

ANSI T1.627-1993: Telecommunications broadband ISDN-ATM Layer Functionality and specification

III. ATM adaptation layer

ITU-T recommendation I.366.2: B-ISDN ATM Adaptation Layer Type 2 Specification

ITU-T I.363.5: B-ISDN ATM Adaptation Layer 5 Specification: Type 5 AAL

IV. TCP/IP

RFC791: Internet Protocol

RFC793: Transport Control Protocol

V. Abis interface high layer protocol

3GPP2 A.R0003: Abis interface technical report for cdma2000 1X Spread Spectrum System

VI. Self-defined standard

cdma2000 1X Abis Interface High Layer Protocol

E.3 Lightning Protection

- IEC 61312-1(1995) Protection Against Lightning Electromagnetic Impulse Part I: General Principles
- IEC 61643-1(1998) Surge Protective devices connected to low-voltage power distribution systems
- ITU-T K.11 (1993) Principles of Protection Against Over-voltage and Over-current.
- ITU-T K.27 (1996) Bonding Configurations and Earthing Inside a Telecommunication Building

- ETS 300 253(1995) Equipment Engineering; Earthing and bonding of telecommunication equipment in telecommunication centers

E.4 Safety

- IEC60950 Safety of information technology equipment Including Electrical Business Equipment
- IEC60215 Safety requirement for radio transmitting equipment
- CAN/CSA-C22.2 No 1-M94 Audio, Video and Similar Electronic Equipment
- CAN/CSA-C22.2 No 950-95 Safety of Information Technology Equipment Including Electrical Business Equipment.
- UL 1419 Standard for Professional Video and Audio Equipment
- 73/23/EEC Low Voltage Directive
- UL 1950 Safety of information technology equipment Including Electrical Business Equipment
- IEC60529 Classification of degrees of protection provided by enclosure (IP Code).

E.5 EMC

- TS 25.113v3.1.0; 3rd Generation Partnership Project; Technical Specification Group Radio Access Networks; Base station EMC
- ITU-R Rec. SM.329-7: "Spurious emissions"
- TS 25.141; 3rd Generation Partnership Project; TSG RAN WG4; UTRA (BS) FDD; Base station conformance testing (FDD)
- TS 25.142; 3rd Generation Partnership Project; TSG RAN WG4; Base station conformance testing (TDD)
- TS 25.104; 3rd Generation Partnership Project; TSG RAN WG4; UTRA (BS) FDD; Radio transmission and reception
- TS 25.105; 3rd Generation Partnership Project; TSG RAN WG4; UTRA (BS) TDD; Radio transmission and reception

Appendix F Abbreviation

3GPP2	3rd Generation Partnership Project 2
A	Availability
A1/A2/A5	Interface between BSC and MSC
A3/A7	Interface between BSCs
A8/A9	Interface between BSC and PCF
A10/A11	Interface between PCF and PDSN
AAA	Authorization, Authentication and Accounting
AAL2	ATM Adaptation Layer 2
AAL5	ATM Adaptation Layer 5
Abis	Interface between BSC and BTS
AC	Authentication Center
AC	Alternating Current
A/D	Analog/Digital
ADC	Analog Digit Converter
AGC	Automatic Gain Control
ANSI	American National Standards Institute
ARQ	Automatic Repeat Request
ATM	Asynchronous Transfer Mode
AUC	Authentication
B	
BPSK	Binary Phase Shift Keying
BAM	Back Administration Module
BBFL	BTS BTRM FAN Lamp Module
BBFM	BTS BTRM FAN Monitor
BCIM	BTS Control Interface Module
BCKM	BTS Control & Clock Module
BCPM	BTS Channel Process Module
BDCS	BTS Direct Current Switchbox
BEOM	BTS Electric-Optical Module
BESP	BTS E1 Surge Protector
BFAN	BTS FAN Module
BFMM	BTS Fan Monitor Module
BFNB	BTS Fan Block Interface Board
BHPA	BTS High Power Amplifier Unit
BICM	BTS Intermediate Frequency Control Module
BIFU	BTS Intermediate Frequency Unit
BPLI	BTS Power & Lighting protection lamp Indicator board
BRCU	BTS Radio Up-Down Converter Unit
BRDM	BTS Resource Distribution Module
BRFM	BTS RF Fan Module
BS	Base Station
BSC	Base Station Controller
BSS	Base Station Subsystem
BTBM	BTS Transceiver Backplane Module
BTEM	BTS Test Module
BTRM	BTS Transceiver Module
BTS	Base Transceiver Station
C	
CCITT	International Telephone and Telegraph Consultative Committee
CBKM	CDMA Backplane Module
CDMA	Code Division Multiple Access
CDU	Combining Duplexer Unit
CE	Channel Element
CLI	Command Line Interpreter
CLK	Clock
CM	Connection Management

CMM	Capability Mature Mode
CN	Core Network
CPU	Central Processing Unit
CRC	Cyclic Redundancy Check
CTC	Common Transmit Clock
D	
D/A	Digit/Analog
DAC	Digit Analog Converter
DC	Direct Current
DAGC	Digit Automatic Gain Control
DCE	Data Communications Equipment
DDU	Dual Duplex er Unit
DFU	Duplex er and Filter Unit
E	
EMC	Electro Magnetic Compatibility
EMI	Electro Magnetic Interference
EMS	Electro Magnetic Sensitivity
EIA	Electronics Industry Association
EIB	Erasure Indicator Bit
EIR	Equipment Identity Register
ESD	Electrostatic Discharge
ETS	European Telecommunication Standards
ETSI	European Telecommunication Standards Institute
F	
FA	Foreign Agent
F-APICH	Forward Assistant Pilot Channel
F-ATDPICH	Forward Transmit Diversity Assistant Pilot Channel
F-BCH	Forward Broadcast Channel
FCACH	Forward Common Assignment Channel
FCC	Federal Communications Commission
F-CCCH	Forward Common Control Channel
FCH	Fundamental Channel
F-DCCH	Forward Dedicated Control Channel
F-DD	Frequency Division Duplex
FER	Frame Error Rate
F-FCH	Forward Fundamental Channel
F-PCH	Forward Paging Channel
F-PICH	Forward Pilot Channel
F-QPCH	Forward Quick Paging Channel
F-SCCH	Forward Supplemental Code Channel
F-SCH	Forward Supplemental Channel
F-SYNCH	Forward Sync Channel
F-TCH	Forward Traffic Channel
F-TDPICH	Forward Transmit Diversity Pilot Channel
FTP	File Transfer Protocol
G	
GLONASS	Global Navigation Satellite System
GPM	General Paging Message
GPS	Global Position System
GRIL	GPS/GLONASS Receiver Interface Language
GUI	Graphics User Interface
H	
HA	Home Agent
HDLC	High level Data Link Control
HLR	Home Location Register
HPAU	High Power Amplifier Unit
HPBW	Half Power Beam Width
HPSK	Hybrid Phase Shift Keying
I	
ICP	IMA Control Protocol
ID	IDentification
IEC	International Electrotechnical Commission

IEEE	Institute of Electrical and Electronics Engineers
IF	Intermediate Frequency
IMA	Inverse Multiplexing for ATM
IP	Internet Protocol
IPOA	IP over ATM
ISDN	Integrated Services Digital Network
ITC	Independent Transmit Clock
ITU	International Telecommunications Union
ITU-R	International Telecommunications Union- Radiocommunication Sector
ITU-T	International Telecommunications Union-Telecommunication Standardization Sector
IWF	Interwork Function
J	
JTAG	Joint Test Action Group
L	
LAC	Link Access Control
LED	Light Emitting Diode
LMF	Local Maintenance Function
LNA	Low-Noise Amplifier
M	
MAC	Medium Access Control
MC	Message Center
MCPA	Multi-Carrier Power Amplifier
MCU	Main Control Unit
Mcps	Million chips per second
MM	Mobility Management
MMI	Man Machine Interface
MOC	Mobile Originated Call
Modem	Modulator-Demodulator
MPU	Micro Process Unit
MS	Mobile Station
MSC	Mobile Switching Center
MT0	Mobile Terminal 0
MTC	Mobile Terminated Call
MT1	Mobile Terminal 1
MTBF	Mean Time Between Failures
MTRB	Micro-bts Transceiver Board
MTTR	Mean Time To Repair
N	
O	
OAM	Operation & Maintenance
OEM	Original Equipment Manufacturer
OMC	Operation & Maintenance Center
OML	Operation & Maintenance Link
OMU	Operation & Maintenance Unit
OCXO	Oven voltage Control Oscillator
OQPSK	Offset Quadrature Phase Shift Keying
OTD	Orthogonal Transmit Diversity
P	
PCB	Printed Circuit Board
PCF	Packet Control Function
PCH	Paging Channel
PDSN	Packet Data Service Node
PGND	Protection Ground
PLL	Phase-Locked Loop
PLMN	Public Land Mobile Network
PMRM	Power Measurement Report Message
PN	Pseudo Number
PP2S	Pulse Per 2 Seconds
PPP	Peer-Peer Protocol
PRM	Paging Response
PSPDN	Packet Switched Public Data Network
PSTN	Public Switched Telephone Network

PSU	Power Supply Unit
PVC	Permanent Virtual Channel
PVP	Permanent Virtual Path
PWM	Pulse-Width Modulation
Q	
QIB	Quality Identification Bit
QoS	Quality of Service
QPCH	Quick Paging Channel
QPSK	Quadrature Phase Shift Keying
R	
R-ACH	Reverse Access Channel
RC	Rate Configuration
RC1	Rate Configuration 1
RC2	Rate Configuration 2
RC3	Rate Configuration 3
RC4	Rate Configuration 4
R-CCCH	Reverse Common Control Channel
R-DCCH	Reverse Dedicated Control Channel
R-EACH	Reverse Enhanced Access Channel
RF	Radio Frequency
R-FCH	Reverse Fundamental Channel
RLDU	Receive LNA Distribution Unit
RLP	Radio Link Protocol
RM	Radio Management
RNC	Radio Network Controller
R-PC	Reverse Power Control subchannel
R-PICH	Reverse Pilot Channel
R-SCCH	Reverse Supplemental Code Channel
R-SCH	Reverse Supplemental Channel
RSQI	Receive Signal Quality Indicator
R-TCH	Reverse Traffic Channel
S	
SCH	Supplemental Channel
SDH	Synchronous Digital Hierarchy
SID	System Identification
SME	Signaling Message Encryption
SDU	Selection/Distribution Unit
SPU	Signaling Process Unit
SSSAR	Special Service Segmentation and Reassemble
STM-1	Synchronization Transfer Mode 1
STS	Space Time Spreading
T	
TA	Timing Advance
TA	Terminal Adapter
TAm	Mobile Terminal Adapter
TCP	Transport Control Protocol
TDD	Time Division Duplex
TDMA	Time Division Multiple Access
TE1	Terminal Equipment 1
TE2	Terminal Equipment 2
TIA	Telecommunications Industry Association
TMSI	Temp Mobile Subscriber Identifier
TRX	Transceiver
U	
Um	Interface between BTS and MS
UNI	User Network Interface
UTC	Universal Coordinated Time
UART	Universal Asynchronous Receiver/Transmitter
V	
VCI	Virtual Channel Identifier
VLR	Visitor Location Register
VPI	Virtual Path Identifier

VSWR	Voltage Standing Wave Radio