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Airbridge cBTS3612-800 12-carrier CDMA Base Station

User Manual

V100R001

Airbridge cBTS3612-800 12-carrier CDMA Base Station
User Manual

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About This Manual

Contents

The manual introduces the insulation methods and procedure of cBTS3612-800. It is divided into three modules:

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2 Hardware Architecture

3 Software Architecture

4 System Function

5 System Configuration

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Appendix B EMC Indices

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Appendix D Standard Compliance

Appendix E Abbreviation

- Module 2: BTS Maintenance

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Sub Module 2 Common Fault Analysis and Locating

Sub Module 3 Board and Part Replacement

Sub Module 4 Board Indicators and DIP Switches

Target Readers

The manual is intended for the following readers:

- 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

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

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

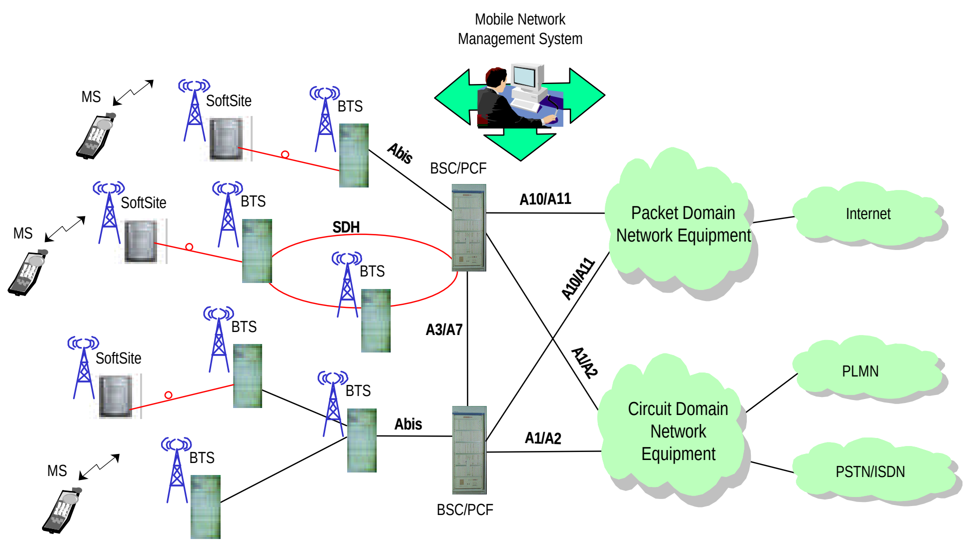
1 System Overview

This chapter firstly presents an overview to the cBTS3612-800 base station system, then briefs the system features, technical index and external interfaces, followed by and introduction to the system reliability design in aspects of hardware and software. By reading this chapter, users can have a basic understanding of cBTS3612-800.

1.1 System Overview

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 inter-works with Internet, and that of the circuit field inter-works with the conventional PLMN and PSTN/ISDN. The system's operation and maintenance is implemented via the mobile integrated network management system (iManager M2000).

The position of BTS in CDMA system is as shown in Figure 1-2.



MS: Mobile Station
BSC: Base Station Controller
PLMN: Public Land Mobile Network
PCF: Packet Control Function
BSS: Base Station Subsystem
Internet: Internet
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 cBTS3612-800 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 cBTS3612-800 serves as the wireless transceiving equipment of one cell or multiple logical sectors. By connecting to BSC via the Abis interface, it assists the BSC with 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.

cBTS3612-800 cabinet is as shown in Figure 1-2.

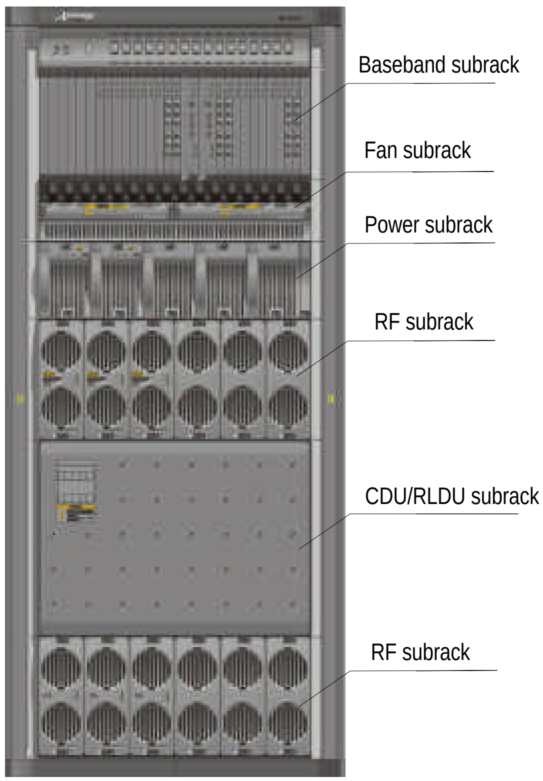


Figure 1-2 cBTS3612-800 cabinet

cBTS3612-800 has the following functions:

I. Interface function

1) Um interface supports cdma2000 1X. Its basic features meet the requirement of cdma2000 Release A. It is fully compatible with IS-95A/B. The physical layer supports a rate as high as 307.2kbit/s. It supports hard handoff, soft handoff and softer handoff. It also supports fast forward power control, slow forward power

control, fast reverse power control and reverse open-loop power control. It further supports omni-cell, directional 3 sectors and 6 sectors configurations.

2) 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 16xE1/T1 trunk lines and optical fiber transmission mode will support 2 pairs of STM-1 optical fibers. It also supports chain, star and tree networking modes.

II. Optional function

- Support Orthogonal Transmit Diversity (OTD) and Space Time Spreading (STS).
- Support softsite(ODU3601C) extended afar via optical fiber.

III. Basic functions of operation and maintenance

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

1.2 System Features

cBTS3612-800 is a BTS of large capacity, high integration and low power consumption. One cabinet can accommodate as many as 12 sector carriers. It caters for the customer's needs in all aspects such as 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

Advanced architecture, well-developed Huawei ATM platform and cell switching & broadband processing technology, providing standard interface, and open application.

Designed with the resource pool mode, which helps increase the availability of hardware resources and the system's fault-tolerance.

Equipped with the digital intermediate frequency technology to enhance the signal processing capability.

Designed with the technology of diversity receiving and transmission to improve the radio signal transceiving performance.

Supporting remote installation of the softsite via optical fiber and able to realize flexible networking

Equipped with the blind mate technology on the radio frequency module for convenient maintenance.

Controlled with intelligent fans which prolongs the fan's service life and reduces its noise.

1.2.2 Protecting User Investment

The cBTS3612-800 is compatible with IS-95A/B. It can be added to on the existing IS-95 network, and through channel assignment, can support both IS-95 or cdma2000 1X equipment on the network, so no equipment modification is needed when upgrading the entire network.

The cBTS3612-800 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 guarantees the original antenna and feeder equipment (including CDU, DFU, RLDU, antenna, feeder and the optional tower-top amplifier) can be fully used in the event of BTS expansion or upgrade.

1.2.3 Convenient Operation and Maintenance

Emergency serial ports are provided for the board and system operation to ensure the alarm information to be reported in the case of communication link fault so as to raise the effective and real-time level of maintenance.

Supporting the real-time status query, online board test and system fault locating as well as system restart.

Provided with a Telnet Server so that the user can log in to the BTS via the local Ethernet interface in the standard Telnet mode to performance O&M.

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

All boards and modules 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 cBTS3612-800 system can restart automatically right after the faults are cleared.

1.2.4 Flexible Networking Mode

I. Suitable for networking of large capacity and broad coverage

- A single cabinet supports as many as 12 sector carriers. 3 spliced cabinets provide a maximum capacity of 36 sector carriers.
- Large capacity trunk. Abis interface of BTS can support as many as 16xE1 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).

II. Support 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)

IV.

In this networking mode, the baseband 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, and so on.

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

1.2.5 Advanced and Reliable Power Supply System

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

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

1.3 Technical Index

1.3.1 General index

I. Standard for structure design, physical appearance and dimension

1) Structure design complies with IEC297 standard and IEEE standard

2) Dimension of the cabinet

- Height: 1800mm
- Width: 800mm
- Depth: 650mm

3) Package dimension of the cabinet should be not more than

- Height: 1900mm
- Width: 900mm
- Depth: 750mm

4) Physical appearance of PCB and the dimension for installation

- Base band board dimension: 33.35mm (H)%460mm (D), 2.5mm thick
- Base band backplane dimension: 664.00mm (W)%262.00mm (H), 4.8mm thick

II. Input power

-48V DC: -40~-60VDC

III. Power consumption

The maximum power consumption of a single cabinet in full configuration is no more than 7000W.

IV. Weight

The weight of a single cabinet in full configuration should not exceed 450kg.

Weight bearing of the equipment room (battery weight not considered): 6kN/m^2

Power consumption of a BTS with typical configuration and the weight of the cabinet:

BTS configuration	Power consumption (W)	Weight (kg)
S(1/1/1)	<2000	351
S(2/2/2)	<3500	388
S(4/4/4)	<7000	500

V. Working frequency band

BTS working frequency band:

- BTS receiver (RX): 824 ~ 849MHz
- BTS transmitter (TX): 869 ~ 894MHz

VI. Clock parameter

Frequency: 10MHz, precision must be within !0.5Hz before delivery.

Temperature characteristics: <!0.2%10^{-7}, one-hour test after heating up for 15 minutes

Annual aging rate: <!0.5%10^{-9}

VII. Receiver sensitivity

Better than-126dBm (tested according to TAI/EIA-97D)

VIII. Transmit power

The maximum power of each 1.23M carrier measured at the feeder port on the top of the BTS is 20W.

1.3.2 Radio Interface Index

BTS receiver and transmitter work in 824~849MHz band and 869~894MHz band respectively. The performance meets or exceeds the requirement specified in TIA/EIA IS-97-D *Recommended Minimum Performance Specification for cdma2000 Spread Spectrum Base Station*. Refer to "Appendix A Technical Performance of Receiver and Transmitter " for details.

1.3.3 Environment Index

In terms of environment adaptability, cBTS3612-800 conforms with 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.

1.3.4 EMC Index

EMC specification of cBTS3612-800 conforms with ETSI EN 300 386 Electromagnetic compatibility and Radio spectrum Matters (ERM), Telecommunication network equipment, ElectroMagnetic Compatibility (EMC) requirements, which are world-adopted standards. For details, please refer to Appendix B EMC Performance.

1.3.5 Noise

In compliance with ETS 300 753 Noise Requirement for telecommunication equipment and base station environment, BTS is designed in compliance with the requirement of a dedicated telecommunication equipment room, where noise should be less than 72dB. Actually the equipment noise is less than 70dB.

1.3.6 Environmental Protection

BTS protects environment in stages of designing, manufacturing and running. Following environment friendly principles should be observed:

- Reduce power consumption of products whenever possible.
- Compactness of products and energy saving in product transportation.
- Recycle proposal attached to the product design.
- Materials used for the equipment do not produce hazardous gas (except CO and HCl, which are inevitable). Do not use materials that may do harm to the environment (such as BeO, ream, mercury, cadmium and siloxane).

1.4 External Interface

1.4.1 Overview

The external interfaces of cBTS3612-800 are shown in Figure 1-3.

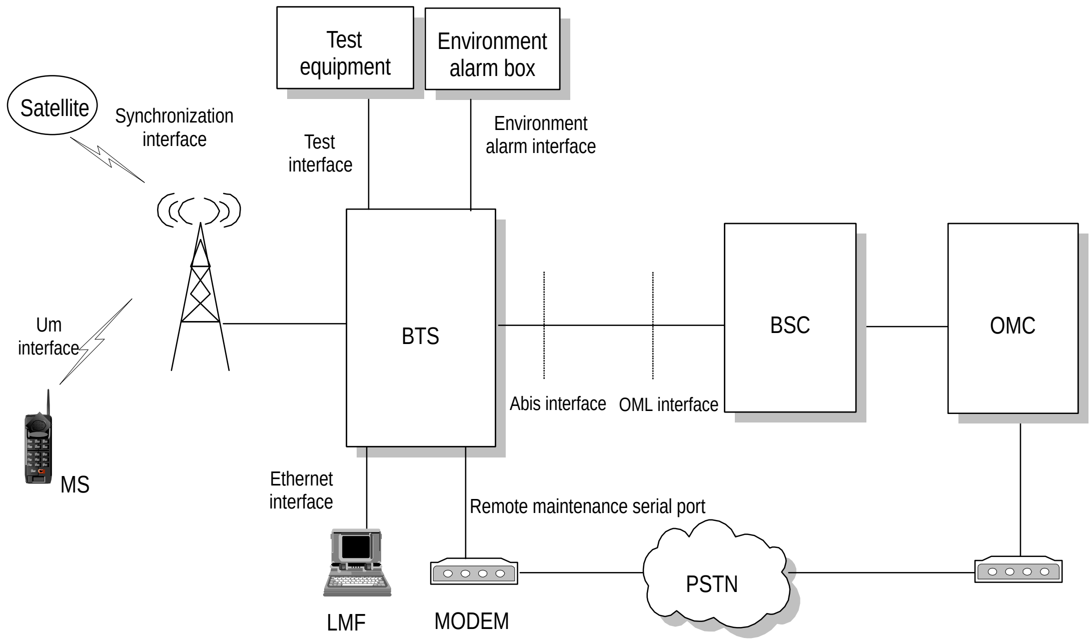


Figure 1-3 BTS external interface

- 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: provide interface for BTS test, such as 10MHz, 2s signal.
- Remote maintenance serial interface: another interface with remote console. This is a standby maintenance interface 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. Um interface 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 attain communication service. 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 operates 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 mode

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

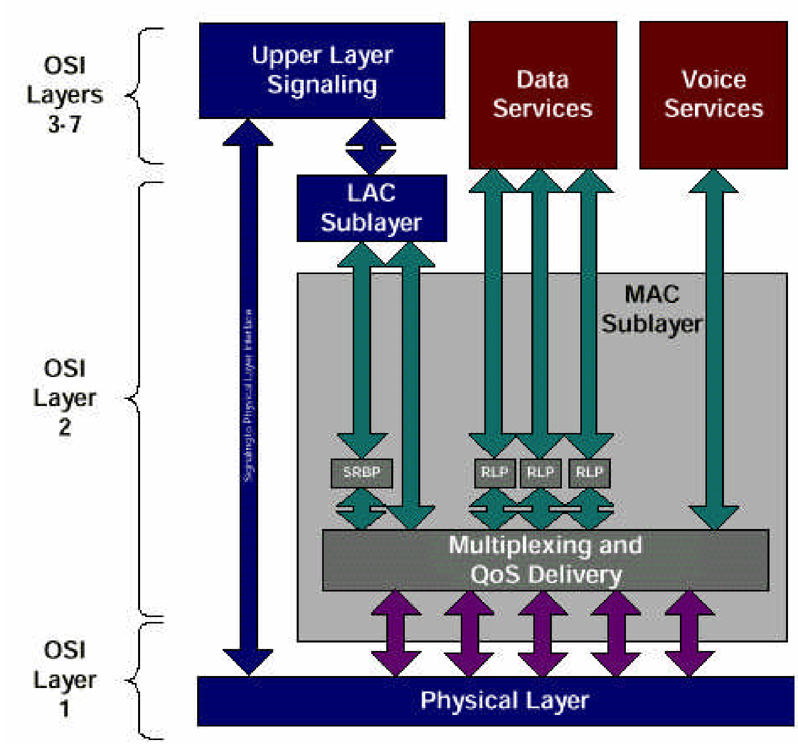


Figure 1-4 Um interface layered structure

- 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 RLP function. The cdma2000 LAC sublayer performs such functions as authentication, 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) Working band

Cellular band:

Reverse (MS? BTS): 824 ~ 849MHz.

Forward (BTS? MS): 869 ~ 894MHz.

Duplex spacing: 25MHz.

Channel bandwidth: 1.23MHz

Carrier spacing: 1.25MHz

2) Physical layer function

- Service bearer: the physical channel in the physical layer provides a 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 (RC). 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 (from 1.2kbit/s to 2Mbit/s).
- 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:

- Provide radio link protocol (RLP), ensuring reliable transmission on the radio link.
- Provide multiplex function and QoS function, with diversified services and higher service quality.

2) LAC sublayer

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

V. Layer 3

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

1) Radio resource management

It is mainly used to create, operate and release radio channels, performing functions such as soft switching, softer switching and hard switching.

2) Mobility management

It is mainly used to support the mobility features of the mobile user, performing such functions as registration, authentication and TMSI re-distribution.

3) Call control

It is mainly used to create, maintain and terminate calls in circuit switching mode.

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.

1) Forward power control supports closed-loop 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.

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

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

- Reverse open-loop power control means that MS adjusts its transmitting power as the receiving power changes.
- Reverse closed-loop power control means that BTS compares the received MS transmitting power with the preset power control threshold and sends power control command based on the comparison. MS changes its transmitting 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 can utilize many handoff technologies. It supports three types of handoff in traffic channel communication:

1) Hard handoff: MS interrupts the connection with the old BTS before creating connection with a new BTS.

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

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

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

For more information, please refer to Section 4.5.2 Handoff.

1.4.3 Abis Interface

I. Abis interface 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 for BTS accessing BSC via the terrestrial link.

1) Composition of Abis interface

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

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

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 a customized signaling by equipment manufacturers. In Abis interface, there is a transparent channel, used to transmit customized signaling OML between OMC and OMU on BTS.

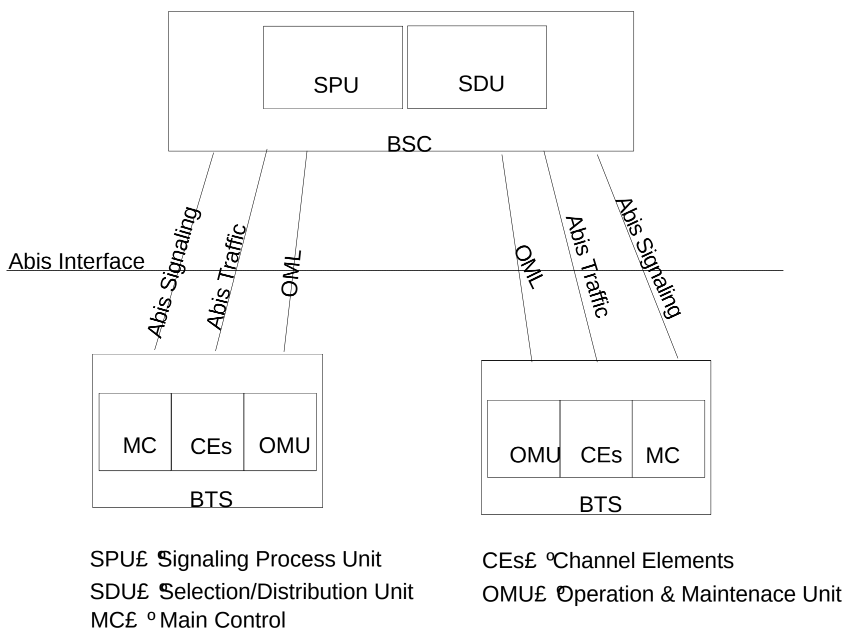


Figure 1-5 Composition of Abis interface

2) Protocol stack of Abis interface

The protocol stacks used by Abis signaling and the signaling performing operation & maintenance are as follows:

Abis Signaling Application/OAM Application
TCP
IP
AAL5
ATM

Physical Layer

Protocol stacks used by Abis service are as follows:

Abis Traffic
SSSAR
AAL2
ATM
Physical Layer

II. Physical layer of Abis interface

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 of Abis interface

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

Signaling matches with AAL5 and is borne in IPOA (IP Over ATM) mode. At Abis interface, Abis signaling path connects the main control software (MC) and SPU of BSC via 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 transmit it to OMC transparently. BSC does not process any signaling that performs operation and maintenance.

Abis service adapts itself through AAL2. At Abis interface, BCPM uses several PVCs to connect the channel 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. The Layer 3 of Abis interface--service management.

At Abis interface, Abis signaling and Abis service are in the domain of service management. Specifically, Abis service 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 function: with this function, BSC configures logic parameters of cells to BTS, specifically including cell pilot channel PN offset, sector gain, public channel number and parameter.

- General message updating: with this function, BSC configures or update general 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 that BSC send to MSs through Abis interface.

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

3) Procedure of dedicated channel creation and release

It is used to control the setup and release of air 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 service data.

⚠ **Caution:**

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

---

4) Service bearing procedure

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

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

5) Power control

Abis interface supports various power controls of CDMA. Power control is performed through setting parameters. Power control falls into 4 types: forward fast closed-loop power control, forward slow closed-loop power control, reverse fast closed-loop power control and reverse open-loop power control.

1.4.4 OML Interface

OML interface is the interface between BTS and remote OMC. It is actually one of Abis interface applications. But in the application layer, OML interface is the interface between BTS and the remote OMC. OML interface shares resources of Abis interface, including physical layer, ATM, AAL5 and TCP/IP. Refer to Abis interface.

OML interface is used for OMC to perform operation and maintenance to BTS. It is a signaling defined by various 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 GSP/GLONASS is in compliance with the requirement of *Technical Specifications of Interface Between GPS/GLONASS Dual-Mode Receiver and Base Station in CDMA Digital Cellular Mobile Communication Network.*

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 emergence 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 manufacturer is used between BTS and the environment alarm collection box. Therefore, BTS must support an environment alarm collection box of the matched type.

1.5 Reliability Design

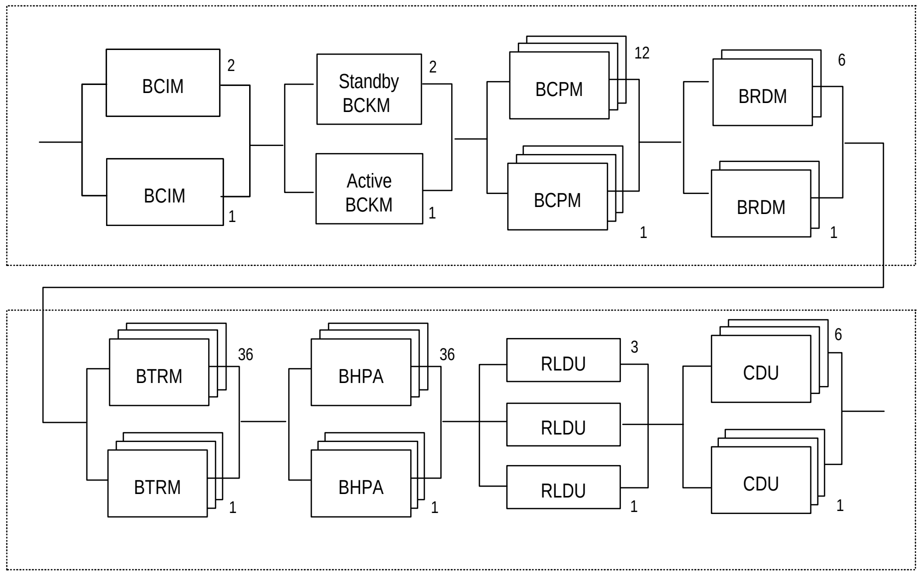
Reliability design of a system is shown in the stability and reliability of the product running.

Huawei cBTS3612-800 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 all boards is in strict accordance with the requirement of above standards pertaining to reliability design. Many measures have been taken to ensure the reliability of boards. 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.

The reliability model of the system is as shown in Figure 1-6.



BCIM: BTS control interface module
BCKM: BTS control & clock module
BCPM: BTS channel processing module
BRDM: BTS resource distribution module
BTRM: BTS transceiver module
BHPA: BTS high power amplifier unit
RLDU: Receive LNA distribution unit
CDU: Combining duplexer unit

Figure 1-6 BTS reliability model

System reliability index:

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 index 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

cBTS3612-800 is designed with substantial hardware reliability, such as board active/standby mode, load sharing and redundancy configuration. In addition, system maintainability is improved with fault checking 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 of the boards, 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 measures is taken 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 faults. 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 like 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 line 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 of 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 should ensure that cBTS3612-800 would not degrade to an unacceptable level due to the electromagnetic interference from other equipment in the same electromagnetic environment. At the same time, cBTS3612-800 will not cause other equipment in the same electromagnetic environment to degrade to an unacceptable level due to the EMI from it.

XII. Electromagnetic compatibility

Proper measures are applied to ensure that the BTS system performance will not be degraded due to the electromagnetic interference from other devices in the same electromagnetic environment, nor will other devices or systems in the same environment be degraded by the BTS 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. BTS ensures the software reliability in the whole process from system requirement analysis, system design to system test.

Starting from the requirement analysis, software development process is going under regulations such as CMM (Capability Mature Mode) and controlling 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, measures of precaution such as fault checking, isolating and clearing are also important in improving the system reliability. Other effective methods include code scanning, inspection, and sectional test.

Various software tests are necessary to improve the software reliability. Test staff are engaged in the whole software develop process, from unit test to system test. They make plans strictly compliant with the demand of the upper level flow. plans 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 shown in the following aspects:

- All boards work in a real-time operating system of high reliability.
- Important data on BCKM are real-time backed up in active/standby mode. Operation is switched to the standby board when a fault occurs.
- When a fault occurs to some transmission links, services borne on them can be transferred to other links smoothly.
- Each board's software saved 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 is a briefing of cBTS3612-800 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 block diagram of BTS is as shown in Figure 2-1.

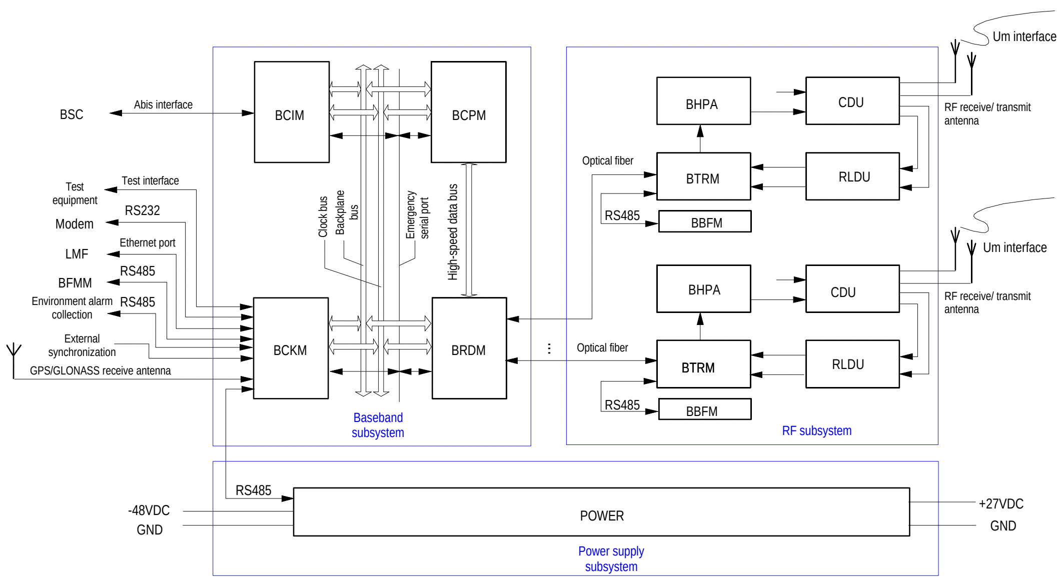


Figure 2-1 BTS block diagram

Note:

In Figure 2-1, DFU can be used to replace CDU or used together with CDU. The difference between CDU and DFU is as below:

CDU: Combining and filterring of two transmitting carriers, main transmitting and receiving signals duplexing and isolating, and diversity receiving signal filtering.

DFU: Transmitting and receiving signal duplexing, isolating and filtering of one channel, diversity receiving signal filtering.

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 through 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, as hot mutual backup. BCKM receives GPS signals (or other synchronized 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 switching over, operation & maintenance (O&M) and 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 and pastes the data before sending them to BCPMs via the high-speed data bus. BRDM can also build daisy chains for BCPMs. The resource management mode of BRDM daisy chain makes BCPM provide shorter daisy chains (short daisy chain hereinafter). After pasting at BRDM, a standard daisy chain is formed, which helps to improve the utilization ratio of channel resource and facilitates the flexible configuration of channel capacity for each sector carrier. BRDM interacts O&M information with BCKM through the backplane bus. The emergency serial port of BRDM is attached to the UART of the backplane as a standby node.

3) BCPM

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

4) BCIM

BCIM performs data transmission between BTS and BSC of the BSS, including voices, data and O&M commands. With the Inverse Multiplexing on ATM (IMA) technology, BCIM multiplexes the BTS uplink data to IMA group that is composed of multiple E1s, and then transmits it to BSC via coaxial or optical fiber. Inversely, it can also demultiplex the IMA group 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), Combining Duplexer Unit (CDU), Duplexer Filter Unit (DFU) and Receive LNA Distribution Unit (RLDU). Functions of all parts are briefed as follows:

1) BTRM

BTRM consists of BTS Intermediate Frequency Module (BIFM), BTS Intermediate Frequency Control Module (BICM) and BTS Radio frequency up/down-conversion Module (BRCM). Its functions are as follows:

BIFM: BIFM 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 filtering, baseband molded filtering, Digit Automatic Gain Control (DAGC), uplink & downlink RF automatic gain control (AGC), multiplexing/demultiplexing to forward & reverse orthogonal (IQ) signals, clock recovery and RF module operation & maintenance.

BICM is a small plate mounted on the BIFM. It performs the control over BTRM, including power-on initialization, function configuration, alarm collection and reporting, and processing of O&M related messages.

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

- Main/diversity transmit unit realizes analog up-conversion and spurious suppressed filtering regarding each carrier BTS main/diversity transmitted signal output by BIFM.
- Main/diversity receive unit realizes analog frequency down-conversion, channel selective filtering and receive nose coefficient control regarding BTS main/diversity received signals output by RF receive front RLDU.
- Frequency source unit combines 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 to a transmitted carrier signal, checks its own working status in real time mode and generates alarm. It is composed of main signal power amplification unit and signal checking alarm unit. Signal checking and alarming 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 interconnection between BTRM and BHPA.

4) CDU

Combining and filterring of two transmitting carriers, main transmitting and receiving signals duplexing and isolating, and diversity receiving signal filtering.

5) DFU

Transmitting and receiving signal duplexing, isolating and filtering of one channel, diversity receiving signal filtering.

6) RLDU

RLDU performs low noise amplification and division to the receiving signals, providing standing wave alarm and forward power checking voltage output, checking the physical connection status of the antenna port in real time mode and monitoring whether the output of BRCM, 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), high power DC/DC power supply module, power distribution box, medium/low power DC/DC power supply module for boards (or modules).

In BTS equipment, the power supply subsystem provides all power for the BTS.

2.2 Baseband Subsystem

2.2.1 Overview

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

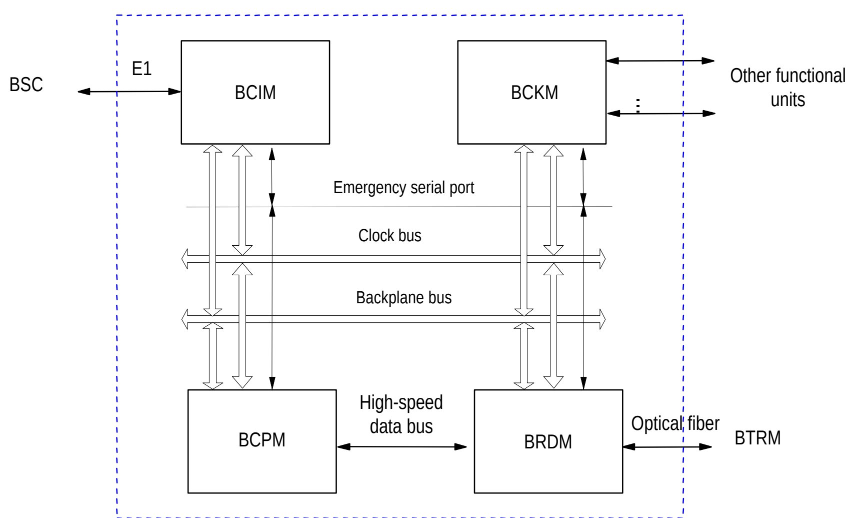


Figure 2-2 Block diagram of baseband subsystem

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 through an 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 synchronous to an external clock.
- Fan module interface: It is connected with fan module through RS485 serial port, monitoring the 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 provides interface for BTS test, such as 10MHz, 2s signals.

Baseband subsystem is physically located in the baseband subrack, powered by power supply subsystem (power supply subsystem is 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.

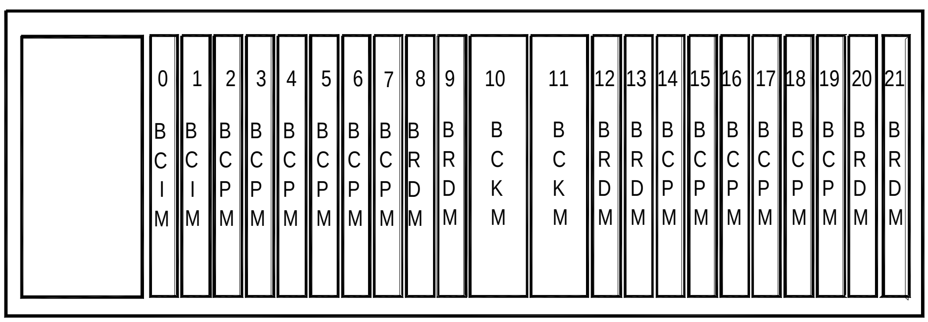


Figure 2-3 Baseband subrack configuration

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). Here MPU performs Abis interface signaling processing, O&M management, while CLK provides reference clock signal 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 to other boards in the baseband subrack, making in band signaling communication.
- Connected with external LAN (Local Area Network) and WAN (Wide Area Network) through the 10/100M compatible Ethernet interface, for the use of local/remote O&M or program debugging. The Ethernet port uses international physical address (MAC, Medium Access Control) and IP(IP, Internet Protocol) address. It can be allocated with external LAN/WAN address.
- The active/standby asynchronous serial port serves as a path for out-of-band signaling backup. MPU functions as the main node and other boards functions 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, providing 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 or can be synchronous with an external clock (such as GPS clock).
- BCKM has active/standby switching 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 switching of the whole BCKM.

II. Structure and principle

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

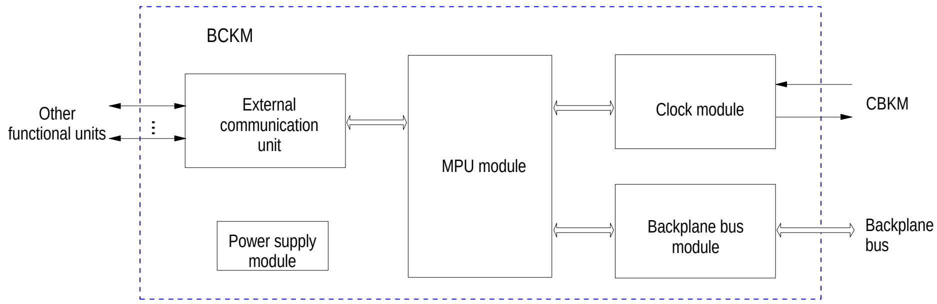


Figure 2-4 Structure of BCKM module

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 get synchronized with external clock source (GPS, GLONASS, external synchronization equipment).

3) Backplane bus module

The fast communication port of the main control 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, implementing functions such as LMF interface, external monitoring module interface, maintenance terminal interface, debugging interface, test module 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 to supply power for various modules of local board.

III. Interface

- Remote maintenance serial port (RS232)
- 10/100 Base-T LMF interface
- GPS/Glonass antenna port
- 2s and 10MHz test port
- Inter-board interface

Interfaces with other boards in the baseband subrack.

IV. Index

The board area 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 service 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 to corresponding processing boards through the backplane bus.
- Each BCIM provides 8xE1 links, which can support at most 4xIMA groups. In BTS, there are two BCIM, providing physical interfaces with BSC in load sharing mode. At most 16xE1 links can be provided.
- Communicate with BSC through IMA state machine program on the local board, monitoring the working status of E1 link and ensuring the implementation of IMA protocol.
- Transmit O&M command through backplane bus or out-of-band signaling serial port, report the status information of the local board to BCKM and provide interface for board maintenance and network management.

II. Structure and principle

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

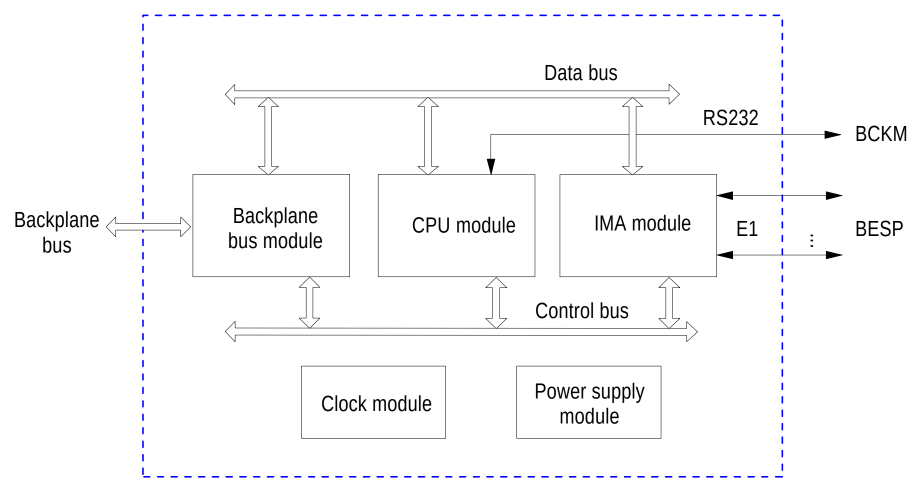


Figure 2-5 Structure of BCIM module

BCIM comprises the following parts:

1) IMA module

The purpose of IMA is to inversely multiplex an ATM cell flow based on cells onto 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 service 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 it to BSC.

In downlink direction, it receives ATM cells from BSC that are distributed on multiple E1 trunk lines, inversely multiplexes it into a single ATM cell flow. Then it sends AAL2 service 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 service data communication with BCPM.

4) Power supply module

Implement DC-DC power conversion from +27V to 3.3V.

5) Clock module

Provide 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

Interface with BCKM, as an emergency serial port

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 with12PCS in full configuration. It is of much importance. Data of various forward channel services and reverse channel services are processed by this board. BCPM also processes digital signals, including encoding/decoding baseband signals and one-time modulation and demodulation of baseband. 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), interleave, 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 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 connected with 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. It has powerful processing capacity.

II. Structure and principle

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

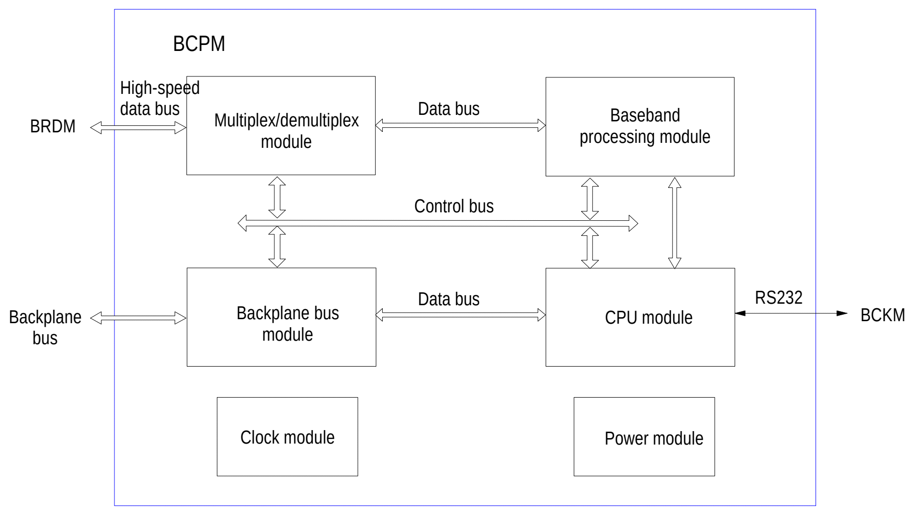


Figure 2-6 Structure of BCPM module

1) Multiplex/demultiplex module

In forward direction, baseband data in the channel board should be 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 quantity is increased greatly. Supporting 6 sectors, the maximum rate at physical level of each sector carrier reaches 403.2kbit/s and 307.2kbit/s in forward and reverse direction respectively.

3) CPU module

The high performance control CPU on BCPM mainly processes the forward & reverse high-speed service 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 baseband dedicated chip processing chip to generate orthogonal (IQ) data. After multiplexing, the data pass BRDM as a high-speed differential signal, to implement data interaction 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 service data communication with E1 interface board.

5) Clock module

Perform double-frequency phase-locking to the clock signals from the backplane, provide clock for boards, and drive and co-phase the clock signals generated on the local board, to get a satisfactory clock signal.

6) Power supply module

Perform 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

Interface with BCKM, which is used as emergency serial port.

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 switching between the two so as to support the flexible configuration relation between BCPM and BTRM. BRDM also support daisy chain cascading between BCPMs.

Data sent by BTRM are sent to BRDM through optical fiber. BRDM distributes and pastes the data before sending them to BCPMS via the high-speed data bus. BRDM can also build daisy chains for BCPMs. BRDM performs resource management to the daisy chain, making the short daisy chain provided on the channel board (short daisy chain hereinafter) become standard daisy chains after pasting at BRDM. 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 fiber-optic interfaces, providing high-speed data path with BTRM.
- When it is necessary to extend optical interfaces, insert BRDM board in BCPM slot.

- Provide 16 pairs of high-speed data bus interface, connected with 16 slots through the backplane.
- Provide flexible data distribution and switching between BTRM and BCPM
- Provide flexible data switching between BCPMs, for building daisy chains or resource pool, improving the utilization ratio of channel resource and configuring channel capacity of each sector carrier flexibly.
- Interact O&M information with BCKM through the backplane bus or emergency serial port.
- Forward and receive O&M information of BTRM via optical fiber and provide 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.

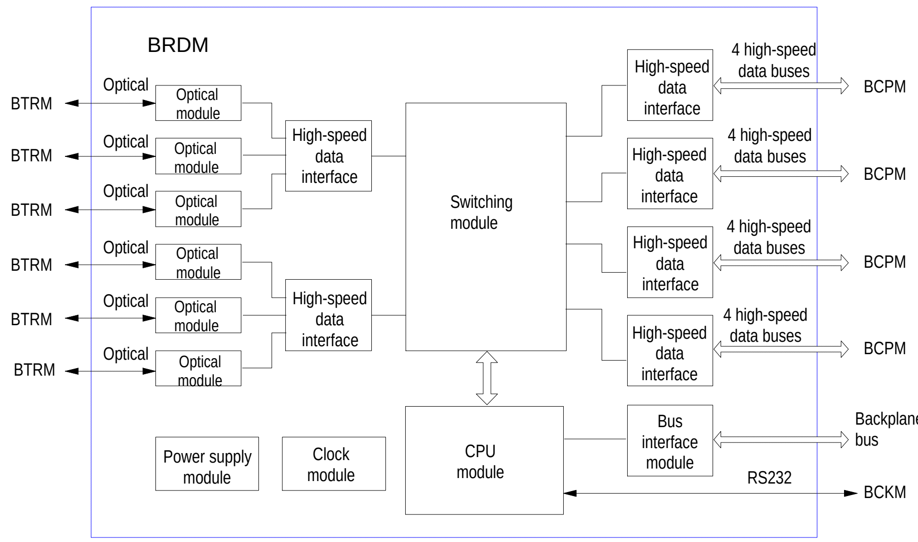


Figure 2-7 Structure of BRDM module

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. Different modules perform different functions.

- Optical module

Perform optical/electrical conversion of signals. Each BRDM board has 6 optical modules, providing 6 pairs of optical fiber interfaces externally.

- 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 slice 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

Perform conversion of interface between the board and the backplane and provide a path for the O&M information between this board and the backplane.

- Power supply module

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

- Clock module

Provide 2S, 16%1.2288MHz, 100%1.2288MHz clocks for the local board.

III. Interface

- Optical interface

It is on the handle bar, 6 pairs altogether. They are connected with BTRMs, transmitting orthogonal (IQ) data and O&M information.

- High-speed data interface

It is led out from the 2mm connector on the backplane. The interfaces are connected with 16 service slots through the backplane, for transmitting orthogonal (IQ) data.

- Backplane bus interface

It is led out from the 2mm connector on the backplane and attached to the backplane bus, used for transmitting O&M information between the BCKMs.

- Clock

Led out from the 2mm connector on the backplane, and 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 led out from the 2mm connector on the backplane and 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, and 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 between the boards of baseband part and between various management and control information of boards with high-speed backplane technology.

The backplane has the following features:

- Realize interconnection of various signals between boards.
- Support hot plug/unplug of all boards.
- Support active/standby switching of BCKM.
- Lead in system power, providing distributed power to all boards.
- Lead in the signal monitoring line for fan subrack and power subrack.
- Support mistaken plug proof function.

II. Structure

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

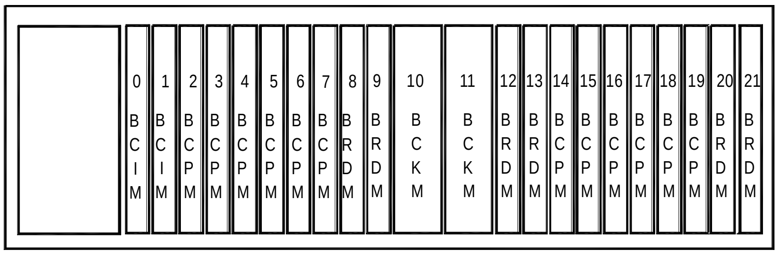


Figure 2-8 Functional units of all slots in CBKM

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 select crimped devices.

Slots of BTS are defined as follows:

- Slots 0~1 are slots for BCIM.
- Sots 10~11 are slots for BCKM.
- Slots 8~9, 12~13, 20~21 are slots for BRDM.
- Slots 2~7, 14~19 are slots for BCPM.

III. Interface

The interfaces between the backplane and outside include:

- System power interface
- Remote maintenance serial port
- Environment alarm interface
- Fan alarm serial port in baseband subrack
- External 2s signal input interface
- 16 E1 interfaces

IV. Index

Size of baseband subrack backplane: 664mm%262mm.

2.2.7 E1 Surge Protector (BESP)

I. Overview

BESP is placed on the top 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, protecting equipment from lightning attack.

II. Structure and principle

Board structure is as shown in Figure 2-9.

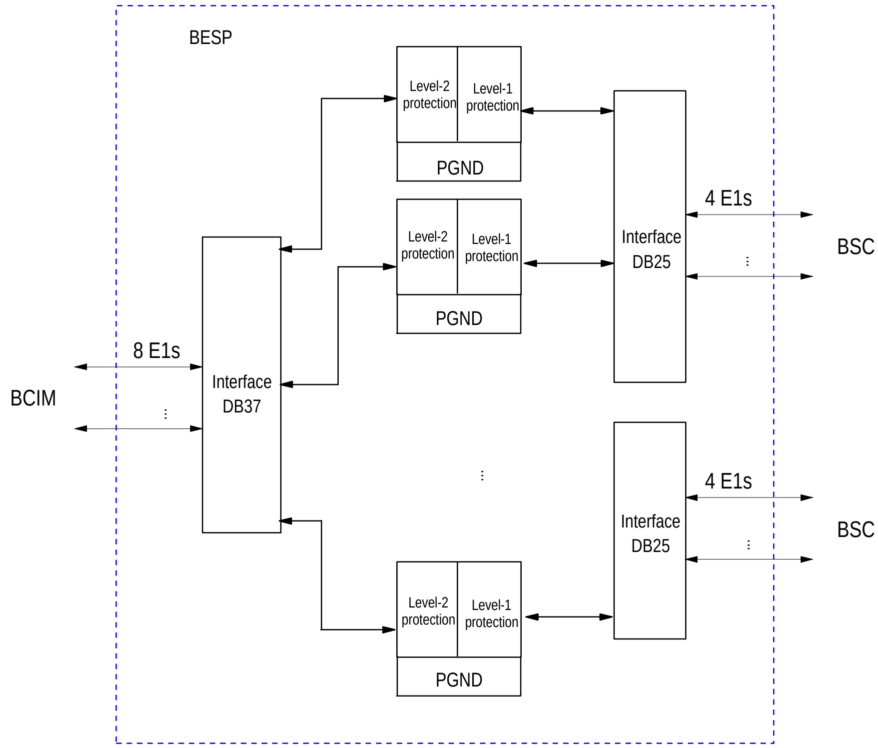


Figure 2-9 Structure of BESP

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, a high voltage will arise first on DB25. The high voltage will spread to the lightning protection unit. The lightning protection unit has two protection layers: air discharge tube and voltage limit mesh. The air discharge tube discharges the high voltage to the ground and lowers the voltage to a degree less than 600V. Then the voltage limit mesh further lowers the voltage to a degree less than 30V.

III. Interface

- E1interface

Interface with BSC (DB25).

Connected with BCIM (DB37)

IV. Index

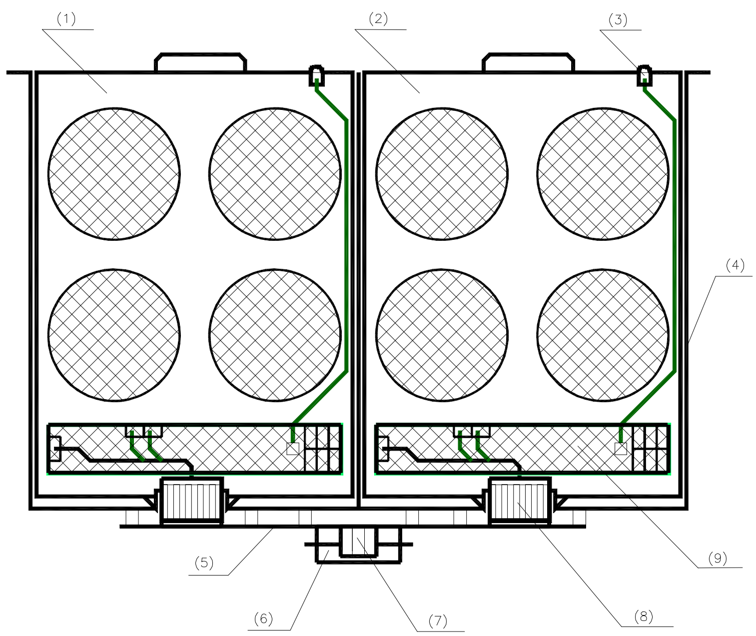
Board size: 140mm%120mm

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 boxs, 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 boxs. 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

II. 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 unit in the drawer and report board status information to BCKM when it is queried. BFMM can guarantee a safe and properly cooling system and lower system noise. Its main functions are as follows:

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

- Report alarms of switch value type (it is a standby function and not used in normal conditions).

2) Structure and principle

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

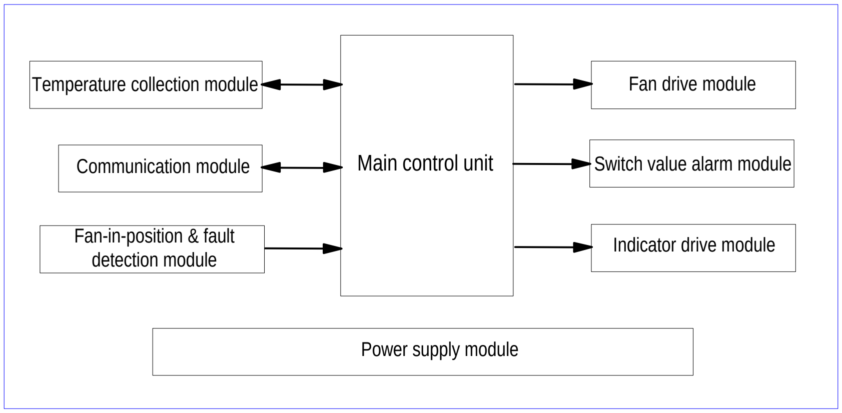


Figure 2-11 Illustration of BFMM

- Power supply module:

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

- Main Control Unit (MCU):

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

- Communication module:

Perform 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 checking module:

Isolate the fan in position checking signal and fan blocking alarm signal then convert them into logic level for MCU to sample, analyze and control.

- Temperature collection module:

Collect the ambient temperature of BFMM in real time, realized it 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.

- Switch value alarm output module:

When some systems have no serial port communication, fan fault has to be checked with switch value. In such case, BFMM should provide necessary output interface.

3) Interface

- Power interface

It is used to lead in working power for BFMM.

- Communication serial port 0, 1

Serial port communication signals interface 0 and interface 1, providing access condition for system active/standby serial port. When the system has only one serial port, only interface 0 is used.

- LED indicator driving output interface

Driving interface for LED status indicator on the panel of the fan box.

- Fan unit driving interface

Driving interface for as many as 6 fan units. It also serves as the interface to indicate fan in position and fan block alarm checking.

- Switch value alarm interface

Standby switch value alarm form interface, not used in normal condition.

4) Index

The size of BFMM: 280mm%35mm.

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

III. BTS Fan block iNterface Board (BFNB)

1) Overview

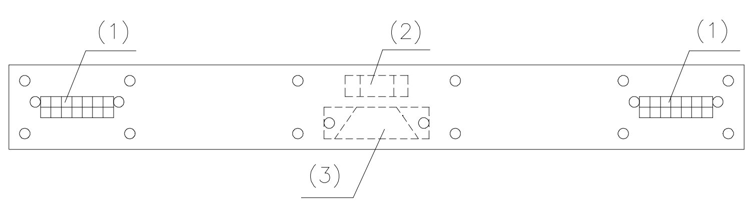
BFNB provides electrical connection between the fan box and the system. On one hand, it provides blind plug/unplug interface for the fan box. On the other hand, it provides the system with power interface and serial communication interface.

2) Structure and principle

BFNB structure and position are as shown in Figure 2-10.

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

BFNB structure is as 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

Provide power supply ports and serial port communication ports for the two fan boxes through MOLEX connectors.

- System power supply interface

Lead in system power through big 3-pin connector.

- System serial communication interface

Provide external serial communication interface through DB-15.

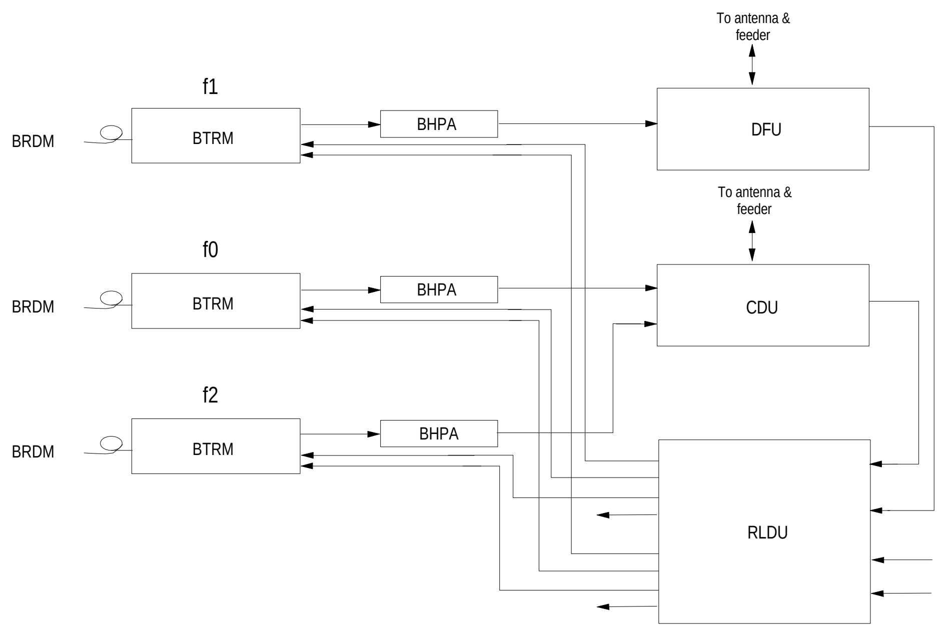
4) Index

The size of BFNB: 380mm%30mm.

2.3 RF Subsystem

2.3.1 Overview

The block diagram 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 block diagram of RF subsystem

In forward link, it performs power adjustable up-conversion to the modulated transmission signals and linear power amplification, 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-of-band interference and performs low noise amplifying. The noise factor can be adjustable in frequency down-conversion and channel selective filtering units.

RF subsystem is composed of the following function modules:

- BTRM performs frequency up/down-conversion of the transmitted and received signals and adjust the transmitted power and received noise factor.
- BHPA performs linear power amplification of single carrier-transmitted signal.
- CDU performs multi-carrier combining and filtering for transmitted signals, and receiving/transmitting signal isolating.

- DFU performs the transmitting signal filtering and receiving/transmitting signal isolating. There is a diversity filter in it.
- RLDU performs low noise amplifying of each sector received signals and multi-carrier distributing.
- BTBM performs mechanical support and signal interconnection of BTRM and BHPA.

2.3.2 Transceiver Module (BTRM)

BTRM is composed of BTS Intermediate Frequency Module (BIFM), BTS Intermediate Frequency Control module (BICM) and BTS Radio frequency up/down Conversion Module (BRCM).

I. BTS Intermediate Frequency Module (BIFM)

1) Overview

BIFM and BRDM are both used to provide interface between the channel board and RF transceiver. Its functions are as follows:

- Reverse path signals A/D conversion and digital frequency down-conversion.
- Baseband digital filtering to compensate the analog acoustic surface wave filter outband rejection.
- Transmitting signals data shaping filtering and digital auto-gain controlling.
- Digital frequency up-conversion in the forward path signal and D/A conversion.
- Multiplexing/demultiplexing of forward/reverse signals.
- Interfacing with BRDM through its optical fiber port.
- Provide RF phase lock loop reference clock and clock of the Ethernet port and various necessary clocks for BIFM itself.
- Provide power supply for BICM and BRCM.

2) Block diagram and principle

BIFM consists of the following parts. The structure is as shown in Figure 2-14.

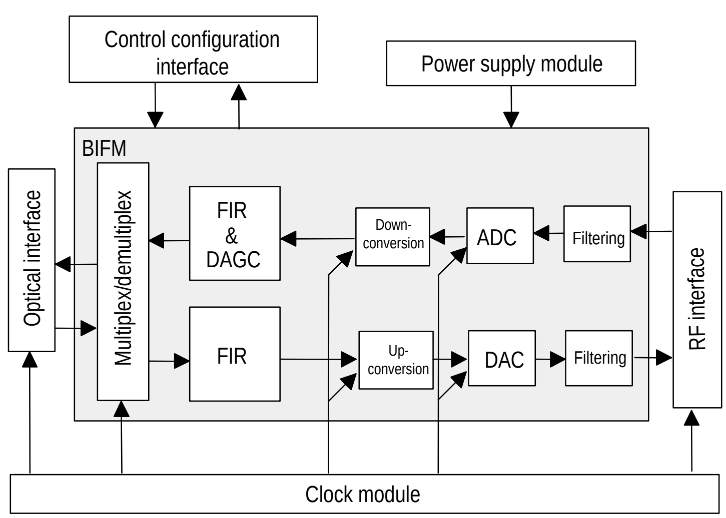


Figure 2-14 Block dagram of BIFM module

- Up-conversion module

Up-conversion module performs signal filtering and digital frequency up-conversion and D/A conversion in transmit path. In this module, the demultiplexed baseband signal is filtered and up-converted digital intermediate frequency signal which will be D/A converted to an analog intermediate frequency signal sent to BRCM after filtering.

- Down-conversion module

Down-conversion module performs signal A/D conversion, digital frequency down-conversion and filtering in the receive path. In this module, the analog intermediate frequency signal from BRCM module is A/D converted to digital intermediate frequency signal which will be down-converted to baseband signal,and then be filtered and sent to the multiplex/demultiplex unit.

- Multiplex/demultiplex module

In reverse path, multiplex/demultiplex module multiplexes the O&M signal of BIFM and baseband signals after frequency down conversion to optical fiber interfacing module. In forward path, it demultiplexes the signals from the optical fiber interfacing module into the baseband intermediate frequency signals and O&M signals.

- Optical fiber interfacing module

Optical fiber interfacing module performs signals encoding and decoding and optical-electrical or electrical-optical conversion. It is the only interface between BIFM and BRDM.

- Clock module

Clock module generates all clocks needed by BIFM, including those for frequency up/down-conversion, A/D conversion, D/A conversion and other clocks. At the same time, it also provides a reference clock for BRCM.

- Control & configuration interface module

Control & configuration interface is the interface between BIFM and BICM. BICM performs all control & configuration functions to BIFM through this interface. It also serves as the interface for collecting alarms on BICM and BRCM.

- Power supply module

BIFM requires a power of +27V because it simultaneously provides power for BRCM and BICM. The requirement for power capacity is 100W.

3) Interfaces

- Optical interfaces

Optical fiber Interfaces with BRDM

- RS485 interfaces

interfaces with BHPA fan monitoring units.

- RF interface

Various interfaces with BRCM.

4) Power consumption

Its power consumption less than 25W on DC +27V.

II. BTS Intermediate Frequency Control Module (BICM)

1) Overview

BICM is a small board mounted on the BIFM. It performs the control of BTRM, including power-on initialization, function configuration, alarm collection, reporting and message processing related to O&M.

2) Block diagram and principle

The block diagram of BICM includes the following parts as shown in Figure 2-15:

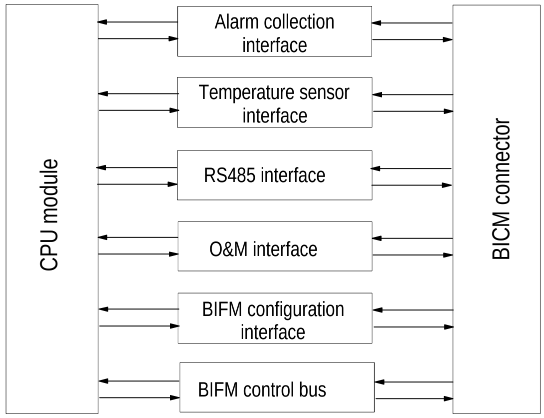


Figure 2-15 Block diagram of BICM module

- CPU module

CPU module performs control and configuration of BIFM. It also processes and reports O&M message and alarm message of BIFM. CPU module also stores the configured data and programs.

- Alarm collection interface module

Alarm collection interface module collects all alarms of BIFM and BRCM to CPU module, which will process and report these alarms.

- Temperature sensing interface function

Temperature information of BIFM is sent to CPU module through the temperature sensor interface.

- RS485 interface module

RS485 interface is the monitoring interface of the fan and HPA. The monitoring information is reported to CPU module via RS485 ,then CPU reports it to BCKM.

- O&M interface module

O&M interface receives and transmits O&M message through the multiplex/demultiplex module on BIFM. CPU module will process the messages.

- BIFM configuration interface module

BIFM configuration interface module performs configuration of clock module and frequency up/down conversion module on BIFM, including modification and initialization of configuration data.

- BIFM control interface module

BIFM control interface module performs the controls of frequency up/down conversion module and baseband filter.

III. BTS radio frequency up/down conversion module (BRCM)

1) Overview

BRCM consists of three functional sub-units: main/diversity transmit unit, main/diversity receive unit and local oscillator unit. It mainly performs such functions as analog frequency up-conversion of main/diversity transmitted signal from BIFM, signal amplification and spurious suppression filtering. It also performs analog frequency down-conversion of main/diversity received signals at BTS from RLDU, signal amplification, channel selective filtering and receiving noise factor adjustment.

2) Block diagram and principle

The block diagram of BRCM is as shown in Figure 2-16.

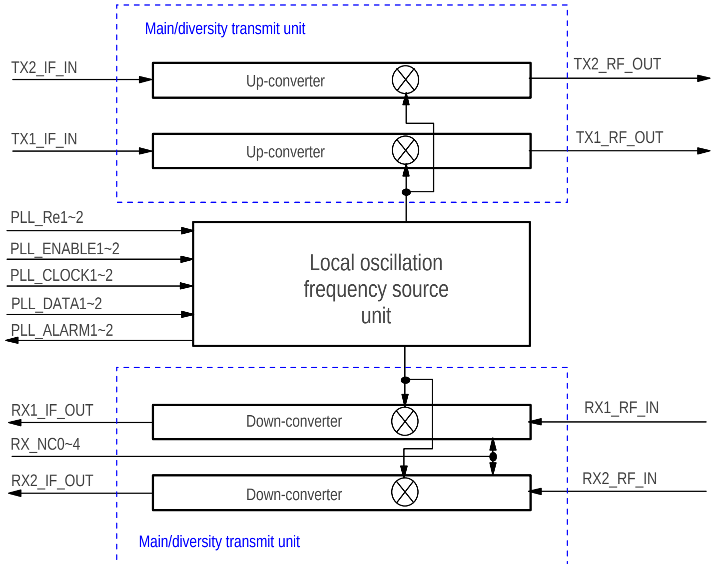


Figure 2-16 BRCM operational block diagram

- Main/diversity transmit unit

Performs two stage up-conversion of the input modulated analog intermediate frequency signals into a specified RF band and performs signal filtering, amplification, and power adjustment before/after the conversion, ensuring that the output RF signals satisfy the protocol's requirement for power level, ACPR (Adjacent Channel Power Ratio) and spurious suppression.

- Main/diversity receive unit

Performs down-conversion of the input RF signal into the specified intermediate frequency and performs signal filtering, amplification and power level control before/after the conversion, ensuring that the output intermediate signals satisfy the requirements of the protocol for anti-interference, spurious suppression and power level.

- Local oscillator unit

It includes an IF local oscillator used by transmit unit and a transmit/receive units sharing RF local oscillator. The IF oscillator generates a frequency fixed IF LO signal for frequency up conversion in the transmit path. The transmit/receive units sharing RF oscillator generates a frequency adjustable LO signal for frequency up-conversion in the main/diversity transmit path and frequency down-conversion in the main/diversity receive path.

3) External interface

In the whole BTS system, at IF signal side, BRCM interfaces with BIFM. At RF signal side, BRCM interfaces with BHPA in forward path and interfaces with RLDU in reverse path.

a) Interface signals between BRCM and BIFM :

- Main/diversity transmit analog intermediate frequency signal, provided by BIFM for BRCM.
- Main/diversity receive analog intermediate frequency signal, provided by BRCM for BIFM.

- Local oscillator PLL (phase locked loop) reference clock signal, provided by BIFM for BRCM.
- Receive noise factor control signals, provided by BIFM for BRCM.
- Local oscillator PLL (Phase Locked Loop) data, enable and clock signal, provided by BIFM for BRCM. And out lock alarm signal of two PLLs, provided by BRCM for BIFM.
- RLDU, BHPA alarm signal and +27V power supply signal, for BIFM, provided by BRCM for BIFM.
- +12V, -12V power supply signal of BRCM, provided by BIFM for BRCM.

b) Interface signals between BRCM and BHPA:

- Main/diversity RF transmit signals, from BRCM to BHPA.
- BHPA alarm signals, from BHPA to BRCM.

c) Interface signals between BRCM and RLDU:

- main/diversity RF receive signals, from RLDU to BRCM.
- RLDU alarm signals from RLDU to BRCM via BTBM DB15 connectors

(4) Index

- Power consumption: +12VDC, maximum current 3A; -12V, maximum current 20mA
- Board size: L%W=225mm%233.35mm

2.3.3 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 power amplifier base board temperature exceeds a specified threshold, BBFM will process the over temperature alarm signal generated by HPAU and report it to BTRM.
- Input overdrive alarm: when the power level of BHPA input RF signal exceeds a specified threshold, BBFM will process the input overdrive alarm signal generated by HPAU and report it to BTRM.
- Gain drop alarm: when the gain of the power amplifier drops over 6dB, BBFM will process the gain drop alarm signal generated by HPAU and report it to BTRM.
- Fan monitoring: BBFM installed in BHPA, performs such functions as fan alarm, power amplifier alarm signal processing & reporting, fan speed adjustment.

II. Block diagram and principle

The block diagram of BHPA module includes the following parts, as shown in Figure 2-17:

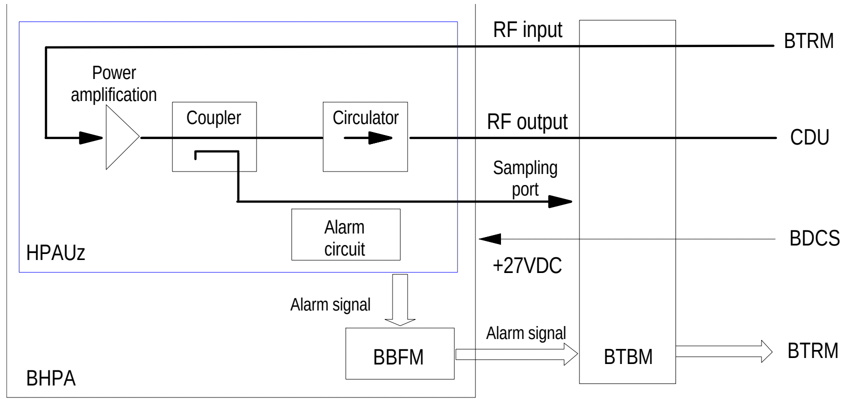


Figure 2-17 Block diagram of BHPA module

1) High Power Amplifier Unit (HPAU)

HPAU mainly consists of two parts: power amplifier and alarm circuit. The power amplifier amplifies the power of the RF signals from BTRM. The amplified output RF signals are then sent to CDU or DFU via BTBM. Alarm circuit monitors the power amplifier status and generates over temperature alarm, over excitation alarm and gain drop alarm signal when necessary. The alarm signals will be sent to BBFM, from where they will be processed and reported to BTBM. The coupler is used to couple the RF output signal 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. BBFM can adjust the fan speed based on the ambient temperature and the actual BHPA output power in order to lower the noise of fan.

III. Interface

External interface of the BHPA module is D-sub combination blind mate connector. It includes the following parts:

- 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 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 which reports them.

IV. Index

- Operation Frequency range: 869~894MHz
- Max. Average output power: 40W
- Power Supply: +26V~28VDC

- Power consumption: <380W
- Module size: L%W%T=460mm%233.5mm%64mm

2.3.4 Transceiver Backplane Module (BTBM)

BTBM performs interconnecting and fixing of 6 BTRMs and 6 BHPAs, including 6 sets of 2mm connectors for BTRM plugging, 6 sets of 24W7 combination D-sub blind mate connectors for BHPA, and three DB9 connectors for RLDU alarm collection and 6 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 type A connector and three 3-socket, type N connectors. Type A connector transfers RLDU alarm signals imported from DB9 connector and RS485 interface message from BHPA 24W7 combination D-sub connector. Type N connector transfers the main/diversity input/output RF signal of BTRM and +27V DC power signal needed by BTRM.

- BHPA 24W7 combination D-sub blind mate connector

Each 24W7 combination D-sub 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 temperature sensor connection signals.

- DB9 connector

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

- Temperature sensor

There are 6 sets of temperature sensors for the 6 BHPA slots, used for sensing the air temperature of each BHPA air outlet, converting into current and sending to BFMM on BHPA for processing. In this way, fan speed is controlled in real time.

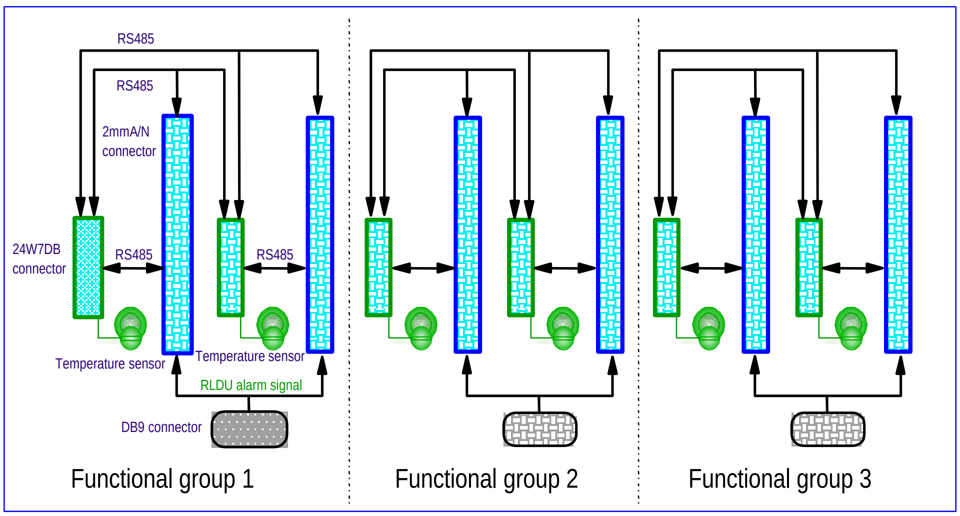


Figure 2-18 Operational block diagram of BTBM

- 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 carriers from the two BHPAs into one signal.
- Receive & transmit signals duplexing.
- Transmit signal filtering, to suppress BTS spurious emissions.
- Receive signal filtering, 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. Block diagram and principle

CDU block diagram is as shown in Figure 2-19.

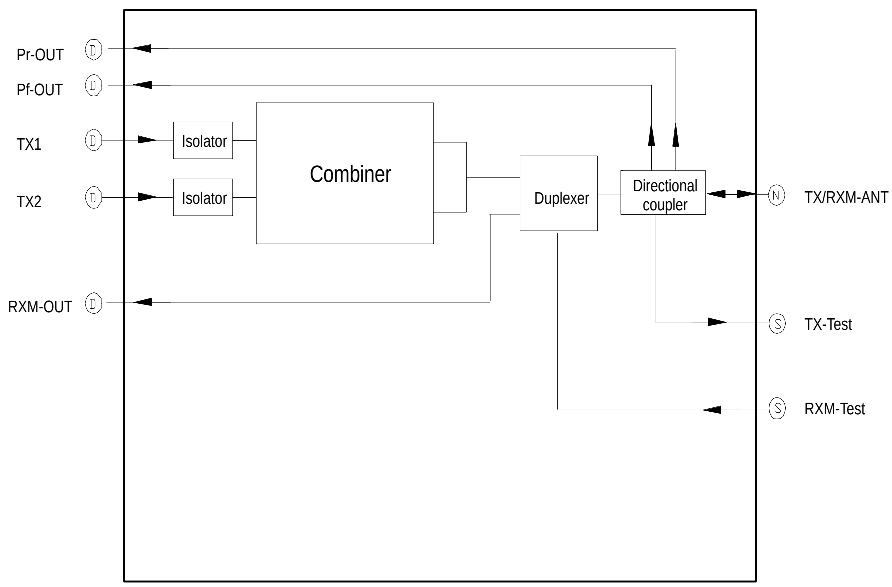


Figure 2-19 CDU block diagram

- Isolator

There are two isolators at each input port of 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, the narrow band combiner features has 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, implementing the antenna VSWR monitoring and BTS transmit power detecting.

III. External 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-sub combination blind mate connectors on the backside and a set of N connectors, SMA connectors on the front side. The interface signals include:

- RF Signals between CDU combiner input ports and BHPA output ports, transferred through the blind mate connectors on the backside.
- BTS Transmit 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 Receive 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 receive signals output from the duplexer, sent to RLDU via the blind mate connector on the backside.
- Forward/reverse coupled RF signals, sent to RLDU via the blind mate connector on the backside.
- Forward/reverse coupled test signals, output through the standard SMA connector on the front side of CDU.

IV. Index

- Number of combined channels: 2
- Frequency gap of two combined carriers: 2.50MHz
- Frequency band of combined signal: Any continuous 3.75MHz within 869~894MHz
- Operation frequency band (receive path): Any continuous 3.75MHz within 824~849MHz
- Module size: L%W%H=450mm%100mm%344.8mm

2.3.6 Duplexer Filter Unit (DFU)

I. Overview

DFU mainly has the following functions:

- Performs transmit/receive duplex isolation and filtering for the single carrier signals from BHPA.
- Diversity receive signals filtering in order to suppress outband interference.

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

II. Block diagram and principle

DFU block diagram is as shown in Figure 2-20.

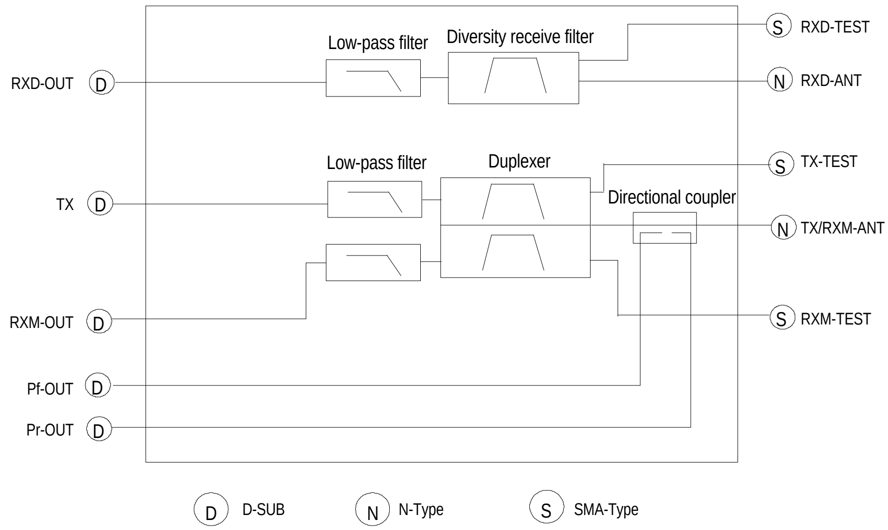


Figure 2-20 DFU block diagram

- Low-pass filter

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

- Duplexer

The duplexer is used to isolate transmit and receive 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 signal power for RLDU, implementing the antenna VSWR monitoring and BTS transmit power detecting.

III. External interface

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

- The signal between DFU and BHPA is transferred through the blind mate connectors on the backside.
- BTS Transmit signal which is transferred to the cabinet-top antenna interface through the RF cable connected with the N connector at the front side of the module.
- BTS receive signal which is 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 receive Signals output from the duplexer and diversity receive filter, sent to RLDU via the blind mate connector on the backside.

- Forward/reverse coupled RF signals, sent to RLDU via the blind mate connectors on the backside.
- Forward/reverse coupled test signals, output through the standard SMA connector on the front side .

IV. Index

- Operation frequency band (transmit path): Any continuous 3.75MHz within 869~894MHz.
- Operation frequency band (receive path): Any continuous 3.75MHz within 824~849MHz.
- Module size: L%W%H=450mm%100mm%344.8mm

2.3.7 Receive LNA Distribution Unit (RLDU)

I. Overview

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

- Performs BTS receive signals low noise amplification and distribution
- Built-in electronic RF switch supports multiple BTS configurations of 3 sectors or 6 sectors.
- Antenna VSWR monitoring and alarming, BTS forward RF power detecting, LNA runing status monitoring and alarming.

II. Block diagram and principle

RLDU block diagram is as shown in Figure 2-21.

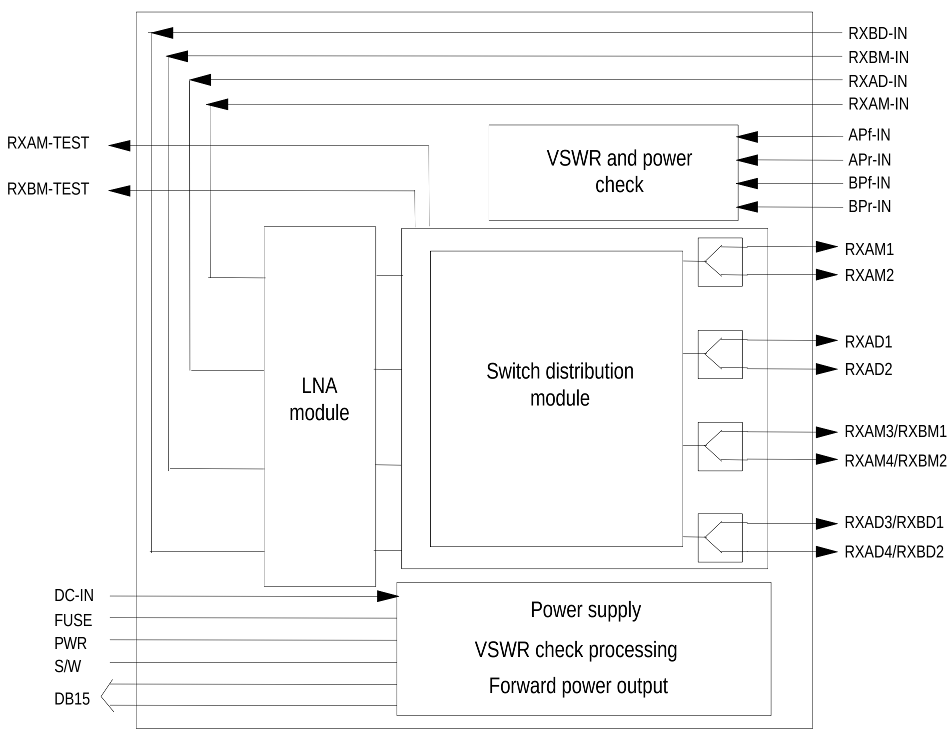


Figure 2-21 RLDU block diagram

1) Receive signal low noise amplification and distribution units

There are 4 LNAs and distributors inside RLDU, which can perform BTS receive signals low noise amplification and distribution into 4 branchs. The 4 LNAs have the same specifications such as gain, noise factor and dynamic. It is ensured that 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 digitally , making sure that RLDU operating in a single sector that has only two receive paths(main and diversity path). Each path provides 1: 4 dividers to support 1~4 carriers configuration for each sector. When the BTS is configured in 6-sector mode, the electronic switches can be set digitally, making sure that RLDU operating in two sectors, each of which has 4 receive paths (two main paths and two diversity paths). Each path provides 1:2dividers, 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 are processed in the antenna VSWR monitoring circuit inside RLDU. When the transmit antenna VSWR exceeds a specified threshold, alarm signal 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 each antenna can be monitored in real time. LNA status monitoring circuit monitors the working voltage and current of the 4 LNAs inside RLDU. It gives alarm when any faults t is found.

III. External interface

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

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

- Main/diversity path receive RF signals output from two CDU/DFU receive filters which then will be amplified and distributed by RLDU.
- CDU/DFU coupling RF signal is mainly used for antenna VSWR monitoring and forward power detecting.

2) Interface signals between RLDU and BTRM are:

- Main/diversity path receive RF signal transmitted to BTRM after being amplified and distributed.
- Antenna VSWR, LNA status monitoring alarm signal and forward power detecting DC voltage signal, output to BRCM by RLDU through a DB15 interface on the front side of the module and transferred to BIFM for processing.

3) The +27V DC power is necessary for RLDU, 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

- Operation frequency band: 824~849MHz
- Power Supply: +27VDC
- power consumption <50W
- Board size: L%W%H= 450mm%180mm%50mm

2.3.8 RF Fan Module (BRFM)

BRFM mainly consists of BBFM, BBFL and fan. 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 audio noise, gives the equipment a longer 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 speed adjustment control of BTRM module. At the same time, BBFM reports to BCKM the gain drop, over-temperature, input overdrive alarm and fan fault alarm of BHPA, to ensure the safety of BHPA module. Its functions are as follows:

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

2) Block diagram and principle

The position of BBFM in BHPA module is as shown in Figure 2-22.

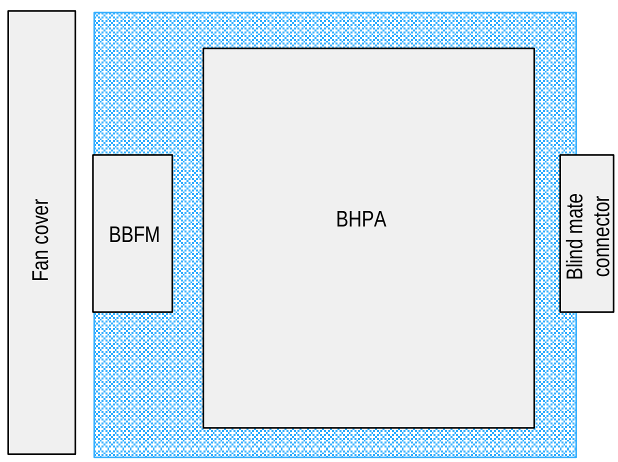


Figure 2-22 Position of BBFM in BHPA module

The block diagram of BBFM is as shown in Figure 2-23.

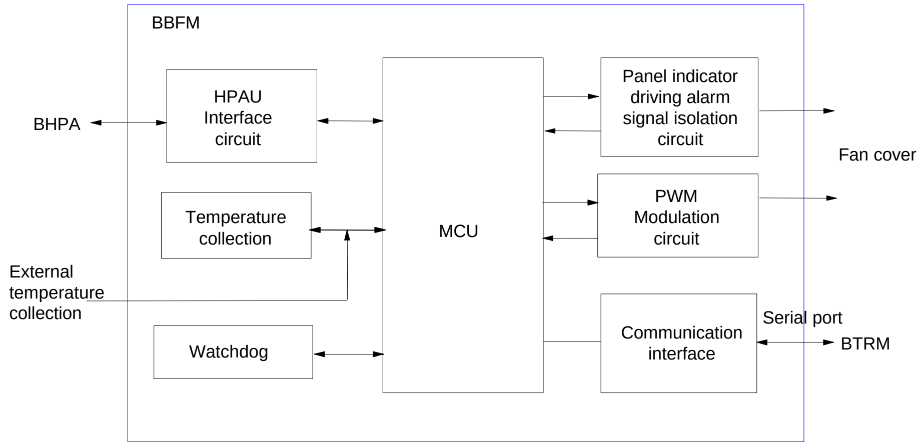


Figure 2-23 block diagram of BBFM module

- MCU module

Collect and analyze the temperature information to generate PWM signal for controlling the fan speed. Receive alarm signal generated by BHPA module and fan alarm signal and report to BTRM module. Generate panel indicator signal. Communicate with BTRM module.

- BHPA interface module

Complete the isolation and driving of interface between BHPA.

- Temperature information collection module

Collect the temperature information of BHPA module in real time to be implemented by MCU in query operation.

- Panel indicator drive and alarm signal isolation module

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

- Communication module

Perform serial communication with BTRM module.

- Power supply module

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

3) Interface

- BHPA interface

Interface with BHPA module, used for BHPA alarm monitoring.

- Serial communication interface

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

- Interface with the fan cover

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

4) Index

The 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, fan and BHPA module. The board is connected with BBFM via the fan cover interface. It is an auxiliary board.

2) Block diagram and principle

The block diagram of BBFL is as shown in Figure 2-24.

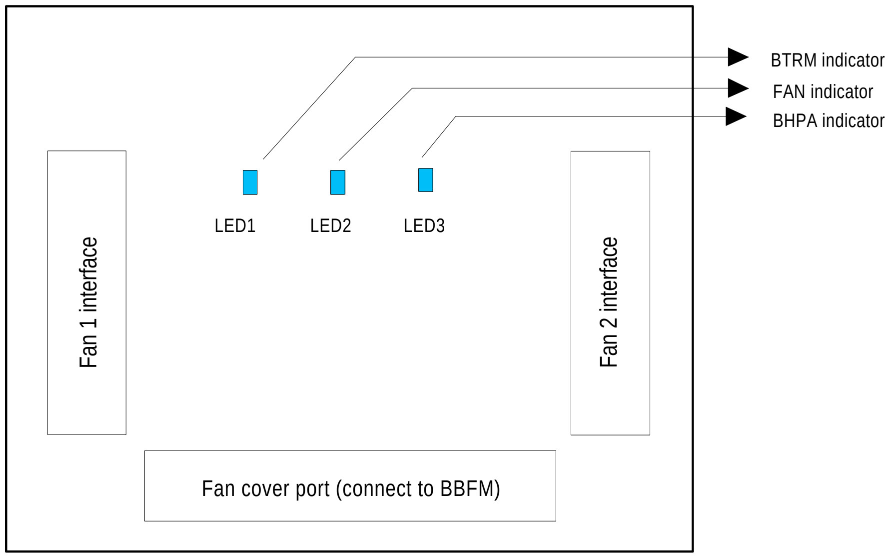


Figure 2-24 Block diagram of BBFL module

BBFL consists of the following parts:

- Fan 1 interface module

Connected with Fan 1, power supply input port of Fan 1 and fan alarm output port. It is a 4Pin ordinary socket connector.

- Fan 2 interface module

Connected with Fan 2, power supply input port of Fan 2 and fan alarm output port, It is a 4Pin ordinary socket connector.

- Fan cover port interface module

Connected with the fan cover opening of BBFM.

3) Panel indicator

LED1: BTRM running signal

LED2: Fan running signal

LED3: BHPA running 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 signal 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 2-25.

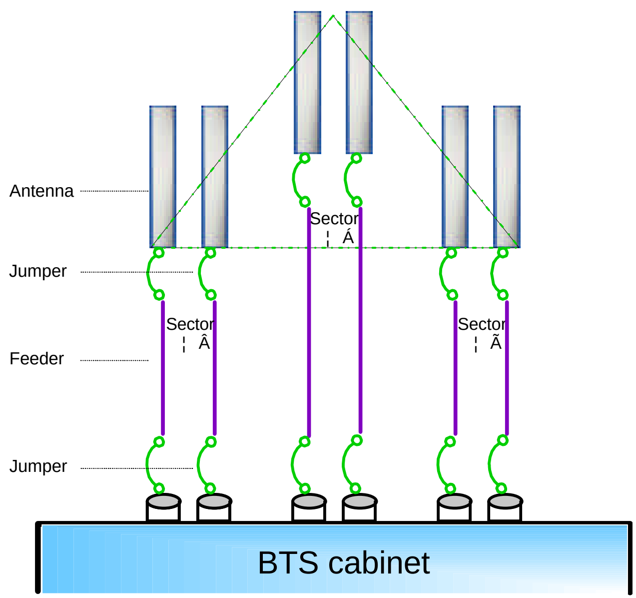


Figure 2-25 Structure of RF antenna & feeder

II. 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 user number and 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 intensities of the antenna in all directions. In the field of communications, 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 an uni-polar antenna. Bi-polar antennae have been used recently. The two poles are perpendicular to each other, which reduces the quantity of antenna used.

4) Diversity technology

Electrical wave propagation in urban area has the following features:

- Field intensity value changes slowly with different places and different 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 receive/transmit antenna must be installed with sufficient isolation to minimize the effect on the receiver. The isolation extent is subject to the out-of-band noise of the transmitter and the sensitivity of the receiver.

III. Feeder

Normally, the standard 7/8 inch or 5/4 inch feeder line should be used to connect the outdoor antenna and indoor cabinet. In the site installation, 7/16 DIN connectors should be made on the line that has been laid. The feeder should enter the equipment room from the tower top or building top. Three grounding cable clips for lightning protection should be installed in the intermediate section and the wall hole where feeder enter indoors. If the feeder is excessively long, additional cable clips are needed.

Since 7/8 inch feeder line should not be bent, the tower top or building 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, 7/16DIN connector.

2.4.3 Dual-Satellite Synchronization Antenna & Feeder

I. Overview of dual-satellite synchronization antenna & feeder

Many important features of CDMA system are closely connected 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. The full name is Global Timing & Positioning Navigation Star System (NAVSTAR). 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, land control and user.

Space part is a group of satellites of 20183 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 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 is the GPS receivers and their supporting equipment. The local system is actually a GPS user, utilizing 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 uses a highly stable crystal clock, which is stable on a short-term base. When the crystal clock works with GPS, it makes the clock of CDMA system absolutely stable and reliable.

(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 of USA. There are 24 satellites distributed on 3 orbits. The inclination of the orbit is 64.8® at a height of 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 carriers 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. The position of the user can be figured out. The algorithm used is similar to that of GPS.

BTS system uses intelligent software phase-locking, memory 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 provide accurate calendar clock (hour, minute, second). 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 signal sent by GPS satellite is received by GPS antenna. The received L1 GPS signal is filtered by a narrowband filter and amplified by a preamplifier. Then it is sent to a GPS receive card. GPS antenna applies to all kinds of GPS receivers. Feature indices are as follows:

Frequency: 1.575GHz

Bandwidth: 20MHz

Gain: 32~35dB

Voltage: +5.0 ± 0.25VDC

Current: 35mA

Impedance: 50⦸

Polarity: RHCP

- GPS/GLONASS dual-satellite receiving antenna

This antenna receive GPS signal of band L1 (1.575GHz) and GLONASS signal (1.611GHz), power with 5~18V, gain is 36dB.

III. Feeder

The feeder is the physically foamed polyethylene insulation RF coaxial cable, impedance 50-ohm, 10-FB. Nominal parameters are:

70dB/km (400MHz)

113dB/km (900MHz)

The 100m loss in 1.575GHz frequency is 13.78dB.

The coaxial cable is mainly used to transmit the GPS signal 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.

The cable is useable when dual-satellite solution is adopted.

IV. Lightning arrester of antenna and feeder

The lightning arrester of antenna and feeder used in BTS, clamp voltage -1~+7VDC, standing wave ratio less than 1.1:1, signal attenuation 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 5V DC regulated power supply. 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 converted to digital signal and sent to 8-path code and carrier correlator, where signal detect, code correlation, carrier tracking and filter are performed. The processed signal is synchronized and sent to positioning MPU. This part of circuit controls the working mode and decoding of GPS receiver, processes satellite data, measures pseudo-distance and pseudo-distance increment so as to calculate 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 with any other options in a password mechanism. The time accuracy can be up to 25ns.

2.5 Power Supply Subsystem

2.5.1 Overview

BTS built-in power supply module converts -48V DC into +27V, provided for 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 as necessary 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. They are connected on the backplane and report to BTRM through the universal monitor bus, to implement power management and monitoring.

The -48V power input is filtered by EMI filter and connected to the wiring terminal on the top of the equipment, and then connected to the power backplane input junction bar in the secondary power supply subrack. The +27V power is output from the output junction bar of power subrack backplane. Then the +27V power is led out from the busbar, going 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. They go along through the copper bar leading wire and the over-current protection devices for individual power consumption units and connected with the outbound terminals at the back of the distribution box. In this way, it is ensured that the line is disconnected when there is over-current to a specific unit and other units will not be affected.

The schematic diagram of the whole power supply subsystem is as shown in Figure 2-26.

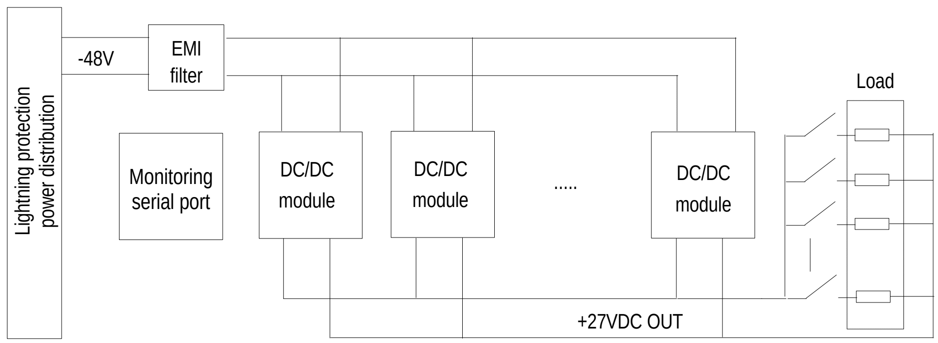


Figure 2-26 BTS power supply subsystem

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 cabinet wiring trough, and connected to the input junction bar of the power subrack backplane. The power supply subsystem uses 5xDC/DC power supply units (PSU) in full configuration. The PSU is +27V/65A. 5xPSUs provide 4+1 backup mode, ensuring an output of at least 7200W. The board size: L%W%H=400mm%121.9mm%177.8mm. The operation principle of the power supply subsystem is as shown in Figure 2-27.

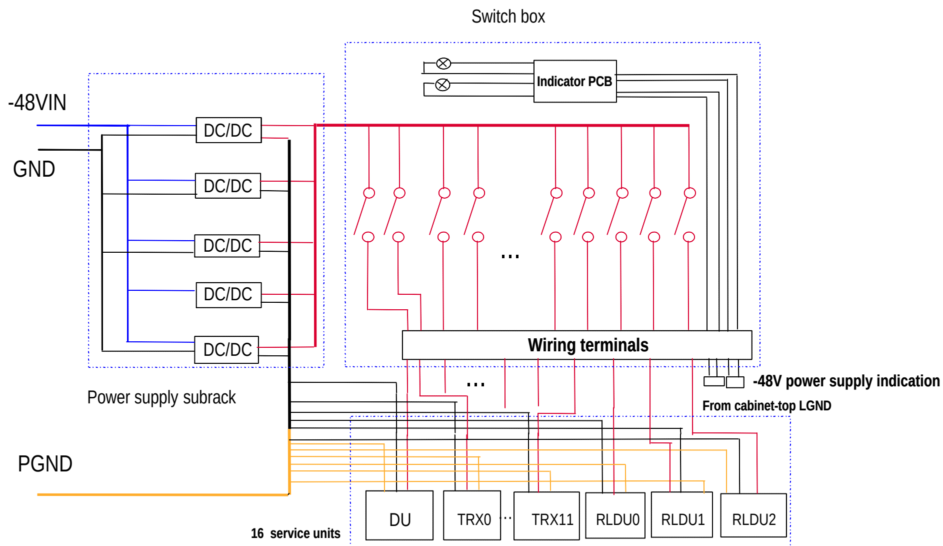


Figure 2-27 Operational diagram of the power supply subsystem

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 the following:

- Temperature detect fusing technology is used, with built-in over-current protection circuit, preventing fire.
- Multiple autonomous current equalization technology is used, capable of withstanding successive lightning attack.
- Common mode, differential mode all protection, low residual pressure.
- Dual-color working status indication, with remote alarm trunk node.
- Compact, easy installation.

1) Input parameter

Input mode: -48VDC

Working voltage range: -40VDC~-60VDC

Maximum input current: 30kA

2) Wiring mode

Connect the positive and negative poles of the power cord with V+, V- of the lightning arrester.

Connect the PE end to the lightning protection and grounding copper bar.

3) Lightning protection index

Maximum flow: 30kA, once, 8/20µs impact current wave

Rated flow: 5kA, 5 times for positive and negative each, 8/20µs impact current wave

Residual pressure: 250V

4) Indicator and alarm dry node parameter

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.

Normally-closed contact. The alarm dry node is closed when the lightning arrester is normal and it is open when the device is faulty. Regulated current 1A.

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

II. DC/DC power supply module technical parameters

Power supply module uses well-developed circuits, with perfect protection function. The safety specification is UL, TUV, CCEE proven. EMC is compliant with EN55022 and IEC61000-4 standards.

- Working temperature: -10~45?
- Storage temperature: -40~70?
- Atmospheric pressure: 70~106kpa
- Relative humidity: 15%~85%
- 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%

  Loaded regulation: ±0.5%

  Voltage regulation: ±0.2%
- Output noise voltage

  Balanced noise of the telephone: 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: ƒ85% (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: ƒ2M0

  Test conditions: ambient temperature: 20±5?

  Relative humidity: 90%

  Test voltage: DC 500V
- Dielectric strength

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

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

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

Conducted interference

On 150kHz~30MHz frequency, the conducted interference level in the power cord of the tested equipment should not exceed class "A" limit in EN55022 Table 1.

Radiated interference

On 150kHz~1000MHz frequency, the radiated interference level of the power cord of the tested equipment should not exceed class "A" limit in EN55022 Table 1.

- Reliability

Test the product reliability with MTBF. The MTBF value of the power supply subsystem should not be lower than 15%10^4h.

- High temperature aging

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

2.5.4 Power Supply Monitoring

The monitoring information of the whole power supply subsystem and each power supply module is all provided via the RS485 serial port on the backplane. Monitor items are as follows:

I. What is to be monitored

1) Control value

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

2) Switch signal 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 setup note

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

2.5.5 BTS Direct Current Switchbox (BDCS)

BDCS is used to power the system. When +27V is output 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 on the copper bars, going through the switch and connected with terminal bars. In line distribution, the outbound terminals are connected with the power consume supply units. There are also lightning protection alarm indicators -48V power status indicators in the switchbox.

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

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 equipment, and operate in a harsher environment where fire or flooding is likely to happen. To ensure that BTS equipment works normally, intensive environment monitoring system is required to handle any accidents.

The environment monitoring system of the BTS consists of the environment monitoring equipment and BCKM. The environment monitoring equipment collects environment information and reports the information to OMC.

The environment monitoring equipment consists of environment alarm collection box and the sensor.

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 signal, makes corresponding processing and reports to OMC.

The alarm box in the system can real-time monitor the temperature, humidity, smoke and illegal invasion alarm in the environment. It can also automatically detect the environment 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 the following:

- Real-time indication of temperature and humidity
- Time indication
- Fire, smoke, humiture, water and three types of burglar alarms
- Panel control key pad
- Provide 10x switch value input (optical/electrical isolation)
- 6x relays (max. 5A/220V) drive external actuator
- 2x PWM outputs (8bit resolution, basic clock not more than 500kHz)
- 7 independent open-collector gates (absorption current 300mA) driving
- Communicate with BCKM of BTS through RS485 interface

2.6.1 Alarm Box Input

- Monitor temperature: frequency type hygrothermograph
- Monitor humidity: frequency type hygrothermograph
- Monitor smoke: ionic smoke sensor or optical/electrical smoke sensor
- Monitor naked flame (optional): flame detector or hyper-thermo detector
- Burglar proof monitoring: infrared monitor, optical/electrical monitor, door magnetic monitor
- Other sensor input: the input signals of all above sensors can be expanded to 10 switch values except the quantum temperature and humiture signals

2.6.2 Alarm Indicator

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

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

When a sensor has more than one input signals, alarming on any signal will be considered an alarm event. All sensors can be expanded to multi-channel sensors, at most 10 channels except the temperature and humiture sensors.

2.6.3 Interface of Executive Mechanism

The environment monitoring function of BTS also includes the following interfaces of executive mechanism.

1) Six (A~F) normally open/closed optional relay contacts output to control the protection devices. The relay is 1A/220V. Usage can be customized, but the default setting is as follows:

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

2) Two PWM outputs, driven by the open-collector gate, drive current 300mA. Period can be customized, 1 second by default, resolution 8 bits (0~255).

3) Seven open-collector gate outputs, drive current 300mA, controlling the specified actuator.

2.6.4 Communication

There is bi-directional link between the alarm box and BCKM. The alarm box reports BCKM through the link about the alarm status and monitored data. BCKM can send commands to control the alarm box to actuate the protection devices and set alarm parameters.

2.7 Lightning Protection System

2.7.1 Overview

Thunder and lightning is a universal natural phenomenon. It is impossible to prevent it. What can be done is to reduce the accident probability. Lightning attack probability is different in different areas. It is related to the external environment (weather, lightning protection and grounding) where the equipment is located and the protection quality of the equipment.

The lightning protection of communication equipment should be in line with the following principles:

Systematic protection: since information equipment is extensively connected and lightning surge is all pervasive, protection by means of equipment and board only is not enough. A thorough research should be conducted to the systematic environment where the communication station (site) is located.

Probability protection: lightning discharge is random. Statistics can be roughly made to the lightning parameters. Lightning protection equipment cannot prevent the lightning and lightning protection devices cannot suppress all over-voltage and over-current. Although there is small probability for destructive lightnings, it costs much to guard against it.

Multi-level protection: IEC 61312 divides the equipment premises area into several lightning protection zones: LPZ0A, LPZ0B, LPZ1 and LPZ2, as shown in Figure 2-27.

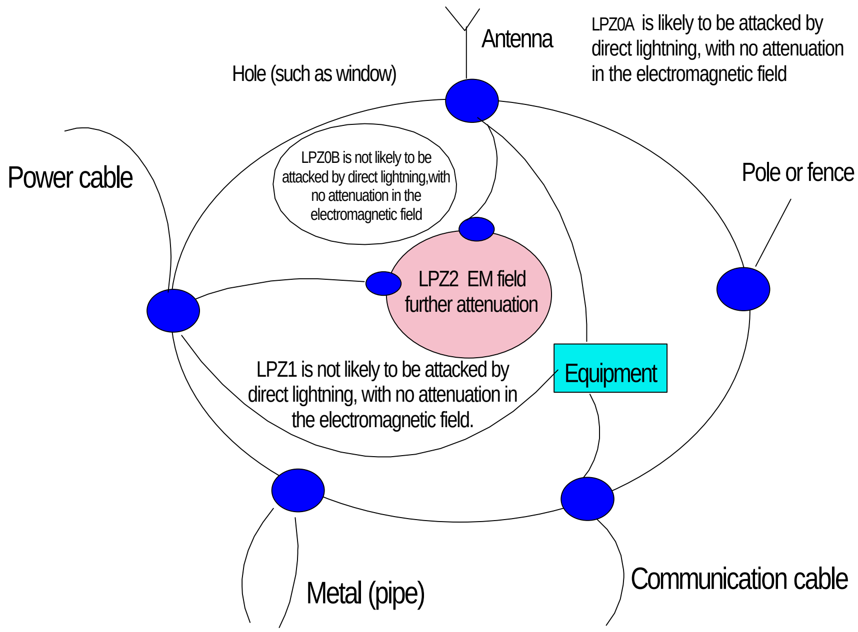


Figure 2-28 EC 61312 Space division of lightning protection zone

BTS equipment is usually in LPZ1 and communication cables, power lines 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 with conductors or surge protectors of lightning apparatus with metal structures of the premises, metal devices, foreign conductor, electrical appliances and telecommunication equipment located in the area where lightning protection is necessary), to reduce metal parts in the lightning protection zone and minimize potential difference between the systems.

Generally, to lower the probability of lightning attack to the BTS, much attention should be devoted to three points: protection system where the station (site) 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 2-29.

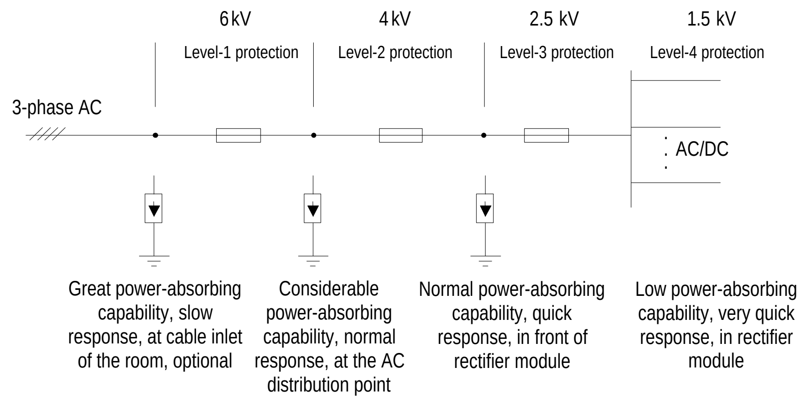


Figure 2-29 Illustration of lightning protection of BTS power

II. Principle of DC lightning arrester

Level-5 protection is a built-in integrated lightning arrester in the cabinet-top box. The operation principle is as shown in Figure 2-30.

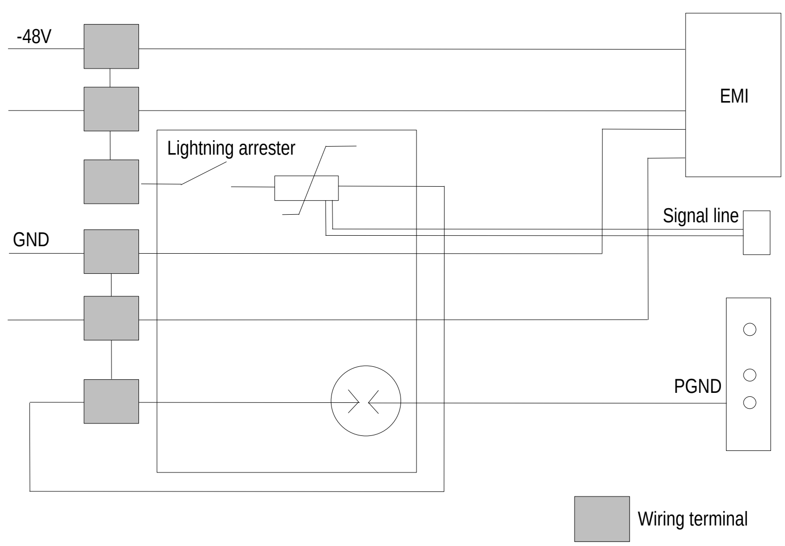


Figure 2-30 Illustration of lightning protection of BTS power

2.7.3 Lightning Protection for Trunk Line

I. Overview

Three kinds of trunk line are supported in BTS: 750 coaxial cable (E1), 1200 twisted pair (E1) and optical fiber. Lightning protection is out of question if optical fiber is used as the trunk line because the BTS is connected with fiber pigtail. For the two kinds of E1 trunk line, lightning protection is provided by the BTS E1 surge protector (BESP) on top of the equipment.

II. Connection to BTS via E1 trunk line

As shown in Figure 2-31.

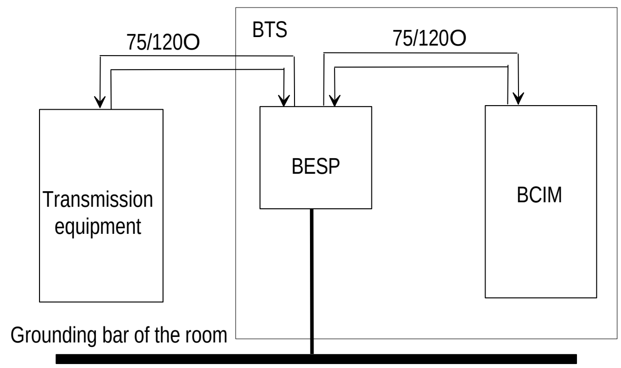


Figure 2-31 Connection to BTS via trunk lines

III. BESP introduction

E1 interface protection of BTS is implemented through a BESP on top of the equipment. In consideration of the limit cabinet-top space or the convenience of installation or dismounting, two identical BESPs are used, each with 8 pairs (16 PCS) E1 lightning protection units, 1 DB37 connector and 2 DB25 connectors, as shown in Figure 2-32.

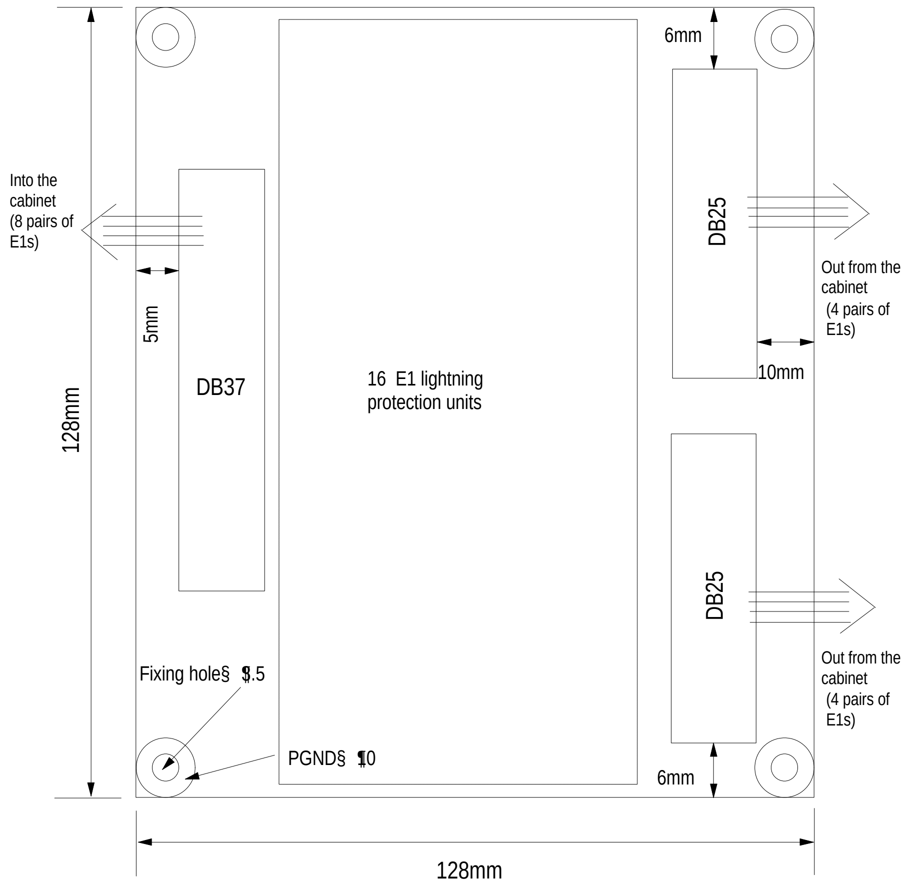


Figure 2-32 Physical appearance of BESP

E1 lightning protection unit has two inbound lines connected with DB25 and two outbound lines connected with DB37 and one PGND. Here PGNDs of all lightning protection units can be interconnected. DB37 connector is male and DB25 connector is female, with 8 pairs of shielded E1 cables connected. 750 and 1200 impedance match is provided with the cables. The principle of lightning protection units is as shown in Figure 2-33.

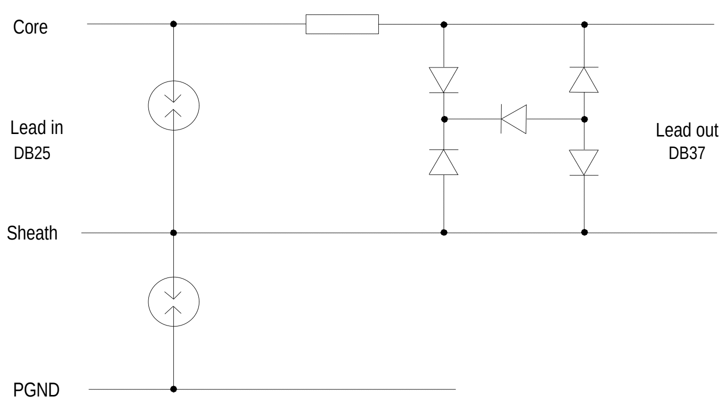


Figure 2-33 Principle of E1 lightning protection units

2.7.4 Lightning Protection for Antenna & Feeder Port

I. Lightning protection design 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 transient moment of lightning attack, which 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 in the feeder can be discharged through the antenna.
- CDU DC is grounded. The inductive current on the conductor in the feeder can be discharged through CDU.

The above three measures can be taken to guard against 8kA lightning current.

II. Lighting protection design 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 and passive:

- Passive lightning protection: the low frequency lightning current is grounded by 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.

The dual-satellite synchronization antenna & feeder adopts passive lightning protection. Its equivalent circuit is as shown in Figure 2-34.

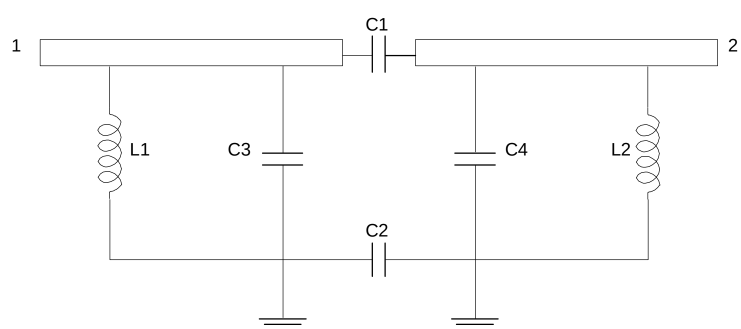


Figure 2-34 Lightning protection for BTS antenna & feeder port

3 Software Architecture

3.1 Overall Architecture

cBTS3612-800 software consists of application 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.

cBTS3612-800 software structure is as shown in Figure 3-1.

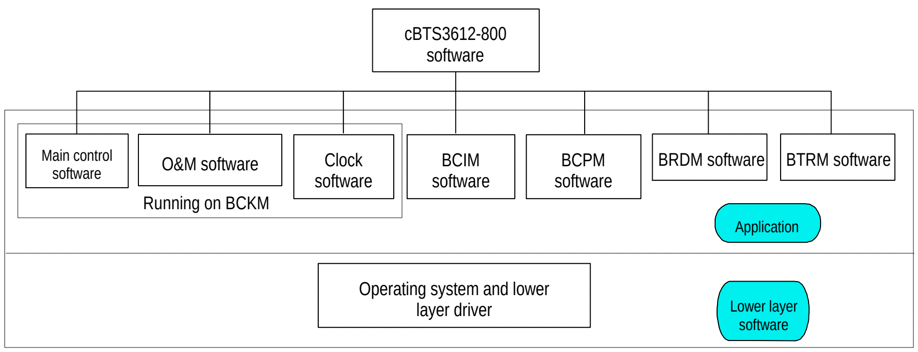


Figure 3-1 cBTS3612-800 software architecture

I. cBTS3612-800 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. cBTS3612-800 bottom layer software

This part works on a unified software platform. Bottom layer software includes operating system and bottom layer drivers. The operating system is a well-developed imbedded real-time multi-task operating system, which delivers 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 of main control software

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

II. Structure of main control software

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

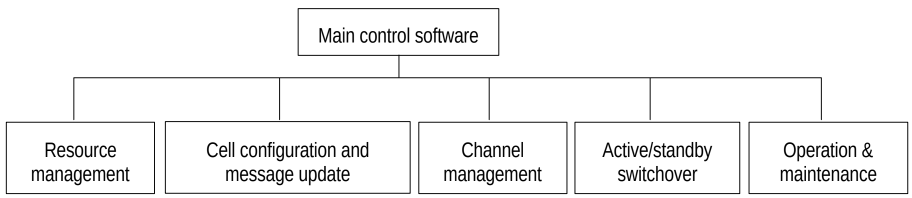


Figure 3-2 Structure of main control software

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 resource status of BTS, 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 resource includes cell, carrier, forward channel and reverse channel in the channel unit resource pool.
- Resource measurement report: Main control software submits the cell public parameter measurement report received from BTRM to BSC. Specific parameters of the public measurement report 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 resource 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, carrier attribute configuration of BTRM and cell public channel attribute configuration of BCPM. Carrier attribute configuration attributes are: carrier band, carrier absolute band number and carrier transmit gain. Cell public channel attribute configuration parameters are: BASE_ID, cell ID, pilot PN sequence offset, cell gain, public channel number and attribute (including pilot type, pilot gain, SCH gain, QPCH quantity, QPCH gain, QPCH rate, PCH quantity, PCH gain, PCH rate, ACH quantity).

- General message update: after cell configuration, when the cell logic resource changes, it is necessary to update the general message of the cell. General message includes system parameter message, access parameter message and synchronization channel message.
- Cell breath control: when the user load of adjacent cells is not balanced, BSC activates the cell breath control. The main control software resets 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 from BSC to corresponding BCPM according the parameters such as cell ID, absolute band 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 created, the main control software will first check information such as the carrier absolute band of the private channel, channel type, RC, rate, frame length, whether it is a branch of the existing channel for a softer handoff, and then distribute channel resource in the corresponding channel unit resource pool and send message instruction to BCPM to create the channel. Similarly, when a channel is to be released, the main control software first sends message instruction to BCPM to release the channel, which will be returned to corresponding channel unit resource pool. When a private channel is to be created or released, main control software needs to distribute or release the service link of AAL2 of the corresponding Abis interface.
- Physical channel change function: in the process of communication through a private channel, BSC can modify some parameters of this channel in the physical layer. The parameters are: long code mask, reverse pilot door 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 private channel, and sends message to the BCPM board, instructing the modification of physical parameters.
- Public channel mutual-aid function: when part of channel units in a channel unit resource pool are damaged, which makes part of or all of public channels in this channel unit resource pool unavailable, the main control software will attempt to move the affected public channels onto some available channels. At the same time, BCKM will send message to BCPM, requesting it to re-create these channels.
- Transmission delay report function: when the BTS seizes a reverse private channel, or the air interface delay from the MS to the BTS changes over 1 code, BCPM will report to main control software about the air interface delay of this private channel. Then main control software forwards the channel delay to BSC.

4) Active/standby switchover

To improve the system reliability, Main control software works in active/standby mode. The active Main control software backups call data to the standby in real time. When the active equipment gets faulty, active/standby switching occurs. Therefore the communication can go on on the created channel without any interruption.

5) Operation & maintenance

Include functions such as data configuration, status report, interface tracing, fault alarm, reboot control, switching control, log sending and process reporting.

3.2.2 O&M Software

I. Function of O&M software

Operation & maintenance software unit (OMU) is the O&M part of cBTS3612-800. Other software modules on the BTS have their own interfaces.

OMU monitors the BTS operation. It is the intermediate section between the O&M center (OMC) and all equipment of cBTS3612-800. 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 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 of O&M software

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

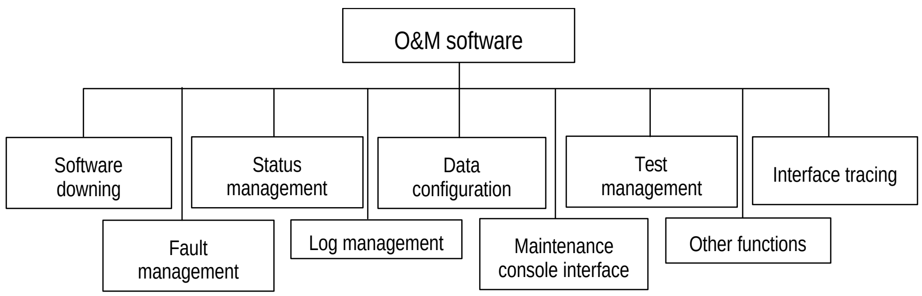


Figure 3-3 Structure of O&M software

III. Introduction to software units

1) Software downloading

Software of all parts of BTS (including O&M software) can be downloaded remotely. When the software is to be upgraded, it has not to be done on the site of BTS.

2) Status management

Monitor the running status of BTS boards, block/unblock the channels.

3) Data configuration

Set up running parameters of BTS boards, including setting BTS attributes, BTRM attributes, BCPM attributes, and managing Abis interface circuit.

4) Test management

Perform test to BTS equipment, including functional test to the boards, to make pre-warning the fault and locate the fault.

5) Interface tracing

Trace the air interface message, or other interface messages inside BTS, to help locate faults.

6) Fault management

Monitor BTS internal alarm, such as board alarms or monitor environmental alarm, such as temperature, humidity, fire alarm etc. For serious alarms, the O&M part can take protective measures such as shut down the equipment to avoid further damage.

7) Log management

Record equipment operations and abnormal information, to help locate faults.

8) Maintenance console interface

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

9) Other functions

Other functions such as active/standby switching, debugging, etc.

3.2.3 Clock Software

I. Funciton of clock software

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

II. Structure of clock software

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

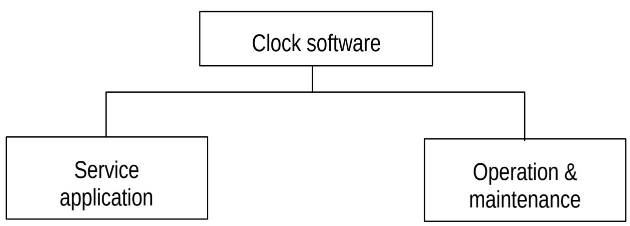


Figure 3-4 Structure of clock software

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 input: 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 sends to the system via OMU.
- Software phase locked sub-module: Combine hardware counting and software phase locked, providing GPS synchronization clock signal for the system, to ensure that CDMA system is globally synchronous.
- Hardware phase locked control sub-module: perform initialization settings of devices about the hardware phase locked loop.

2) Operation & maintenance

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

3.2.4 BCIM Software

I. Function of BCIM software

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

- Receive OMU configuration command and configure ATM transmission link of Abis interface.
- In a frame of 128 cells, the maximum bandwidth of one ATM transmission link is 8%1904kbit/s.
- At most 7 ATM transmission links can be created between BTS and BSC. The bandwidth of each link is 1904kbit/s.

II. Structure of BCIM software

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

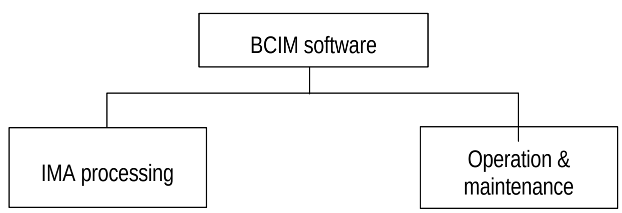


Figure 3-5 Structure of BCIM software

III. Introduction to software units

1) IMA processing

IMA (Inverse multiplexing on ATM) processing is to perform the following functions: add or delete IMA groups and IMA links dynamically. Add or delete UNI link.

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 and link test, perform respective functions.
- Private maintenance: management of E1/SDH interface, IMA state machine and IMA configuration, as well as BCIM board status management, alarm collection, alarm processing and reporting.

3.2.5 BCPM Software

I. Software function

The primary function of BCPM software is to make operation and control to channel processor. Specifically:

- Work with main control software to manage the service layer of BCPM.
- Public channel processing.
- Service channel processing.

II. Software structure

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

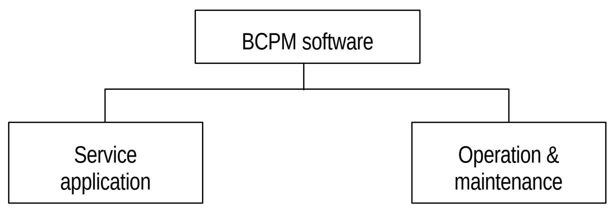


Figure 3-6 Structure of BCPM software

III. Introduction to software units

1) Service application

This unit consists of 3 functional sub-modules:

- Control & management sub-module: the sub-module creates or release specified channel applications according to the control command sent by main control software. At the same, it exercises management over cell configuration and radio link.
- Public channel sub-module: under the control of the control & management sub-module, the sub-module is used to setup or release public channel, perform message dispatching for forward public channel and control the corresponding driver to sent message to the air in correct time. It also receives air reverse message for the reverse public channel, and forwards to BSC through the main control software.
- Private channel sub-module: under the control of the management sub-module, the sub-module setups or releases traffic channel. For the forward dedicated channel it receives data frame of BSC and sends from the air in correct time according to the power set in BSC. For reverse dedicated channel, it receives reverse air frame, adds some information and sends 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 and link test, and perform respective functions.
- Private part: channel processing parameter configuration, status management, alarm collection, alarm processing and reporting.

3.2.6 BRDM Software

I. Function of BRDM software

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

- Provide relay for 36 BTRM signalings (including main control signaling and operation & maintenance signaling).
- Receive OMU configuration command, control the relay of forward & reverse base band data.

II. Structure of BRDM software

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

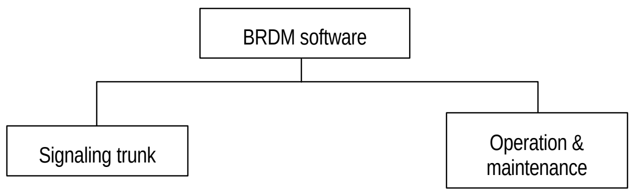


Figure 3-7 Structure of BRDM software

III. Introduction to software units

1) Signaling trunk

Perform BTRM signaling trunk function, including two parts: BTRM signaling trunk task and trunk interface matching. The primary task is to adapt signalings from OMU or BCKM according to the format and protocol established with BTRM software and send them to BTRM. Or adapt signalings from BTRM and send 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 and link test and perform respective functions.
- Private part: perform functions such as base band trunk link configuration, BTRM signaling trunk link configuration, link quality monitoring as well as board status management, alarm collection, alarm processing and reporting.

3.2.7 BTRM Software

I. Function of BTRM software

BTRM software exercises management over BTRM. The main functions are as follows:

- Perform cell carrier configuration, carrier parameter measure and transmit gain compensation.
- Perform operation & maintenance to BTRM module.
- Ensure the precision of the clock of BTRM module through software phase-locking.
- Board device configuration, BFMM & environment monitor box management and fiber-optic link delay measurement.

II. Structure of BTRM software

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

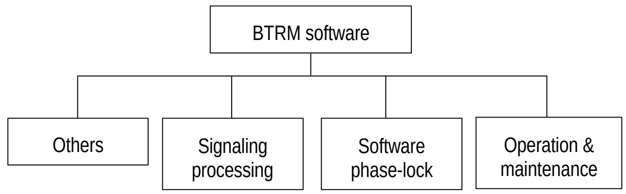


Figure 3-8 Structure of BTRM software

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, configuring the frequency and power level of the sector carrier.
- Public parameter measurement: BTRM makes a regular measurement of the forward transmit power and RSSI (received signal strength indication), and reports measurement result to BCKM.
- Loopback test: BTRM software receives loopback test command from the main control software and returns the test data. The function is used for logic link test 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 constant temperature crystal oscillator with software phase locked algorithm so that the constant temperature crystal oscillator can provide a clock of satisfactory frequency and precision to the system.

3) Others

This unit consists of 2 functional sub-modules:

- Optical fiber delay calculation: when the optical fiber is long enough, the delay of fiber-optic link becomes significant. BTRM software can calculates the delay of the fiber-optic 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 & transmiting alarm information, sending control command and getting 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 and link test, and perform respective functions.
- Dedicated part: control the parameter configuration of RF system, monitor running status and RF PLL status and perform functions such as alarm collection, alarm processing and reporting.

5 System Configuration

This chapter first introduces cBTS3612-800 system configuration, based on which some typical configuration examples are given. After reading this chapter, you will have a basic understanding of cBTS3612-800 configuration principle.

5.1 Configuration Overview

BTS consists of the following parts in physical structure:

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

BTS is designed to accommodate 36 sector carriers in full configuration, which supports 3 cabinets at most, one basic and two extended. The difference between a basic cabinet and an extended cabinet is that a basic cabinet needs a baseband subrack. The basic cabinet and extended cabinet are connected with optical fiber.

A single cabinet supports as many as 12 sector carriers. Main configuration modes are omni cell, 3 sectors and 6 sectors.

5.1.1 Basic/Extended Cabinet Configuration

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

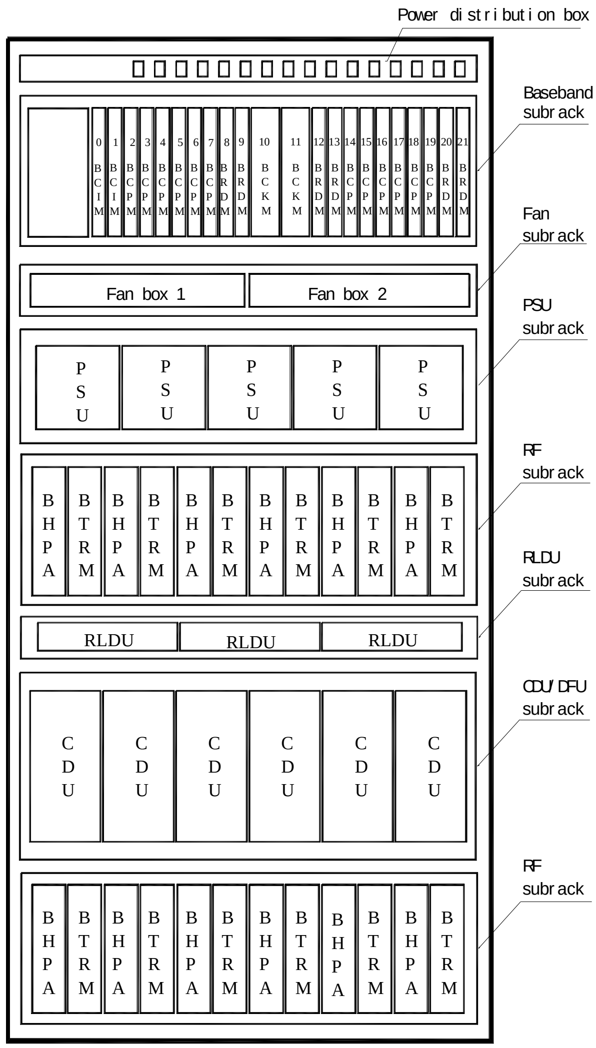


Figure 5-1 Configuration of a basic cabinet

The baseband subrack of extended cabinet don't need configuration.

The front view of a basic cabinet is as shown in Figure 5-4.

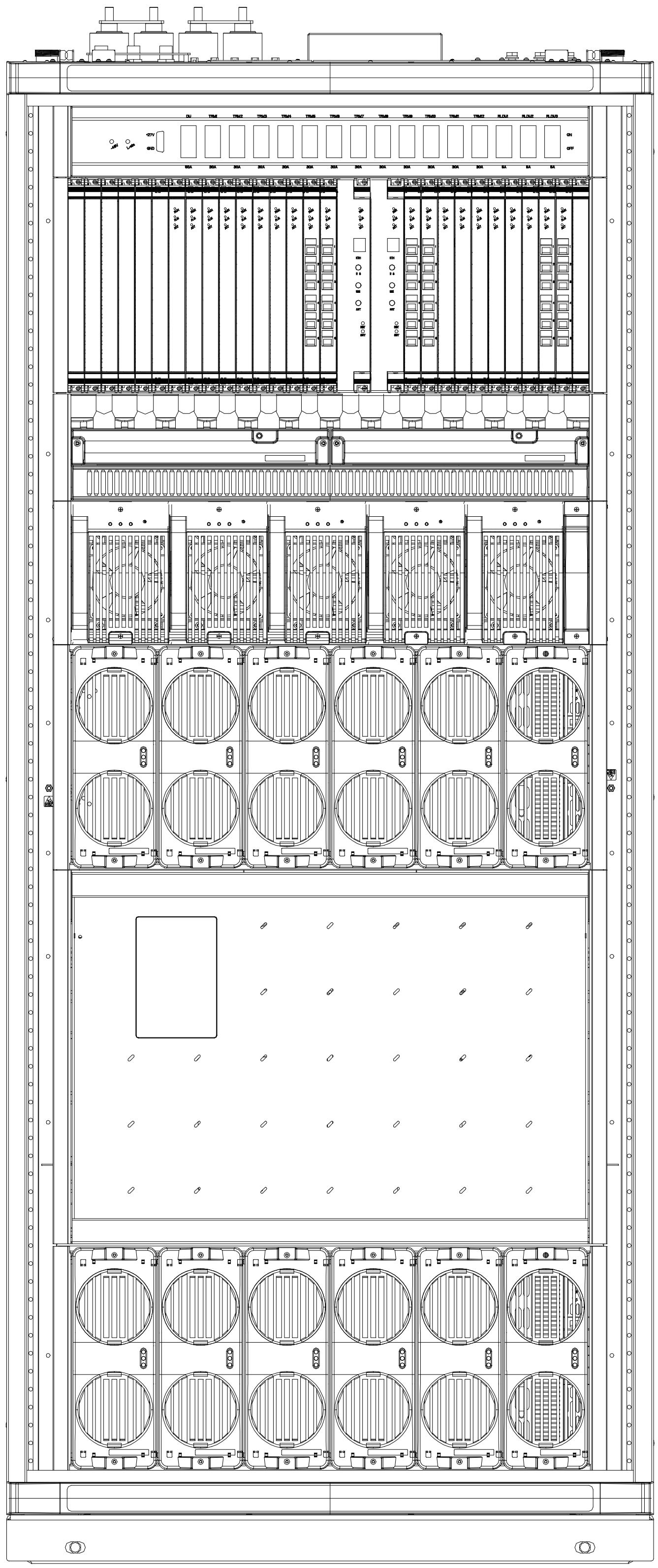


Figure 5-2 Front view of a basic cabinet

5.1.2 Baseband Subrack Configuration

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

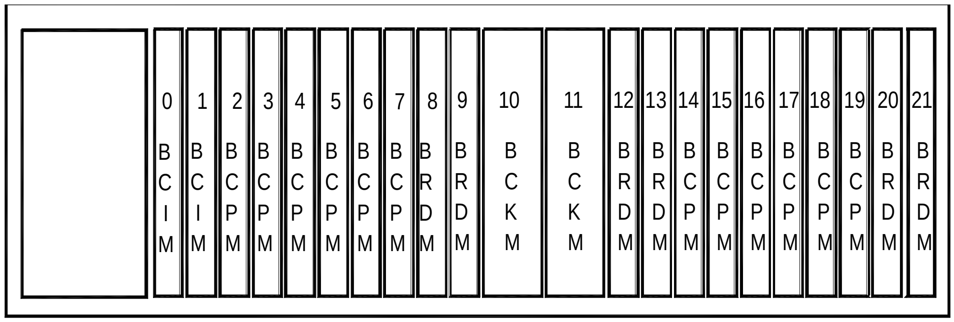


Figure 5-3 The baseband subrack in full configuration

The boards in the baseband subrack include BCIM, BCPM, BRDM, BCKM. The quantity of boards should be configured as follows:

I. BCIM

Provide interface module with BSC. It is according capacity demand and service type. 2 PCS is needed for full configuration. 2 BCIMs configured can be used for load sharing. 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 is 64 reverse channels and 128 forward channels, while the capability of type-B is 128 reverse channels and 256 forward channels

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

Table 5-1 Configuration of BCPMs

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

The above configuration is for CDMA2000 1X, and for 3-sector configuration, type-B BCPMs are recommended. For IS95 configuration, the quantity should be reduced by half.

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

III. BRDM configuration

BRDM board is used to connect BTRM module of RF part. BRDM provides 6 optical fiber ports, which can be connected with 6 TRXM modules. 6 BRDMs are needed in full configuration with 36 sector carriers. When there are less than 6 sector carriers, 1 BRDM is enough. When there are 6~12 sector carriers, 2 BRDMs are needed. BRDMs should be first configured in slots 12 and 13.

When there are more than 12 sector carriers, BRDMs are needed in slots 8, 9, 20, 21, as shown in Figure 5-3. The configuration principle: adding 6 sector carriers requires one additional BRDM.

IV. BCKM configuration

BCKM is the control & clock board, 2PCS as active/standby. Normally, one piece is enough and 2 pieces are used for backup purpose. BCKM receives GPS signal from outside and provides 10MHz clock connection tester externally. In addition, it provides interfaces such as Modem, RS485.

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.

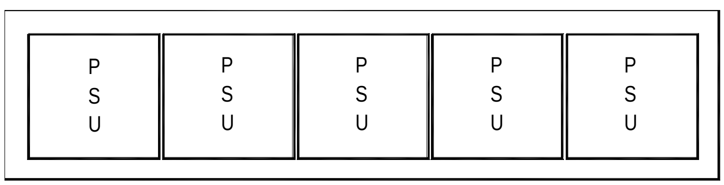


Figure 5-4 Power Supply Subrack in full configuration

The power module can ensure at least 7200W output (4+1 backup). The number of modules used depends on the number of carriers.

Two power supply modules (one backup) should be configured when there are no more than 3 sector carriers. One more power supply module is needed when 3 sector carriers are added.

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

The configuration of power supply module in a cabinet is as follows:

Configuration unit (sector carrier)	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

5.1.4 RF Part Configuration

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

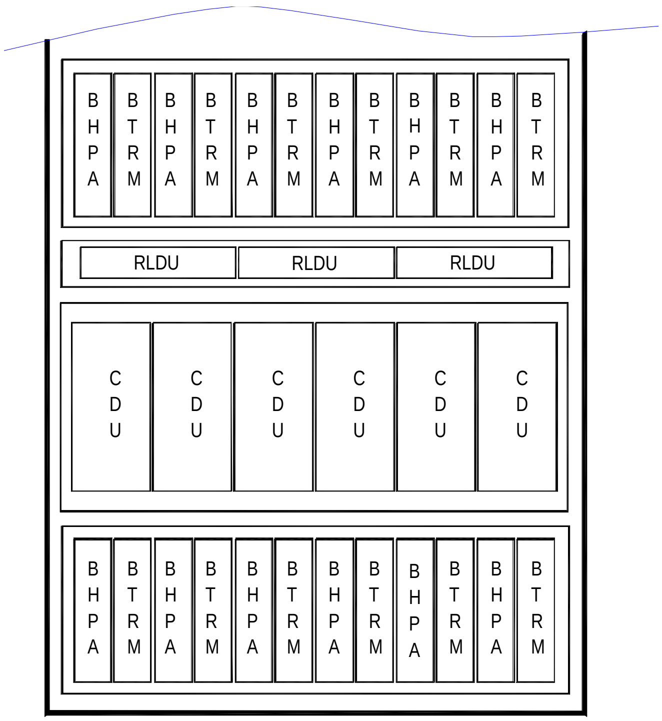


Figure 5-5 RF part in full configuration

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 subrack, configured with 1~6 CDUs or DFUs according to needs. Each DFU supports 1 sector carrier, Each CDU supports 2 sector carriers, and the carriers supported by each CDU should be larger than or equal to 2 carrier intervals.

The configuration of RF devices varies with the quantity of BTS sector carriers.

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.

5.2 Typical Configurations

Typical configurations of BTS include:

O(1)configuration: 1-carrier omni cell

S(1/1/1)configuration: 1 carrier%3 sectors

S(2/2/2)configuration: 2 carriers%3 sectors

S(3/3/3)configuration: 3 carriers%3 sectors

5.2.1 O(1) Configuration

O(1) configuration BTS is as follows:

- Baseband subrack requires 1 BCIM, 1 BRDM, 1~2 BCKM, 1 BCPM (when type-A BCPM is used).
- 2 power supply module.
- 2 omni uni-polarization antennae.

The O(1) configuration RF equipment (without diversity receiving) is shown in Figure 5-6.

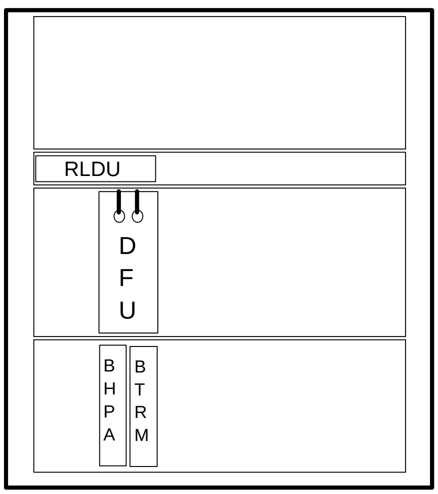


Figure 5-6 O(1) configuration RF equipment

Logic connection of RF equipment is as shown in Figure 5-7.

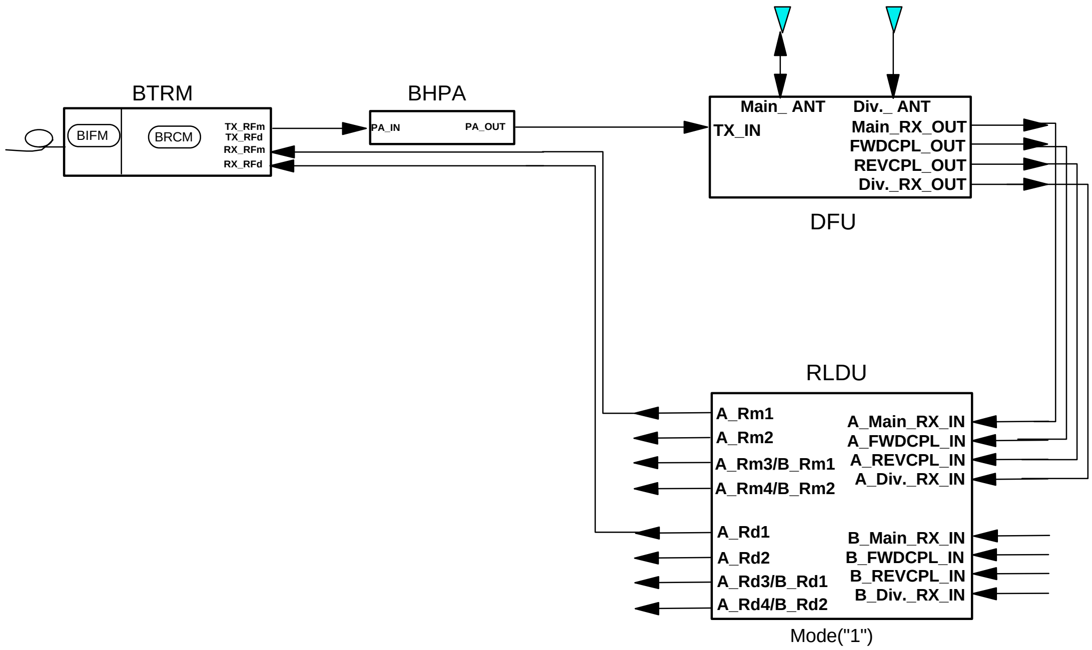


Figure 5-7 RF equipment logic connection, O(1) configuration

5.2.2 S(1/1/1) Configuration

S(1/1/1) configuration BTS is as follows:

- The baseband subrack requires 1 BCIM, 1 BRDM, 1~2BCKM, 2 BCPM (when type-B BCPM is used).
- 2 power supply modules.
- Each sector needs 2 uni-polarization antennae or 1 bi-polarization antenna.

S(1/1/1) configuration RF equipment (without diversity receiving) is as shown in Figure 5-8.

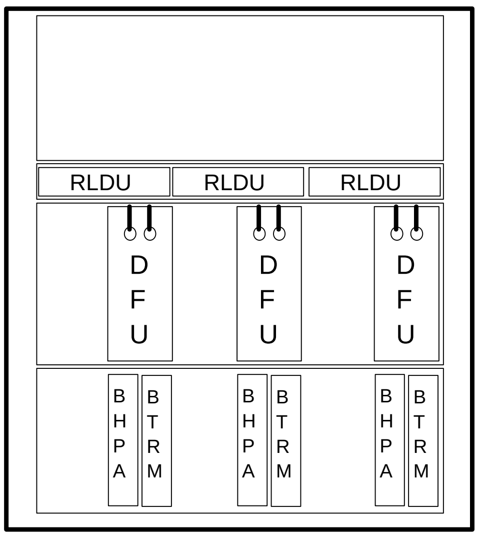


Figure 5-8 S(1/1/1) configuration RF equipment

Logic connection of RF equipment of each sector is as shown in Figure 5-9.

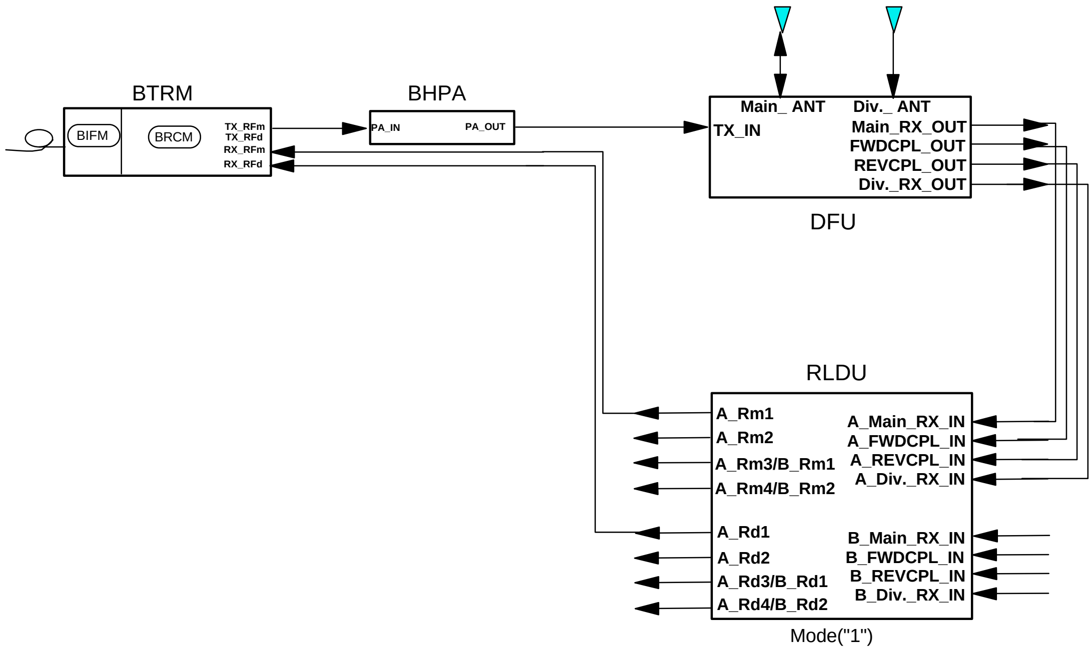


Figure 5-9 RF equipment logic connection, one sector of S(1/1/1) configuration

5.2.3 S(2/2/2) Configuration

S(2/2/2) configuration BTS is as follows:

- The baseband subrack requires 1 BCIM, 1 BRDM, 1~2BCKM, 2 BCPMs (when type-B BCPM is used).
- 3 power supply modules.
- Each sector needs 2 uni-polarization antennae or 1 bi-polarization antenna.

S(2/2/2) configuration RF equipment (without diversity receiving) is shown in Figure 5-10.

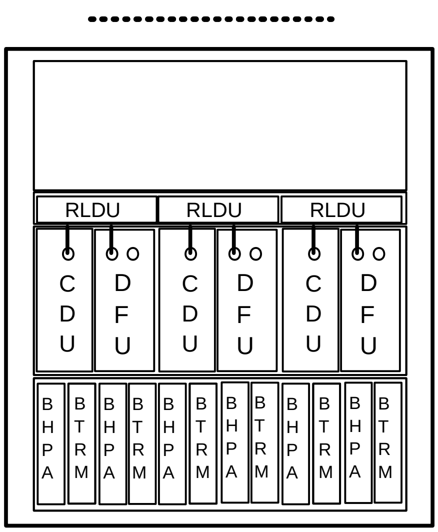


Figure 5-10 S(2/2/2) configuration RF equipment

Note:

The frequency points of CDU is fixed, its upper subrack should be at higher frequency point and the lower subrack at lower frequency point. In actual configuration, the configuration slots should be selected according to the frequency points of CDU.

For 160&260-combining CDU, S(2/2/2) configuration, if the working frequency is determined to be 260, then the carrier modules (one BHPA and one BTRM) should be in the upper subrack, If the system is determined to work at 160, then the modules should be configured in lower subrack.

Logic connection of RF equipment of each sector is as shown in Figure 5-11.

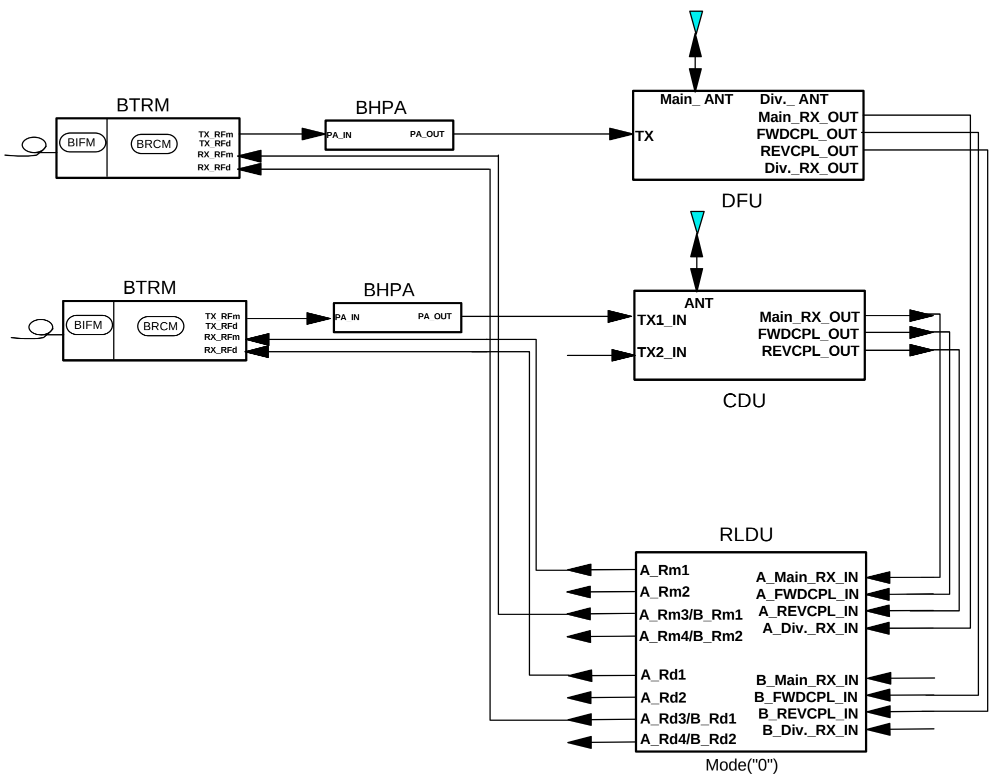


Figure 5-11 RF equipment logic connection, one sector of S(2/2/2) configuration

5.2.4 S(3/3/3) Configuration

S(3/3/3) configuration of BTS is as follows:

- The baseband subrack requires 1 BCIM, 2 BRDMs, 1~2BCKM, 3 BCPMs (when type-B BCPM is used).
- 4 power supply modules.
- Each sector needs 2 uni-polarization antennae or 1 bi-polarization antenna.

S(3/3/3) configuration RF equipment (without diversity receiving) is as shown in Figure 5-12.

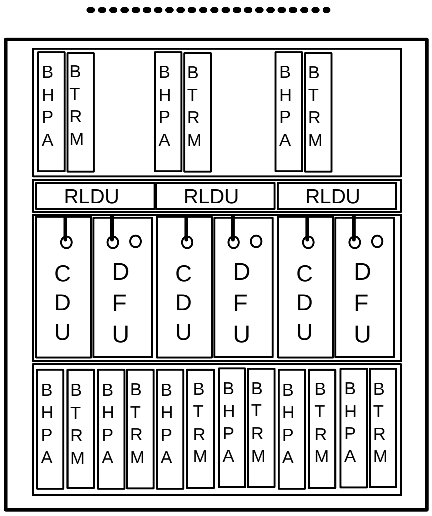


Figure 5-12 S(3/3/3) configuration RF equipment

Logic connection of RF equipment of each sector is as shown in Figure 5-13

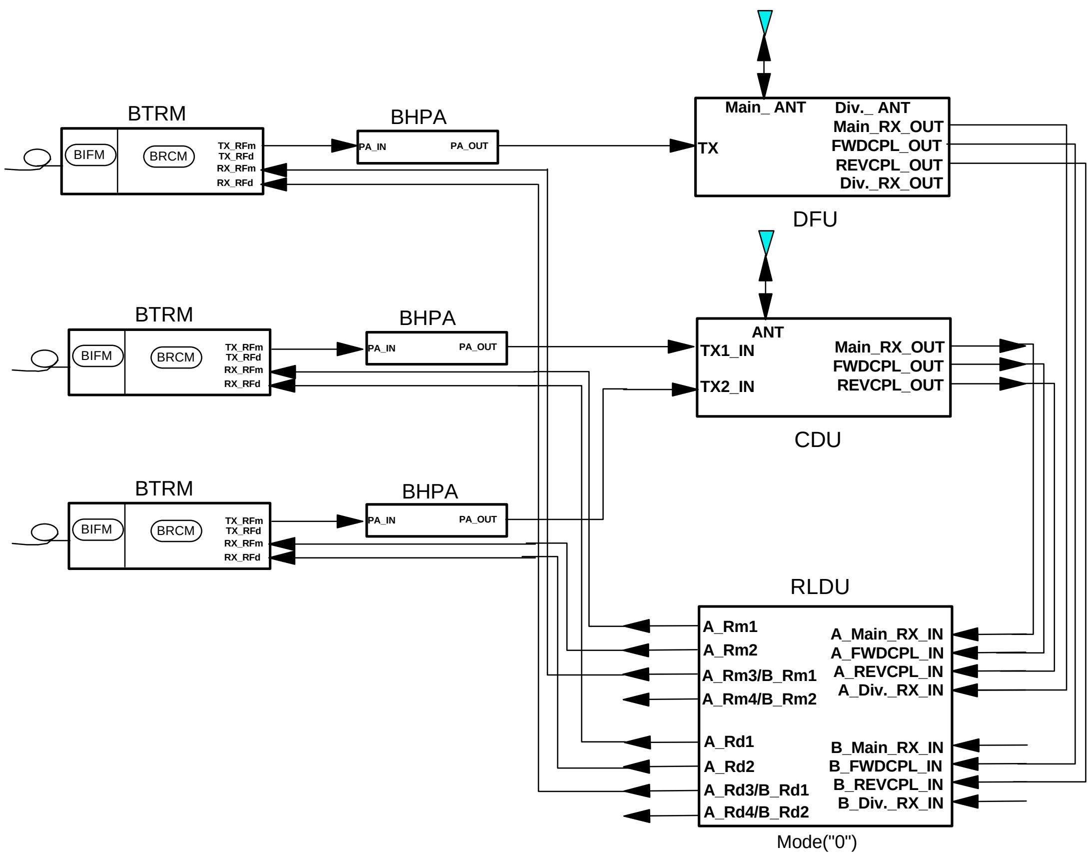


Figure 5-13 RF equipment logic connection, one sector of S(3/3/3) configuration

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 Specification for cdma2000 Spread Spectrum Base Station.*

A.1 Performance of Receiver

A.1.1 Frequency Coverage

BTS receiver runs between the following frequency band: 869~894MHz

A.1.2 Access Probe Acquisition

The access probe failure rates under the reliability of 90% is below the maximum value as shown 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 Reverse Traffic Channel (R-TCH) Demodulation Performance

I. Performance of R-TCH in Additive White Gaussian Noise

The Demodulation performance of the Reverse Traffic Channel in an AWGN (no fading or multipath) environment is determined by the frame error rate (FER) at specified values of Eb/N0.. FER of 4 possible data rates should be calculated respectively. With 95% confidence, the FER for each data rate does not surpass the two given FER in Table A-2 and Table A-9, which adopt the linear interpolation in the form of Log_{10}(FER)in which 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. 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 values of Eb/N0. 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 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. And 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 model of the R-TCH receiving performance test in multipath environment is as shown 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 .0µs	N/A
C	25km/h	1	N/A	N/A	0µs	N/A	N/A
D	100km/h	3	0dB	- 3dB	0µs	2 .0µs	14.5 µs

Table A-11 Channel Model 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 path)
D2	4 (100 km/h, 3 path)

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 values of Eb/N0.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 from the two RF input ports.

Table A-15 Channel Model 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

The R-TCH FER shall be <1.0% with 95% confidence when -126dBm/1.23MHz CDMA RC3 signal level is input at BTS RF main and diversity input ports.

II. Receiver Dynamic Range

The R-TCH FER shall be 1.0% or less with 95% confidence when -126dBm/1.23MHz~-65dBm/1.23MHz CDMA signal level is input at BTS RF main and diversity input ports.

III. Single-tone Desensitization

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, 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 about !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.

IV. Intermodulation Spurious Attenuation

Input two single-tone interference of center frequency at the BTS RF input port: when single-tone interference deviates from the center frequency about !900kHz, the input single-tone interference power is 72dB higher than the output power of the mobile station simulator. When the single-tone interference deviates from the center frequency !1700kHz, 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.

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 (see 6.8).

A.1.5 Limitations on Emissions

I. Conducted Spurious Emissions

- At BTS RF input port, the conducted spurious transmission within the BTS receiving frequency range is <-80dBm/30kHz.
- At BTS RF input port, the conducted spurious transmission within the transmitting frequency range is <-60dBm/30kHz.
- At BTS RF input port, the conducted spurious transmission 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-puls-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

BTS transmitter runs between the following frequency band: 869~894MHz.

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 !5%10^{-8}(!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. Local radio requirements should also be observed.

Table A-25 Conducted Spurious Emissions Performance (800MHz)

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

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, which are 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 are listed in Table B-1.

Table B-1 CE index at -48V port

Frequency range	Threshold (dBμ V)	
	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 are listed in Table B-2.

Table B-2 RE Performance requirement

Band (MHz)	Threshold of quasi-peak (dBμ V/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
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? ~+50? , 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? ~+55? , 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? ~+70? , 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 ? 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 1.1307 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 ccupational/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

$$S = \frac{f[MHz]}{300} = \frac{880}{300} = 2.9 mW / cm^2$$

Power density S [mW/cm^2] for uncontrolled area at 880 MHz

$$S = \frac{f[MHz]}{1500} = \frac{880}{1500} = 0.58 mW / cm^2$$

D.3 Calculation of the 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. The calcualtions are based on FCC OET 65 Appendix B.

D.4 Prediction of the 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.5 Calculation of the 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.6 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.6.1 Exclusions 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.6.2 Guidelines on arranging antenna sites:

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 1X Standards for Spread Spectrum Systems

II. MAC layer

TIA/EIA IS-2000-3-A: Medium Access Control (MAC) Standard for CDMA2000 1X Standards for Spread Spectrum Systems

III. Service capability

TSB2000: Capabilities Requirements Mapping for CDMA2000 1X 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).

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	
AC	Authentication Center
A/D	Analog/Digit
ADC	Analog Digit Converter
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
BIFM	BTS Intermediate Frequency Module
BPLI	BTS Power & Lighting protection lamp Indicator board
BRCM	BTS Radio Up-Down Converter Module
BRDM	BTS Resource Distribution Module
BRFM	BTS RF Fan Module
BS	BTS
BSC	BTS Controller
BSS	BTS 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
CEs	Channel Elements
CLI	Command Line Interpreter
CLK	Clock
CM	Connection Management
CN	Core Network
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

E

EMC	Electro Magnetic Compatibility
EMI	Electro Magnetic Interference
EIA	Electronics Industry Association
EIB	Erasure Indicator Bit
EIR	Equipment Identity Register

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
F-CCCH	Forward Common Control Channel
F-CPCCH	Forward Common Power Control Channel
F-DCCH	Forward Dedicated Control Channel
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
GMSC	Gateway Mobile-services Switching Centre
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
HPSK	Hybrid Phase Shift Keying

I

ICP	IMA Control Protocol
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
IWF	Interwork Function

J

JTAG	Joint Test Action Group

L

LAC	Link Access Control
LMF	Local Maintenance Function
LNA	Low-Noise Amplifier

M

MAC	Medium Access Control
MC	Message Center
MCPA	Multi-Carrier Power Amplifier
Mcps	Million chips per second
MM	Mobility Management
MMI	Man Machine Interface
Modem	Modulator-Demodulator
MPU	Micro Process Unit
MS	Mobile Station
MSC	Mobile Switching Center
MT0	Mobile Terminal 0
MT1	Mobile Terminal 1
MTBF	Mean Time Between Failures
MTTR	Mean Time To Repair

N

Node B	

O

OAM	Operation & Maintenance
ODU	Out Door Unit
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

PCF	Packet Control Function
PDSN	Packet Data Service Node
PGND	Protection Ground
PLMN	Public Land Mobile Network
PN	Pseudo Number
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
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-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

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 Module 1
STS	Space Time Spreading

T

TA	Timing Advance
TA	Terminal Adapter
TAm	Mobile Terminal Adapter
TCP	Transport Control Protocol
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	
UTC	Universal Coordinated Time
UART	Universal Asynchronous Receiver/Transmitter

V

VCI	Virtual Channel Identifier
VLR	Visitor Location Register
VPI	Virtual Path Identifier