HUAWEI

1. System Description

2. System Principle

Airbridge BTS3606A CDMA Base Station
Technical Manual

V200R001

Airbridge BTS3606A CDMA Base Station
Technical Manual

Manual Version	T2-030266-20040602-C-2.10
Product Version	V200R001
BOM	31026366

Huawei Technologies Co., Ltd. provides customers with comprehensive technical support and service. Please feel free to contact our local office or company headquarters.

Huawei Technologies Co., Ltd.

Address: Administration Building, Huawei Technologies Co., Ltd.,

Bantian, Longgang District, Shenzhen, P. R. China

Postal Code: 518129

Website: http://www.huawei.com

Email: support@huawei.com

Notice

The information in this manual is subject to change without notice. Every effort has been made in the preparation of this manual to ensure accuracy of the contents, but all statements, information, and recommendations in this manual do not constitute the warranty of any kind, express or implied.

About This Manual

Release Notes

This manual applies to Airbridge BTS3606A CDMA Base Station V200R001.

Organization

This manual introduces the technical features, system architecture, and basic working principles of the Airbridge BTS3606A CDMA Base Station. It is divided into two modules:

Module 1 System Description

Introduce the features, structure, functions, reliability, operation and maintenance, and relevant technical specifications of the BTS3606A.

Module 2 System Principle

Introduce the general structure of the BTS3606A, the baseband subsystem, RF subsystem, antenna subsystem, power and environment monitoring subsystem. The BTS lightning protection system, grounding system, BTS signaling flow, and BTS configuration are also covered in the module.

Intended Audience

The manual is intended for the following readers:

- Technical marketing specialists
- Installation engineers & technicians
- Operation & maintenance personnel

Conventions

The manual uses the following conventions:

I. General conventions

Convention	Description
Arial	Normal paragraphs are in Arial.

Convention	Description
Arial Narrow	Warnings, Cautions, Notes and Tips are in Arial Narrow.
Boldface	Headings are in **Boldface**.
`Courier New`	Terminal Display is in `Courier New`.

II. Command conventions

Convention	Description
Boldface	The keywords of a command line are in **Boldface**.
italic	Command arguments are in *italic*.
[ ]	Items (keywords or arguments) in square brackets [ ] are optional.
{ x | y | ... }	Alternative items are grouped in braces and separated by vertical bars. One is selected.
[x | y | ...]	Optional alternative items are grouped in square brackets and separated by vertical bars. One or none is selected.
{ x | y | ... }*	Alternative items are grouped in braces and separated by vertical bars. A minimum of one or a maximum of all can be selected.
[x | y | ...]*	Optional alternative items are grouped in square brackets and separated by vertical bars. Many or none can be selected.

III. GUI conventions

Convention	Description
< >	Button names are inside angle brackets. For example, click the <OK> button.
[ ]	Window names, menu items, data table and field names are inside square brackets. For example, pop up the [New User] window.
/	Multi-level menus are separated by forward slashes. For example, [File/Create/Folder].

IV. Keyboard operation

Format	Description
<Key>	Press the key with the key name inside angle brackets. For example, <Enter>, <Tab>, <Backspace>, or <A>.
<Key1+Key2>	Press the keys concurrently. For example, <Ctrl+Alt+A> means the three keys should be pressed concurrently.

Format	Description
<Key1, Key2>	Press the keys in turn. For example, <Alt, A> means the two keys should be pressed in turn.

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 the manual 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

List of Figures

List of Tables

Chapter 1 Introduction

The mobile communication system has experienced the first generation (analog system) and the second generation (digital system).

As one of the main development trends of the second generation, the Code Division Multiple Access 1 Carrier (CDMA2000 1x) technology, advocated by the 3rd Generation Partnership Project 2 (3GPP2), has been widely used for commercial purpose.

The CDMA2000 1x technology is compatible with IS-95A and IS-95B standards. The capacity of the CDMA2000 1x system increases substantially thanks to technologies such as reverse pilot, fast power control and transmits diversity.

As the evolution of the CDMA2000 1x, 1xEV-DO (EVolution-Data Optimized) can provides a peak forward data rate at 2.4 Mbps and a peak reverse data rate at 153.6 kbps. It can deliver diversified radio data services such as multi-media gaming, multi-media news, real-time video traffic news, video phone, video conference, real-time security information, and location-base services.

This chapter provides the compassion between the CDMA2000 1x and the 1xEV-DO technologies, and introduces the network solution of Huawei CDMA2000 1x / 1xEV-DO hybrid mobile communication system and the position of BTS3606A in this solution.

1.1 Comparison between CDMA2000 1x and 1xEV-DO

The BTS3606A supports both CDMA2000 1x and 1xEV-DO.

Table 1-1 exams the differences between them.

Table 1-1 Comparison between CDMA2000 1x and 1xEV-DO

Item	CDMA2000 1x	1xEV-DO
Peak data rate	Forward (RC3): 153.6 kbps Reverse (RC3): 153.6 kbps	Forward: 2.4 Mbps Reverse: 153.6 kbps
Code	Convolutional code and Turbo code	Turbo code
Modulation	Reverse: Hybrid Phase Shift Keying (HPSK) Forward: Quadrature Phase Shift Keying (QPSK)	Reverse: HPSK Forward: QPSK, 8-Phase Shift Keying (8-PSK), 16- Quadrature Amplitude Modulation (16-QAM)
Handoff	Forward: Soft handoff and hard handoff Reverse: Soft handoff and hard handoff.	Forward: Virtual soft handoff Reverse: Soft handoff
Rate/power control	Forward: Power control Reverse: Power control	Forward: Rate control Reverse: Rate control and power control

Item	CDMA2000 1x	1xEV-DO
Channel multiplex mode	Forward: Code Division Multiplex (CDM) Reverse: Code division multiplex	Forward: Time Division Multiplex (TDM) and code division multiplex Reverse: Code division multiplex

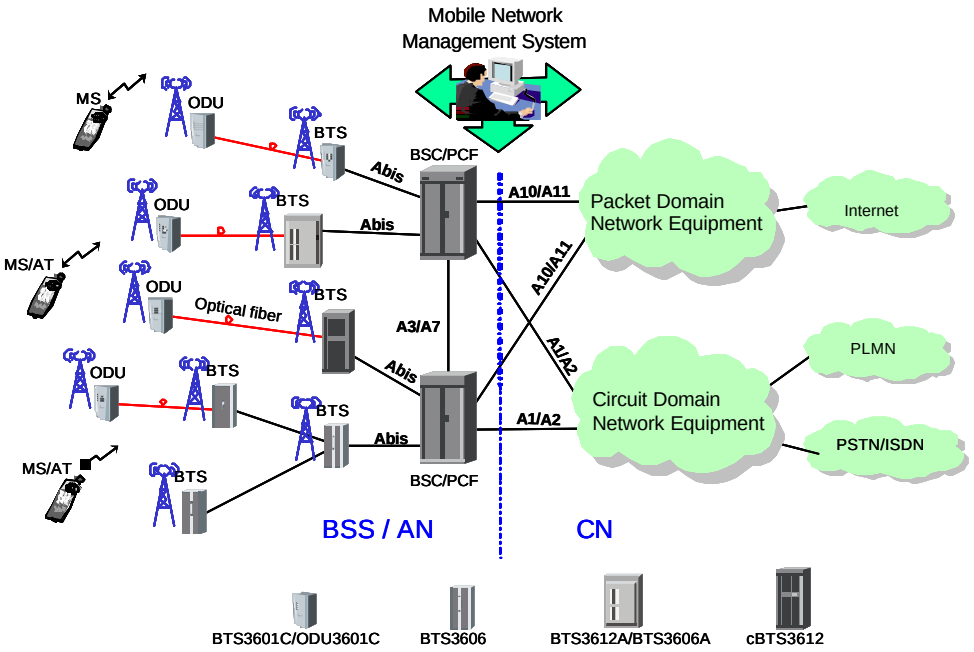
1.2 Huawei CDMA2000 1x / 1xEV-DO Hybrid Network Solution

The Huawei CDMA2000 1x / 1xEV-DO hybrid mobile communication system comprises the Base Station Subsystem/Access Network (BSS/AN) and the Core Network (CN).

The operation and maintenance of the system is implemented through an integrated mobile network management system.

Figure 1-1 shows the network structure of Huawei CDMA2000 1x / 1xEV-DO hybrid system.

As this manual aims to introduce the BTS3606A of the BSS/AN, the following figure emphasizes the network structure of the BSS/AN.



MS: Mobile Station
ODU: Out Door Unit
PCF: Packet Control Function
CN: Core Network
AN: Access Network
AT: Access Terminal
BTS: Base Transceiver Station
BSC: Base Station Controller
BSS: Base Station Subsystem
PLMN: Public Land Mobile Network
ISDN: Integrated Service Digital Network
PSTN: Public Service Telephone Network

Figure 1-1 Structure of Huawei CDMA2000 1x / 1xEV-DO hybrid network

Note:

The appearance of the BTS3601C cabinet is the same as the ODU3601C cabinet.

1.2.1 Brief Introduction to BSS/AN

The BSS is a concept used in the CDMA2000 1x network. It consists of the Base Transceiver Station (BTS), Base Station Controller (BSC), and Packet Control Function (PCF). The PCF is usually integrated with the BSC. The ODU3601C, a soft BTS, is also a part of the Huawei BSS.

The AN is a concept used in the 1xEV-DO network. It consists of the 1xEV-DO BTS and BSC (integrated with PCF).

I. BTS

The BTS transmits and receives radio signals to enable the communication between the radio network system and the Mobile Station/Access Terminal (MS/AT). Huawei provides a series of BTS products, including:

- BTS3606A: Outdoor BTS equipment supporting the CDMA2000 1x and CDMA2000 1xEV-DO standards. The maximum capacity of a single cabinet is six sector carriers. With the multi-carrier technology, the BTS3606A can support a maximum of 18 sector carriers.
- BTS3606: Indoor BTS equipment supporting the CDMA2000 1x and CDMA2000 1xEV-DO standards. The maximum capacity of a single cabinet is six sector carriers. With the multi-carrier technology, the BTS3606 can support a maximum of 18 sector carriers.
- cBTS3612: Indoor BTS equipment supporting both the CDMA2000 1x and 1xEV-DO standards. The maximum capacity of a single cabinet is 12 sector carriers.
- BTS3612A: Outdoor BTS equipment supporting both the CDMA2000 1x and 1xEV-DO standards. The maximum capacity of a single cabinet is six sector carriers.
- BTS3601C: Outdoor one-carrier BTS equipment supporting the CDMA2000 1x standard.
- ODU3601C: Outdoor one-carrier soft BTS equipment supporting the CDMA2000 1x standard. It shares the baseband processing resource of its upper-level BTS. It also transmits and receives the radio signals together with the upper-level BTS.

II. BSC/PCF

The BSC performs the following functions:

- BTS control and management
- Call connection and disconnection

- Mobility management
- Power control
- Radio resource management
- Provision of stable and reliable radio connections for the upper-level services through soft/hard handoff

The PCF manages the Radio-Packet (R-P) connection. As radio resources are limited, they should be released when subscribers are not sending or receiving any information. But the Peer-Peer Protocol (PPP) connection must be maintained. The PCF shields the radio mobility from the upper-level services through the handoff function.

III. MS/AT

- MS

  MS is the equipment used by the mobile subscriber. It can originate and receive calls, and communicate with the BSS.

- AT

  AT is a device with a radio modem and a data interface that allows the user to access a packet data network through the 1xEV-DO Access Network.

  An AT is analogous to a mobile station in an CDMA2000 1x system. It may be connected to a computing device like a laptop computer or may be a self-contained data device like a Personal Digital Assistant (PDA).

1.2.2 Brief Introduction to CN

The CN comprises the packet domain network and the circuit domain network.

I. Packet domain network equipment

The packet domain network equipment covers

- Packet Data Service Node (PDSN)
- Mobile Internet Protocol Home Agent (MIP HA)
- Authorization, Authentication and Accounting (AAA)

They connect to and communicate with the Internet.

II. Circuit domain network equipment

The circuit domain network equipment includes

- Mobile Switching Center (MSC)
- Home Location Register (HLR)
- Gateway Mobile-services Switching Center (GMSC).

They connect to and communicate with the conventional Public Land Mobile Network (PLMN) and Public Switched Telephone Network/Integrated Services Digital Network (PSTN/ISDN).

1.3 Position of BTS3606A

The following examines the position of the BTS3606A in the network and in the application.

I. Position in the network

The BTS3606A is located between the BSC and the MS/AT in the CDMA2000 1x / 1xEV-DO hybrid system. Under the control of the BSC, the BTS3606A is the radio transceiver equipment serving one cell or multiple logical sectors.

Connecting with the BSC through the Abis interface, the BTS3606A helps the BSC manage radio resources, radio parameters and interfaces. It also implements, over the Um interface, the radio transmission between the BTS and the MS, as well as related control functions.

II. Position in the application

The BTS3606A is an outdoor BTS. It can adapt to the sophisticated natural and electromagnetic environment.

The BTS3606A features lower cost, fast deployment, and strong environment adaptability. It facilitates the seamless coverage of the radio network.

The BTS3606A is suitable for the area with medium or large traffic.

Fully compatible with CDMA2000 1x and 1xEV-DO, the BTS3606A can work in the CDAM2000 1x mode, the 1xEV-DO mode, or the CDMA2000 1x / 1xEV-DO hybrid mode.

Chapter 2 Product Features

The BTS3606A is designed in consideration of customers' requirements for service, capacity, coverage, transmission, power supply, installation and maintenance. It employs integrated design, which shows the customer-oriented service idea of Huawei.

2.1 Technical Features

The BTS3606A has the following technical features:

- Support both the CDMA2000 1x and 1xEV-DO standards.
- Support the CDMA2000 1x / 1xEV-DO hybrid networking. The CDMA2000 1x and CDMA2000 1xEV-DO carriers can be configured at any ratio.
- Allow the coexistence of the single-carrier and multi-carrier modules.
- Provide powerful sector processing capability and support the large-power coverage of a single sector or large-capacity coverage of multiple carriers.
- Adopt resource pool design to improve the hardware resource utilization ratio and the system error tolerance capability.
- Adopt the digital Intermediate Frequency (IF) technology to improve the system availability.
- Adopt intelligent fan control to increase the service life of fans and reduce the noise.
- Support anti-interference for inband adaptive wave filtering (applicable to the case of a single carrier)
- Work on such bands as 450 MHz, 800 MHz and 1900 MHz.
- Support cascading with the ODU3601C to expand the coverage area of radio network flexibly.
- Support forward/reverse load control and access channel load control to ensure the system capacity and the service quality.
- Support various service negotiations, including active negotiations, passive negotiations, or non- negotiations.
- Support Push To Talk (PTT) function.
- Support the coexistence of modules of multiple bands.

Note:

- The BTS3606A supports the CDMA2000 1x and 1xEV-DO by using different types of channel processing boards.
- The Channel Element (CE) pool is employed in the CDMA2000 1x, but not in the 1xEV-DO.
- The BTS3606A supports the single-carrier and multi-carrier by using different types of transceiver modules.

2.2 Large-scale Coverage

The BTS3606A can cover a wide area thanks to its excellent performance of transceiving.

I. Receiver sensitivity

The main/diversity receiving technology is employed to optimize the receiving performance. In the case of RC3, the receiver sensitivity of the BTS3606A is better than -127 dBm in the single-carrier mode and better than –126 dBm in the multi-carrier mode.

II. Transmit power (measured at the antenna port of the cabinet)

- Single-carrier mode

  The maximum average transmit power is 25 W.

  When the large-power combiner is configured, two powers can be combined to output an average transmit power up to 50 W.

- Multi-carrier mode

  When the BTS3606 operates at 450 MHz, it does not support the multi-carrier.

  When the BTS3606 operates at 800 MHz, the maximum average transmit power is 50 W.

  When the BTS3606 operates at 1900 MHz, the maximum average transmit power is 40 W.

  For details, see section 7.3 , "Transmitter and Receiver Specifications".

III. ODU3601C cascading

The BTS3606A can be cascaded with the ODU3601C through optical fibers. The BTS3606A can provide a maximum of 12 optical interfaces.

Each optical interface can connect to three levels of ODU3601Cs either in the CDMA2000 1X or CDMA2000 1xEV-DO mode. In this way, the signal coverage area is effectively enlarged.

2.3 Flexible Networking Mode

I. Networking interfaces

The BTS3606A supports the networking by using E1 and T1 links. It supports Inverse Multiplexing for ATM (IMA), User Network Interface (UNI), and timeslot interface.

The Abis interface support the link backup function, which enhances the system availability.

II. Networking modes

The BTS3606A supports diversified networking modes including chain networking, star networking, tree networking, fractional ATM and ODU3601C cascading networking.

The BTS3606A can share the transmission network with the GSM BTS. In addition, it provides the GSM BTS with transmission channels on the Abis interface in the Fractional ATM mode.

III. Clock source

The BTS3606A supports the following clock sources:

- Global Position System (GPS) clock
- Global Navigation Satellite System (GLONASS) clock
- Other external clock sources

Thus, it can adapt to various networking situations.

If the BTS High Precision Clock Module (HPCM) is configured, the BTS3606A can keep clock synchronization for twenty-four hours after the external clock source signal is lost.

2.4 Convenient Operation and Maintenance

Operation and maintenance of the BTS3606A can be implemented through the Local Maintenance Terminal (LMT) and the M2000 mobile integrated network management system.

The following lists the maintenance functions:

I. System status monitoring

This function provides the indication for the system running status and resource status, the configuration of local cell and logical cell, and their status indications.

II. Data configuration

The BTS3606A adopts dynamic data configuration mode. The configured data takes effect without resetting BTS.

It also supports the batch processing of data configuration, which allows the configuration of multiple network elements sharing the same attributes at a time.

The data backup function is also available.

III. Alarm processing

This function involves:

- Alarm collection
- Alarm clearing
- Alarm querying
- Alarm shielding
- Alarm filtering

IV. Security management

The security management function includes:

- User login authentication
- Command authority restriction
- Confirmation of dangerous operation
- User group management
- Timeout locking

V. Test

The BTS3606A supports both offline and online tests. The test items include:

- Board loopback test
- Self-test
- Trunk loopback test

VI. Site monitoring

Data transmission channels are available for the monitoring equipment in the equipment room to facilitate attendance-free and centralized monitoring of the BTS3606A.

VII. Upgrade

Users can upgrade the system through remote loading. The upgrade process is retrievable, that is, the system can back off to the original one when the upgrade fails.

VIII. Equipment operation

The BTS3606A supports front operation, and online insertion and removal of baseband boards. This facilitates the maintenance, upgrade and expansion of the system.

IX. Auto restart function

When the BTS3606A is out of service owing to power failure or transmission failure, it can restart automatically right after the faults are cleared.

X. Reverse maintenance function

With the reverse maintenance function, users can, from the LMT, log in to the BAM through the network port on the BCKM to perform operation, maintenance and management over the whole BSS.

2.5 Powerful Environment Adaptability

The BTS3606A is protected against wind, sand, rain, sun shine, and theft.

I. Totally-enclosed integrated structure

The water-proof and dust-proof measures of the BTS3606A are in compliance with the International Protection (IP55) standard. The moisture-proof, mould-proof, and salt fog-proof level reaches the Class 1 protection standard (3 classes).

Note:

For details about the IP55, see GB4208: Enclosure Protection Level (IP Code) or IEC 60529: Degrees of protection provided by enclosure (IP code).

II. Wide operating temperature range

The BTS3606A is equipped with a temperature control system.

The operating temperature of the BTS3606A with air conditioner is from –40°C to +55°C. The operating temperature of the BTS3606A with heat exchanger is from –40°C to +45°C.

In a high-temperature environment, the BTS3606A uses its temperature control unit to dissipate heat. In a low-temperature environment, the built-in heater is activated to ensure the internal components to operate in a reliable temperature range.

III. Robust power distribution function

The BTS3606A supports 220V, 230V and 240V power and single-phase/three-phase input. The voltage ranges from 176 V to 264V and frequency from 47 Hz to 63 Hz. It provides over-voltage protection when the voltage reaches 290 V.

The system is also compatible with 110 V AC, 115 V AC and 127 V AC power and single-phase/three-phase input. The voltage ranges between 95 V to 135V and frequency between 47 Hz to 63 Hz. It provides over-voltage protection when the voltage reaches 85V.

The built-in battery provides power supply in the case of AC power failure to ensure the normal operation of the BTS3606A for a period of time.

The optional outdoor battery cabinet allows a three-section-carrier system to operate for more than eight hours when the AC power of the BTS is cut off.

The hierarchical power supply function of the BTS3606A can promise the transmission function of lower-level BTSs in the absence of mains support.

IV. Sound lightning protection and monitoring function

The BTS3606A is equipped with reliable lightning protection facilities such as built-in lightning protection board and external lightning protection box.

It is also furnished with comprehensive environment monitoring system to implement remote monitoring.

2.6 Easy Upgrade and Expansion

I. Compatibility design

The BTS3606A is compatible with CDMA2000 1x and 1xEV-DO. It can be evolved to 1xEV-DV (EVolution-Data and Voice) smoothly.

The network can be upgraded from CDMA2000 1x to CDMA2000 1x EV-DO by replacing the CCPM with CECM and upgrading the BTS software to protect the operator's investment.

II. Flexible configuration

The BTS3606A supports the multi-cell configuration. When it is cascaded with ODU3601C, the ODU3601C can be configured as an independent cell to realize the flexible coverage.

The BTS3606A supports the omni cell and 3-sector configuration.

III. Smooth expansion

The modular structure allows the BTS3606A to be expanded simply by adding modules.

With the multi-carrier technology, the capacity of a single-carrier BTS3606A cabinet can be expanded from six sector carriers to eighteen sector carriers.

2.7 Serial Products for Seamless Coverage

Huawei provides a series of BTS products to enable a seamless coverage for urban, suburb, and rural area, highway and hot area.

Table 2-1 shows the application of various BTS products.

Table 2-1 Application comparison among serial BTS products

Model		Max. sector carrier per cabinet	Capacity	Application	Type
BTS3606	Single-carrier	6	Medium	Medium and small cities, towns. Low requirement for equipment room.	Indoor BTS supporting CDMA2000 1x and 1xEV-DO
	Multi-carrier	18	Large	Highly populated area and city	Indoor BTS supporting CDMA2000 1x and 1xEV-DO
BTS3606A	Single-carrier	6	Medium	Highly populated area and city, medium and small cities and towns.	Outdoor BTS supporting CDMA2000 1x and 1xEV-DO
	Multi-carrier	18	Large	High-traffic area and limited equipment room space, highly populated area and city	Outdoor BTS supporting CDMA2000 1x and 1xEV-DO
cBTS3612		12	Large	Highly populated area and city.	Indoor BTS supporting both CDMA2000 1x and 1xEV-DO
BTS3612A		6	Medium	High-traffic area and limited equipment room space	Outdoor BTS supporting both CDMA2000 1x and 1xEV-DO
BTS3601C		1	Small	Indoor, underground, highway and railroad.	Outdoor BTS supporting CDMA2000 1x (also applicable to the indoor condition)
ODU3601C		1	Small	Indoor, underground, highway and railroad.	Outdoor BTS supporting CDMA2000 1x (also applicable to the indoor condition)

Chapter 3 Product Architecture

This chapter introduces the physical features and configuration of the BTS3606A.

3.1 Cabinet Physical Features

The BTS3606A cabinet is designed in accordance with the IEC297 standard.

The outer dimensions are 1700 mm × 1200 mm × 1000 mm (Height × Width × Depth) (excluding the components installed on the top of the cabinet).

Figure 3-1 shows the BTS3606A cabinet.

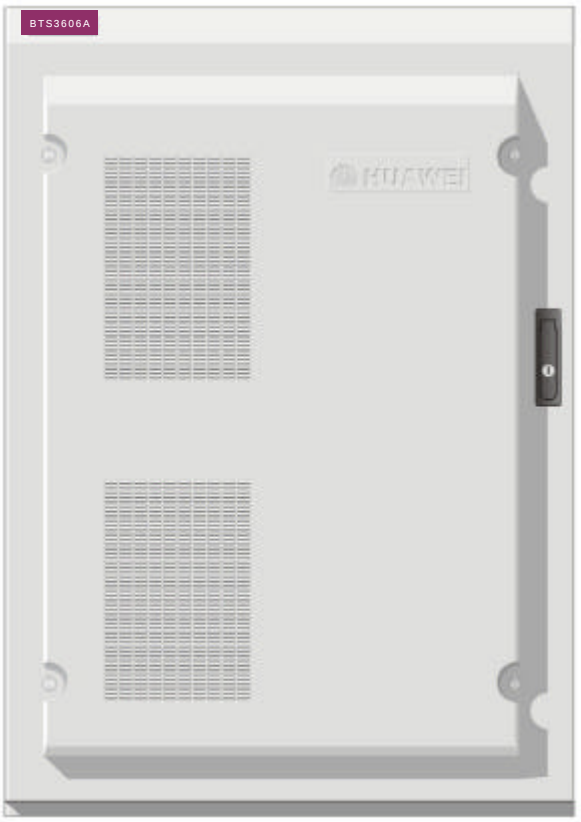


Figure 3-1 BTS3606A cabinet

The BTS3606A cabinet has the following features:

- Total-enclosed integrated structure and power environment adaptively
- Light weight owing to its aluminum alloy materials
- Excellent electrical conductivity and shielding effect
- Good ventilation effect owing to its reasonable design of air ducts
- Easy installation and maintenance

- Nice appearance

3.2 Cabinet Configuration

Figure 3-2 shows the configuration of the BTS3606A cabinet.

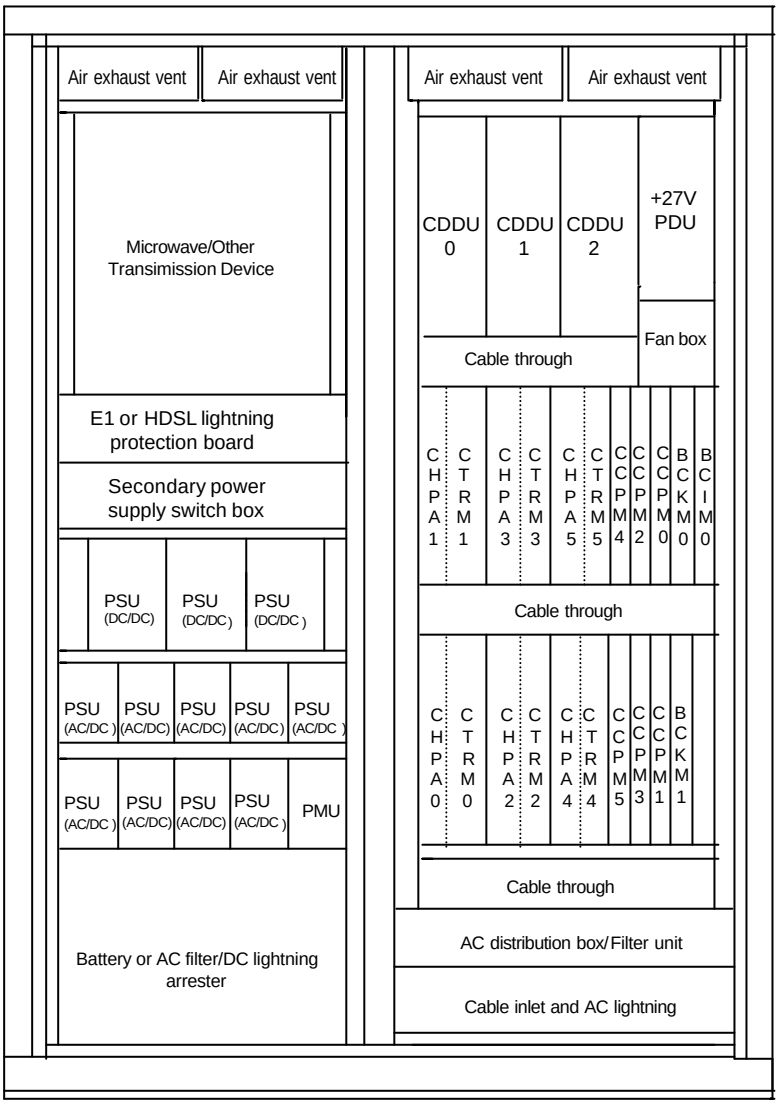


Figure 3-2 A fully equipped BTS3606A cabinet

Table 3-1 lists the boards and modules of the BTS3606A.

Table 3-1 Boards and modules of the BTS3606A

Acronyms	Full name
BCIM	BTS Control Interface Module
BCKM	BTS Control & Clock Module

Acronyms	Full name
CCPM	Compact-BTS Channel Process Module
CECM	Compact-BTS EVDO Channel Module
CDDU	Compact-BTS Dual Duplexer Unit
CHPA	Compact-BTS High power Amplifier
CPCM	Compact-BTS Power Combination Module
CTRM	Compact-BTS Transceiver Module
CMTR	Compact-BTS Multi-carrier Transceiver Module
CMPA	Compact-BTS Multi-carrier Power Amplifier
$PSU_{AC/DC}$	AC/DC Power Supply Unit
$PSU_{DC/DC}$	DC/DC Power Supply Unit
PMU	Power Management Unit

Note:

- The BTS3606A adopts the CCPM to support CDMA2000 1x, and the CECM to support 1xEV-DO.
- The same BTS3606A cabinet can be configured with CCPM and CECM, that is, the BTS3606A can simultaneously support CDMA2000 1x and 1xEV-DO.
- The CPCM supports the power combination when the BTS3606 operates at 1900 MHz.
- CTRM and CHPA support the multi-carrier application.

3.3 System Structure

The BTS3606A system consists of baseband subsystem, Radio Frequency (RF) subsystem, power supply subsystem, and antenna subsystem.

Space is also reserved in the BTS3606A cabinet to hold the transmission equipment such as the micro wave equipment and SDH equipment to support flexible transmission access mode.

Figure 3-3 shows the structure of the BTS3606A.

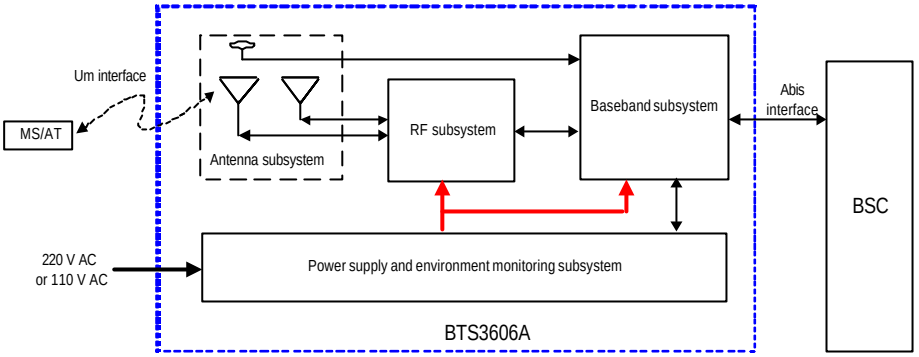


Figure 3-3 BTS3606A system structure

3.3.1 Baseband Subsystem

The baseband subsystem comprises the BCKM, BCIM, CCPM, CECM, and HPCM. It has the following functions:

- Provide Abis interface to process the Abis interface protocol.
- Provide a fiber interface to the RF subsystem to process the Um physical layer and Common Channel (CCH) MAC layer protocols.
- Implement modulation/demodulation of CDMA2000 1x and 1xEV-DO baseband data and the coding/decoding of CDMA channels.
- Provide synchronization clock signal to the BTS.
- Perform system resource management, operation and maintenance, and environment monitoring.

3.3.2 RF Subsystem

The RF subsystem consists of the CTRM, CHPA, CDDU, and CPCM. It has the following functions:

I. On the forward link

The RF subsystem

1) Performs power-adjustable up-conversion and linear power amplification on the modulated transmit signals.
2) Completes power combination (optional).
3) Filters the transmit signals.
4) Finally sends the signals to the antenna subsystem.

II. On the reverse link

The RF subsystem

1) Filters the signals received by the BTS antenna to suppress the out-band interference.
2) Performs low-noise amplification.

3) Performs noise factor–adjustable down-conversion, and channel-selective filtering.
4) Finally sends the signals to the baseband subsystem.

3.3.3 Antenna Subsystem

The antenna subsystem of the BTS3606A includes the RF antenna and the satellite synchronization antenna.

- RF antenna

  This part covers the transmitting and receiving antennas, feeders, antenna lightning arrester (optional), and tower mounted amplifier (optional). It transmits and receives signals on the Um interface.

- Satellite synchronization antenna

  This part includes the satellite signal receiving antenna, feeder, and lightning arrester. It receives synchronization signals from the satellites (GPS or GLONASS) to provide precise clock source for the BTS.

3.3.4 Power Supply and Environment Monitoring Subsystem

The power supply and environment monitoring subsystem includes the power supply, environment monitoring part, and the temperature controller.

- Power supply

  The power supply consists of:

  --AC distribution unit

  --DC distribution unit

  --Power Supply Units (PSUs, including PSUAC/DC and PSUDC/DC)

  --Power Management Unit (PMU)

  --Battery group

  --Management unit of the battery group

  The PSUs work in N+1 redundancy mode. If any PSU fails, an alarm will be reported. The PSUs support online insertion and removal.

- Environment monitoring part

  The environment monitoring part includes the PMU and sensors. The PMU collects the environment variables such as temperature, humidity, smoke, water and access control from the sensors, and reports them to the BCKM of the BTS. Based on the preset configuration, the BTS performs operations and reports the information to the OMC.

- Temperature controller

The temperature controller may be an air conditioner or a heat exchanger, which can ensure the normal operation of the BTS in the following ambient-temperature ranges:

--Air conditioner: –40°C to 55°C

--Heat exchanger: –40°C to 45°C

3.4 Physical Interface

Interface	Type	Quantity	Function
Abis interface	E1 or T1	8	These interfaces connect to the transmission system that connects to the BSC. Support IMA/UNI, cascading, and ATM over Fractional ATM function. When E1 is selected, 75Ω and 120Ω load interfaces are available. When T1 is selected, the 100Ω load interface is available.
ODU3601C cascading interface	Optical fiber	8	One CCPM/CECM can provide two optical interfaces. When it is necessary to connect the BTS3606A to the ODU3601C, up to three levels of ODU3601Cs can be connected.
Clock interface	GPS/GLONASS	2	Connect to the satellite receiver and satellite synchronization antenna to provide long-term stable clock signals.
	External synchronization clock input	1	Provide high-precision clock when the GPS/GLONASS clock signals are unavailable.
Maintenance interface	Ethernet interface	1	Provide local maintenance path.
Clock test interface	Reference clock interface	1	Output 10 MHz signals for test purpose.
	Synchronization test interface	1	Output PP2S signals for test purpose.
Power supply and Protection Ground (PGND) interface	Power supply interface	4	Respectively connect to A, B, C, and N lines.
	PGND interface	2	Respectively connect to grounding cable, and to the auxiliary equipment.
	DC interface	2	Connect to the –48V DC power supply that is used to charge the batteries.
Antenna interface	RF signal	6	When three sectors are configured, each sector corresponds to two DIN connectors, which can be used for both transmitting and receiving.
Environment Alarm Chest (EAC) interface	Alarm signal	1	Provided by the PMU.

Chapter 4 Main Functions

The BTS3606A supports the following CDMA2000 1x standards:

- The Um interface supports the TIA/EIA IS-2000 Rel.A standard and is compatible with the TIA/EIA-95-A/B standard.
- The minimum performance of the BTS3606A satisfies TIA/EIA-97-D requirements.

The BTS3606A supports the following 1xEV-DO standards:

- The Um interface supports the C.S0024-0 standard.
- The minimum performance of the BTS3606A satisfies C.S0032-0 requirements.

4.1 Power Control and Rate Control

The CDMA system is a self-interference system. Every subscriber is an interference source to other subscribers. If it is possible to ensure that every MS transmits at the minimum power it needs, the whole system capacity can reach the maximum. Therefore, power control directly affects the system capacity and the service quality.

Operating in the CDMA2000 1x system, the BTS3606A adopts power control mechanism. Power control is classified into forward power control and reverse power control. Forward power control is used to control the transmit power of the BTS. Reverse power control aims to control the transmit power of the MS.

Operating in the 1xEV-DO system, the BTS3606A adopts rate control in the forward direction, and the rate control plus power control in the reverse direction.

I. Forward power control

There are several methods to realize forward power control, depending on the MS protocol version and the system parameters.

- Power control based on PMRM

  When the MS uses the Power Measurement Report Message (PMRM) for power control, it determines the method and frequency of reporting PMRM according to the received control message contained in the system parameter message.

- Power control based on EIB

  When the MS uses the Erasure Indicator Bit (EIB) for power control, it detects forward frame quality and sends this information to the BTS using EIB. The BTS will adjust the transmit power according to the EIB information.

- Forward fast power control

  The MS adjusts the BTS power according to the power control bit. The power control bit can be transmitted at a maximum speed of 800 bps.

As the CDMA2000 1x system supports the high-speed data service, the requirement on forward power control becomes higher.

The forward quick power control can control the transmit power of forward channel accurately. As a result, the interference is reduced and the capacity is increased.

II. Reverse power control

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

- Open-loop power control

  The MS determines the transmit power to access the BTS according to the strength of the received pilot signal.

- Close-loop power control

  The BTS issues a power control command to the MS, and makes further adjustment according to the feedback from the MS.

Figure 4-1 illustrates the principle of closed-loop power control.

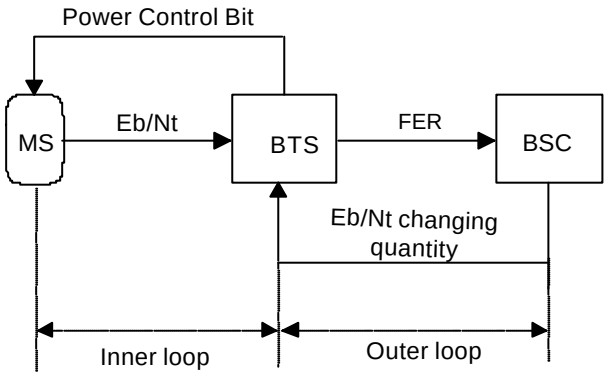


Figure 4-1 Close-loop power control

In the inner-loop power control, the BTS issues the power control bit according to the received Eb/Nt value.

In the outer-loop power control, the BSC adjusts the Eb/Nt value according to the Frame Error Rate (FER) of the received reverse signal. Then the BTS uses the newly set Eb/Nt value to issue the power control bit. In this way, the transmit power of the MS can be controlled.

III. Rate control (only applied to 1xEV-DO forward link)

1) Forward link

   The AT controls the rate of the forward traffic channel through Data Rate Control (DRC) channel assignment.

2) Reverse link

The system transmits at the maximum allowed rate through the Control Channel (CC).

The AT first transmits at 9.6 kbps, and then increases the rate gradually according to the Reverse Activity Bit (RAB) sent by the AN.

- If the RAB sent by all sectors in the Active Set is 0 and when a certain condition is met, the AT multiples the rate every other 26.67 ms until the rate reaches the maximum allowed rate.
- If the RAB sent by at least one sector in the Active Set is 1, the AT decreases the rate by half when a certain condition is met.

4.2 Handoff

When the MS/AT moves out of the current serving cell/sector or the conversation quality deteriorates to an unacceptable degree, the MS will be handed off to another cell/sector to maintain the ongoing conversation.

If the handoff of MS/AT to another cell/sector helps to improve the conversation quality and network performance, it is also possible to trigger the handoff procedure.

Different from the CDMA2000 1x, the 1xEV-DO introduces virtual soft handoff function to the forward link.

I. Soft handoff

The soft handoff happens between neighboring cells which serve on the same frequency and belong to different BTSs. The two different BTSs can belong to the same BSC, or two different BSCs connected with A3/A7 interface.

In the soft handoff procedure, the MS maintains the connection with the previous cell till it establishes the communication with the new cell. The MS can establish radio links with multiple cells, select and combine data received from these links to improve the conversation quality and reduce call drops.

II. Softer handoff

The softer handoff happens between neighboring sectors that serve on the same frequency and belong to the same BTS. It is a special case of soft handoff.

Since the MS establishes radio links with multiple sectors under the same BTS, the BTS can combine the diversity signals received by its sectors from the MS.

Therefore, the conversation quality during softer handoff is better than that of soft handoff.

III. Virtual soft handoff (only applied to the 1xEV-DO forward link)

The AT monitors all pilot signals in the Active Set and selects the best as its serving sector. Then, it receives signaling messages and data from the selected sector. This process is called virtual software handoff.

A cell knows whether it is selected according to the DRC Cover.

IV. Hard handoff

In the hard handoff procedure, the MS firstly interrupts the connection with the previous cell, and then sets up the connection with the new cell. Therefore, call drop may occur.

Hard handoff includes:

- Intra-frequency hard handoff: Handoff between the BSCs without A3/A7 interface in-between.
- Inter-frequency hard handoff: Handoff between cells serving on different frequencies.

4.3 Radio Configuration

The Um interface of the BTS3606A supports CDMA2000 1x. It is compatible with 1xEV-DO. The spreading rate is 1.2288 Mcps.

The CDMA2000 1x physical layer supports multiple Radio Configurations (RCs). Different radio configurations support the frames of the different rate sets, and have different channel configurations and spreading spectrum structures.

The transmission combinations supported by the BTS3606A include:

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

Each RC supports traffic channel at different data rates. The performance of the CDMA2000 1x system varies with RCs. For example, the CDMA2000 1x system with RC1 and RC2 is compatible with IS-95A/B.

4.4 Channel Configuration

A series of physical channels have been defined on the Um interface. These physical channels are classified by the channel features. To support higher-rate data transmission, the 1xEV-DO uses a channel design different from that of the CDMA2000 1x.

4.4.1 CDMA2000 1x Channel

The following shows the classification of the CDMA2000 1x channel.

I. Forward channel

The CDMA2000 1x forward channel includes Forward Common Channel and Forward Dedicated Channel.

The Forward Common Channel is further divided into:

- Forward Pilot Channel (F-PICH)

  It provides synchronization signals to the MSs operating in the BTS coverage. Different from other channels, the F-PICH is an unmodulated spread spectrum signal that is always in the transmitting status.

- Forward Sync Channel (F-SYNCH)

  It provides the initial time synchronization information to MSs operating in the BTS coverage.

- Forward Paging Channel (F-PCH)

  It sends the system information and MS-specific message to the MSs operating in the BTS coverage. Each CDMA channel in a sector can support seven paging channels at most.

- Forward Quick Paging Channel (F-QPCH)

  The BTS uses this channel to send the paging order and system configuration change order to slotted-mode MSs, instructing them to receive the paging messages. As a result, the MS battery energy is saved.

- Forward Common Control Channel (CCCH)

  The BTS uses this channel to send system message and message to dedicated MS.

  The Forward Dedicated Channel is further divided into:

- Forward Dedicated Control Channel (F-DCCH)

  It carries traffic information and signaling information between the MS and the BTS.

- Forward Fundamental Channel (F-FCH)

  It carries traffic information between the MS and the BTS.

- Forward Supplemental Channel (F-SCH)

  It carries traffic information between the MS and the BTS. It is only applicable to RC3, RC4 and RC5.

II. Reverse channel

The CDMA2000 1x forward channel includes Reverse Common Channel and Reverse Dedicated Channel.

The Reverse Common Channel is further divided into:

- Reverse Access Channel (R-ACH)

  The MS uses this channel to communicate with the BTS and respond to paging channel message.

The MS uses random access protocol to initiate access procedure. Regarding each supported paging channel, thirty-two access channels can be supported at most.

- Reverse Enhanced Access Channel (R-EACH)

  The MS uses this channel to initiate the communication with the BTS or respond to dedicated paging channel message.

  The Reverse Dedicated Channel is further divided into:

- Reverse Fundamental Channel (R-FCH)

  It carries the traffic information between the MS and the BTS.

- Reverse Dedicated Control Channel (R-DCCH)

  It carries traffic information and signaling information between the MS and the BTS.

- Reverse Supplemental Channel (R-SCH)

  It carries the traffic information between the MS and the BTS. It is applicable to RC3 and RC4 only.

4.4.2 CDMA2000 1xEV-DO Channel

The following shows the classification of the CDMA2000 1xEV-DO channel.

I. Forward channel

The forward channel of the 1xEV-DO adopts Time Division Multiplex (TDM) mode.

It includes four types of channels: Pilot Channel, Media Access Control (MAC) Channel, Control Channel, and Traffic Channel.

- Pilot Channel

  Different from the continuous pilot of IS-95/1x system, the Pilot Channel is only transmitted on the activated forward channels in the 1xEV-DO system.

  Pilot Channel is the unmodulated signal used for synchronization of ATs under the coverage of the sector and other functions.

- MAC Channel

  There are three code sub-channels under the MAC Channel:

  --Reverse Activity (RA) sub-channel, used for the reverse overload control of the Um interface.

  --Reverse Power Control (RPC) sub-channel, used for reverse power control.

  --Data Rate Control Lock (DRCLock) sub-channel, used by the AN to inform the AT whether the DRC channel of the AT can be properly demodulated. It plays an important role in helping the AT with the forward virtual handoff.

- Control Channel

The Control Channel is similar to the paging channel in the CDMA2000 1x system. It broadcasts various overhead messages and transmits other uni-cast messages such as paging message.

- Traffic Channel

  The Traffic Channel transmits traffic data. It is multiplexed by multiple users at different time.

II. Reverse channel

The reverse channel of the 1xEV-DO includes reverse access channel and reverse traffic channel.

- Reverse access channel

  The AT uses it to originate a call or respond to network paging message. The reverse access channel covers Pilot sub-channel (transmitted on channel I) and Data sub-channel (transmitted on channel Q).

- Reverse traffic channel

  The reverse traffic channel covers Pilot Channel, Media Access Control (MAC) Channel, Acknowledgement (ACK) Channel, and Data Channel.

  --Pilot Channel

  It helps with the coherence demodulation and phase estimation of the BTS3606A.

  --MAC Channel

  It consists of Reverse Rate Indicator (RRI) sub-channel and DRC sub-channel.

  The AT uses the DRC sub-channel to report the quality of the forward channel to the AN. The AN can adjust the rate and the sector for transmitting data to the AT according to the message of DRC channel. In this way, the air resource is best utilized.

  The data channel of the reverse traffic channel uses the RRI sub-channel to determine the rate for transmitting data.

  --ACK sub-channel

  It helps the AT notify the AN whether the data packet of forward traffic channel is correctly received. This function helps adjust the forward rate forecast by the AT to improve the performance of the system.

  --Data sub-channel

  It is used to transmit the reverse data. In the 1xEV-DO system, the data sub-channel can transmit data at five rates: 9.6 kbps, 19.2 kbps, 38.4 kbps, 76.8 kbps, or 153.6 kbps.

4.5 Multi-carrier

The BTS3606A supports multi-carrier technology. The single-carrier cabinet can hold both the single-carrier and multi-carrier modules.

A single-carrier transceiver module (consisting of one CTRM and one CHPA) can process one carrier signal. A multi-carrier transceiver module (consisting of one CMTR and one CMPA) can process three carrier signals. Hence, in a single-carrier cabinet, the adoption of multi-carrier transceiver module can realize the maximum configuration of S(6/6/6), that is, 18 sector carriers.

The multi-carrier module supports the 1900 MHz and 800 MHz. The BTS3606A of later version is expected to supported more bands.

4.6 Receiving Diversity

The BTS3606A supports receiving diversity function. The receiving diversity is realized through two sets of independent receiving equipment, each of which comprises antenna, feeder, CDDU, and main/diversity receiving channels.

The two sets of receiving equipment demodulate the received signals simultaneously. Then the baseband processing unit decodes the signals with diversity combining algorithm so as to provide some diversity gain.

The receiving diversity enhances the anti-attenuation capability of the BTS receiver, and ensures the receiving effect of the BTS under complicated radio environment.

4.7 Cell Breathing

Under the control of the BSC, the BTS3606A adjusts the transmit power to control the effective coverage area and balance the system load as required.

When the BTS3606A provides the cell breathing function, the controllable range of the transmit power is from 0 dB to 24 dB and the adjustment step of transmit power is 0.5 dB.

Chapter 5 Reliability Design

This chapter introduces the system reliability, hardware reliability, and software reliability design of the BTS3606A.

5.1 System Reliability

The system reliability design involves the following aspects:

I. De-rating design

The de-rating design aims to lower the electrical stress and temperature stress on the high-power or heat-generating components to values less than the rated ones. It delays performance degeneration and prolongs the service life of these components.

II. Selection, control, and normalization of components

The category, specifications and manufacturers of the components are carefully selected depending on the requirements of the product reliability and maintainability.

The replaceability and normalization of components is also important in selecting components.

All components are high-quality ones selected through aging test. Strict quality control is implemented on hardware assembling procedures to ensure high reliability and stability in the long run.

III. Thermal design

The thermal design focuses on following items to minimize the impact of temperature changes upon product performance:

- Component selection
- Circuit design
- Mechanical design
- Heat dissipation design

The thermal design of the BTS3606A ensures that it can work reliably in a wide range of temperatures.

IV. EMC design

The EMC design ensures that the ElectroMagnetic Interference (EMI) from other equipment in the same electromagnetic environment does not degrade the performance of the BTS3606A to an unacceptable level. At the same time, the EMI generated by the BTS3606A does not degrade the performance of other equipment in the same electromagnetic environment to an unacceptable level.

V. Redundancy design

For the purpose of reliability, the system is designed with several sets of units performing the same function. The system will not fail unless the number of units failed amounts to the specified quantity.

VI. Reliability design for input voltage

- The system is protected against reverse connection of power supply.
- The input voltage is tested and alarm signal will be generated when the voltage is too low or too high.
- The system is protected against sharp voltage drop and lightning strikes.
- The system can protect program and data in the case of power failure.

VII. Maintainability design

The reasonable internal wiring of the BTS facilitates board replacement. To replace a faulty board, user only needs to remove the cable of this board. The board can be removed and inserted directly from the front of the cabinet.

In addition, board indicators are provided to help users identify board status.

VIII. Fault monitoring and handling

The BTS3606A system can self-detect and diagnose the faults of software and hardware. It can record, output and print various fault information. In addition, it collects environment condition information and generates alarms if there is any problem.

When faults occur to the hardware, the system locates the fault, isolates the faulty component, and automatically carries out switchover to the standby components that operate normally.

The system makes a final confirmation on a hardware fault through repeated detection, thus avoiding the reconfiguration of the system or the degradation of QoS due to contingent faults.

When faults occur to the software, automatic error-correction and recovery functions will be executed, including restarting and reloading.

The network management system records, outputs, and notifies the users of critical faults. In this way, users can operate and maintain the system with ease through maintenance console.

5.2 Hardware Reliability

The hardware reliability design involves the following aspects:

I. Protection against wrong insertion of boards

When a board is inserted into a wrong slot, the special guide pins will prevent the board from touching the backplane. This avoids the possible damage to the equipment owing to wrong insertion.

II. Active-standby switchover of BCKM

The active BCKM can back up the files to the standby BCKM periodically.

Once critical faults occur to the active BCKM, the original standby BCKM will function as the active BCKM to ensure normal operation of the BTS.

III. BCIM backup slots

The BTS3606A has BCIM backup slots. Normally the BCIMs reside in the upper slots. When the upper slots are faulty, the lower slots are used instead.

IV. BCIM/BCKM power supply backup

The power modules of the BCIM and BCKM are mutually backed up. When the power module of one board is faulty, the power module of another board is used instead.

V. N+1 backup for baseband fans

The baseband fans work in the N+1 backup mode. One standby fan is equipped. When one fan is faulty, this standby fan starts working to ensure the performance of the baseband ventilation system.

VI. Link backup of Abis interface

The BTS3606A supports the Abis interface link backup function to improve the reliability of links. When the backup link is configured, if the active link is faulty, the system can automatically carry out the active-standby link switchover.

VII. CE pool design of the CCPM

The CCPM adopts the CE pool design. The CCPMs are connected into a daisy chain, which increases the utilization rate of the channel resource and enables flexible configuration of the channel capacity of each sector carrier. This enhances the reliability of the system.

VIII. Status monitoring and alarm report

The BCKM can monitor the status of other boards or modules, and report alarms to ensure timely fault location.

IX. Distributed power supply

The system adopts distributed power supply. The DC/DC power supply module works in the N+1 redundancy mode.

When an error occurs to a module, an alarm is generated and sent to the BAM. The system also supports online insertion and removal of boards.

5.3 Software Reliability

The software reliability design involves the following aspects:

I. Periodic check of key resources

This function aims to check the software resource which has been occupied for a long time. If certain resource becomes unavailable owing to software error, the check mechanism will release that resource and output logs and alarms.

II. Process monitoring

Process monitoring provides channel for outputting various software and hardware faults while the software is running. It can monitor the running status of a specific task or system, and report the information to the outside.

III. Data check

Data check consists of the following contents:

- Check the data consistency of different processing boards, restore the data, and output logs and alarms.
- Check the consistency of the data input by the user to ensure correct reference relation among data.
- Use the rollback function to restore the data to the initial state when the modification of some data fails at a certain point.

IV. Fault isolation

In the BTS3606A, when a fault occurs to one software module, other software modules can run normally.

The software also has the fault tolerance and correction functions. The minor operation exceptions will not cause the reset or reboot of the system.

V. Reversible upgrade

The system provides such function as program and data restoration. When the upgrade fails, the function helps restore to the original program and data configuration.

VI. Log function

The operation and maintenance software can automatically record user's operations and save them into a log file.

When an unknown error occurs to the system, log files can help to find out the status in the normal condition for fault location or data restoration.

Chapter 6 Operation and Maintenance System

The operation and maintenance system covers the local operation and maintenance system, and the M2000 Mobile Integrated Network Management System (hereafter briefed as M2000 system).

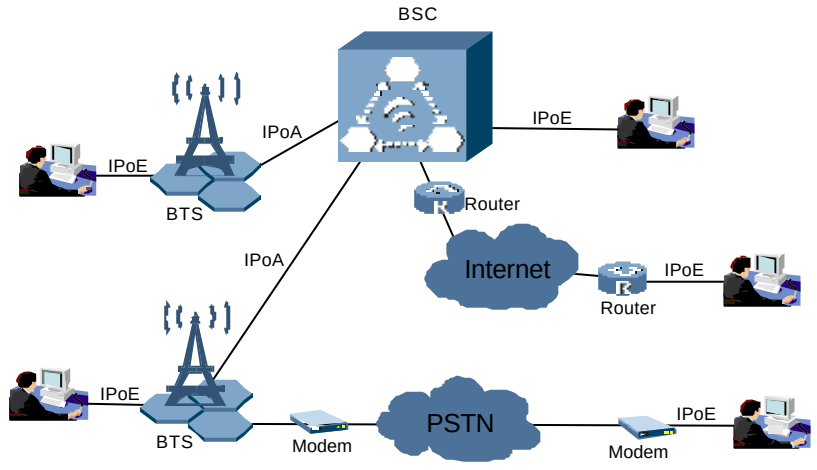
This chapter introduces how to perform the local and remote maintenance through the local operation and maintenance system.

This chapter also briefs the basic structure and functions of the M2000 system. The details information of the M2000 system is available in the related manuals of M2000.

6.1 Structure of the Operation and Maintenance System

6.1.1 Local Operation and Maintenance System

Figure 6-1 shows the structure of the BSS/AN local operation and maintenance system.



IPOA : IP over ATM IPOE: IP over Ethernet

Figure 6-1 BSS/AN local operation and maintenance system

I. Far-end maintenance

The Local Maintenance Terminal (LMT) connects to the BSC BAM to realize the far-end maintenance on BTS.

The local operation and maintenance system of the BSS is designed in Client/Server (C/S) structure, where LMT is a Client and BAM a Server. The operation procedure is as follows:

1) The user inputs operation commands through the LMT.
2) The BAM processes commands from LMTs.

3) After processing, the BAM sends these commands to the host (BSC or BTS) and then waits for the response.
4) The BAM records the operation results (such as success, failure, timeout, or abnormality) and sends the results to the LMT in a specified format.

Users can also use the BAM to manage the BTSs under its control and carry out network planning in a centralized way.

II. Remote maintenance

The LMT visits the BTS by dialing up on the Modem to realize the remote maintenance.

When maintenance engineers cannot perform far-end maintenance owing to some cause (for example, the IPOA maintenance channel is faulty), they can use the remote maintenance method to maintain the BTS.

III. Near-end maintenance

In the BTS equipment room, the LMT connects to the BTS through network cables to realize the near-end maintenance.

Users can log in to the BTS through Telnet Client and execute the MML command to maintain the BTS.

User can also employ the reverse maintenance function to log in to the BAM from the BTS to realize the maintenance of the whole BSS.

6.1.2 Mobile Integrated Network Management System

The M2000 system implements the centralized maintenance function. In this system, the M2000 server is the core. Various mobile network elements (such as BSC, MSC, and HLR) connect to the M2000 system through Local Area Network (LAN) or Wide Area Network (WAN).

The BSC connects to the M2000 system through the BAM.

Figure 6-2 shows the typical networking of the M2000 mobile integrated network management system.

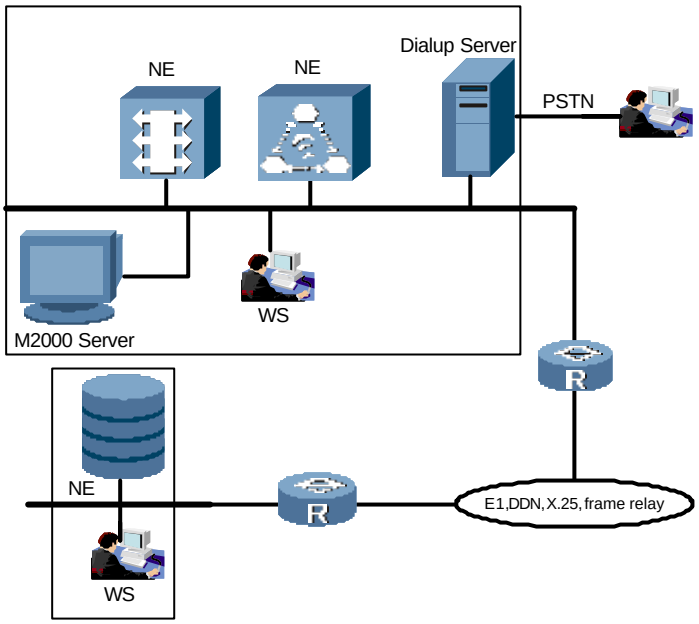


Figure 6-2 Networking of M2000 mobile integrated network management system

The M2000 system completes the configuration management, performance management, and fault management.

- Configuration management. Collect, store, query, and modify the data of NE equipment in the network.
- Performance management. Users can register the traffic measurement tasks of the NEs on the Client, and view the execution results of the traffic measurement tasks registered on the whole network.
- Fault management. Users can set combined conditions to get the required alarm data of the NEs from the Alarm Client, view the results, and perform related operations

6.2 Operation and Maintenance Function

The BTS3606A provides powerful operation and maintenance functions.

I. Security management

To prevent illegal operation, the system provides powerful security management function to manage and control user's operation and operating equipment.

The user needs to log in for authentication before operating the BTS3606A.The system provides multi-level authority mechanism so that only the authorized user can use specified command sets.

The timeout locking function is provided. When the user does not operate the system for a specific period of time, the system will automatically lock the screen. User needs to enter the right password to go on with the operation.

Before the execution of important commands, the system will show the possible execution results and prompt the user for confirmation.

II. Alarm management

The system performs centralized management over the alarms of the BSC and the BTS. The BSS Maintenance Console provides real-time alarm management function:

- Collect alarms
- Clear alarms
- Query alarms
- Handle alarms
- Save alarms
- Interpret alarms
- Prompt alarms
- Shield alarms
- Filter alarms
- Acknowledge alarms
- Analyze alarms

In addition, the alarm management system provides online help and hierarchical filtering to help locate faults and provide alarm recovery method.

While reporting alarms, the BTS3606A drives status indicators and alarm box to provide audible and visual alarms.

III. Loading management

The loading management allows the loading of the software and the configuration data.

Software loading involves the downloading and activation of the Central Processing Unit (CPU) software and the Field Programmable Gate Array (FPGA) logic.

Configuration data loading includes both the downloading and uploading of configuration data.

IV. Configuration management

The configuration management is to configure BTS equipment and radio resources. It also enables the user to query the configuration data and check data consistency.

Both online and offline configuration functions are provided with batch processing function for data configuration.

V. Equipment management

The equipment management is to monitor and query the status of the board and the system, so that users can learn the running status of the system timely. It also provides users with operation log and system running log to facilitate fault location and clearing.

The equipment management function includes:

- Version query
- Status query
- Electronic label query
- Log management
- Equipment reset
- Resource blocking/unblocking
- Power supply management

VI. Test management

The test management facilitates fault location and the optimization of system performance. The tests include board loopback test, self-detection test, and Abis link test.

VII. Tracing management

The tracing management aims to help the fault location and performance measurement analysis. The traced objects include various interfaces and indices.

Some indices (such as CPU load, board temperature, BTRM transmit power, and receive signal strength indicator) can be displayed in graphics on real-time basis.

Chapter 7 Technical Specifications

This chapter provides the engineering specifications, protection specification, capacity specifications, and performance specifications of the BTS3606A.

7.1 Structure and Environment Specifications

The structure and environment specifications include cabinet dimensions, weight, power, ambient temperature, and relative humidity.

Cabinet dimensions		1700 mm x 1200 mm x 1000 mm (Height×Width×Depth)
Power supply		220/230/240V AC: Single-phase/three-phase input Voltage range: 176 V to 264 V Frequency range: 47 Hz to 63 Hz Over-voltage protection when the voltage reaches 290V.
		110/115/127V AC: Single-phase/three-phase input Voltage range: 90 V to 135 V Frequency range: 47 Hz to 63 Hz Under-voltage protection when the voltage reaches 85V.
Cabinet weight		650 kg (excluding the batteries and the built-in transmission equipment)
Power consumption (in full configuration)	**Air conditioner**	6100 W (with air conditioner set to cooling function, and without battery cabinet) 11000 W (with air conditioner set to cooling function, and with battery cabinet) 6000 W (with air conditioner set to heating function, and without battery recharging considered)
	Heat exchanger	4500W (without battery cabinet) 9500W (with battery cabinet) 6000W (heating, without recharging)
Operating ambient temperature	**Air conditioner**	-40°C to 55°C
	Heat exchanger	-40°C to 45°C
Relative humidity		5% to 100%
Noise		≤ 65 dBA (The noise varies with the ambient temperature)
Reliability		Availability ≥ 99.999%
		MTBF:≥ 100000 hours
		MTTR: ≤ 1 hour (excluding the time spent on the journey) MTTR: ≤3 hours (including the time spent on the journey)

7.2 Capacity Specifications

The maximum capacity of one BTS3606A is six sector carriers. With the multi-carrier modules, the capacity can reach 18 sector carriers.

The BTS3606A supports two types of channel processing boards: CCPM and CECM. The CCPM supports the CDMA2000 1x protocols, whereas the CECM supports the CDMA2000 1xEV-DO protocols.

I. CDMA2000 1x capacity

The BTS capacity is given according to the number of sector carriers configured. One sector carrier can serve about 20 IS95 subscribers or about 40 CDMA2000 1x subscribers.

The maximum reverse channel capacity of one carrier (three sectors) is 128 channels.

II. CDMA2000 1xEV-DO capacity

The BTS capacity is given according to the number of sector carriers configured. One sector carrier can serve up to 48 subscribers.

The maximum reverse channel capacity of one carrier (three sectors) is 96 channels.

7.3 Transmitter and Receiver Specifications

This section provides the specifications of the BTS3606A transmitter and receiver at different bands.

7.3.1 Transmitter and Receiver Specifications at 450 MHz Band

This following lists the BTS3606A transmitter and receiver specifications when the BTS3606A works at the 450 MHz band.

I. Transmitter specifications

Working band	460 MHz to 467 MHz
Channel bandwidth	1.23 MHz
Channel precision	25 kHz, 20 kHz
Frequency tolerance	$\leqslant \pm 0.05$ ppm
Transmit power	25 W (the maximum value measured at the feeder port on the top of the cabinet)

II. Receiver specifications

Working band	450 MHz to 457 MHz
Channel bandwidth	1.23 MHz
Channel precision	25 kHz, 20 kHz
Sensitivity of signal receiver	Better than -127 dBm (RC3, main and diversity receiving)

7.3.2 Transmitter and Receiver Specifications at 800 MHz Band

This following lists the BTS3606A transmitter and receiver specifications when the BTS3606A works at the 800 MHz band.

I. Transmitter specifications

Working band	869 MHz to 894 MHz
Channel bandwidth	1.23 MHz
Channel precision	30 kHz
Frequency tolerance	$\leqslant \pm 0.05$ ppm
Transmit power	Single-carrier: 25 W (the maximum value measured at the feeder port on the top of the cabinet) Multi-carrier: 50 W (measured on the top of the cabinet)

II. Receiver specifications

Working band	824 MHz to 849 MHz
Channel bandwidth	1.23 MHz
Channel precision	30 kHz
Sensitivity of signal receiver	Single-carrier: Better than -127 dBm (RC3, main and diversity receiving) Multi-carrier: Better than -126 dBm (RC3, main and diversity receiving)

7.3.3 Transmitter and Receiver Specifications at 1900 MHz Band

This following lists the BTS3606A transmitter and receiver specifications when the BTS3606A works at the 1900 MHz band.

I. Transmitter specifications

Working band	1930 MHz to 1990 MHz
Channel bandwidth	1.23 MHz
Channel precision	50 kHz
Frequency tolerance	$\leqslant \pm 0.05$ ppm
Transmit power	Single-carrier: 25 W (the maximum value measured at the feeder port on the top of the cabinet) Multi-carrier: 40 W (measured on the top of the cabinet)

II. Receiver specifications

Working band	1850 MHz to 1910 MHz
Channel bandwidth	1.23 MHz
Channel precision	50 kHz
Sensitivity of signal receiver	Single-carrier: Better than -127 dBm (RC3, main and diversity receiving) Multi-carrier: Better than -126 dBm (RC3, main and diversity receiving)

7.4 Specifications for ODU3601C Cascading

The following lists the related specifications when the BTS3606A connects to the ODU3601C.

CDMA2000 1x	Maximum distance of single cascading	10 km, 70 km (corresponding to two types of CCPM)
	Maximum number of cascading levels	3
	Maximum total distance after cascading	90 km
1xEV-DO	Maximum distance of single cascading	10 km
	Maximum number of cascading levels	3
	Maximum total distance after cascading	10 km

Chapter 8 Technical Standards

8.1 General Technical Specifications

The BTS3606A is compliance with the following general technical specifications:

- TIA/EIA-97-D: Recommended Minimum Performance Standards for Base Stations Supporting Dual-mode Spread Spectrum Mobile Stations.
- Federal IMT-MC (CDMA 2000) Cellular Mobile System Operating in Band 450 MHZ.
- C.S0032-0V1.0 Recommended Minimum Performance Standards for CDMA2000 High Rate Packet Data Access Network
- C.S0039-0V1.0 Enhanced Subscriber Privacy for CDMA2000 High Rate Packet Data
- C.S0038-0V1.0 Signaling Conformance Specification for High Rate Packet Data Air Interface

8.2 Um Interface

The BTS3606A is compliance with the following Um interface specifications:

I. Physical layer

TIA/EIA IS-2000-2-A: Physical Layer Standard for CDMA 1X Standards for Spread Spectrum Systems.

C.S0024-0V4.0 CDMA2000 High Rate Packet Data Air Interface Specifications

II. MAC layer

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

III. Service capability

TSB2000: Capabilities Requirements Mapping for CDMA 1X Standards.

8.3 Abis Interface

The BTS3606A is compliance with the following Abis interface specifications:

I. Physical layer

- E1 interface:

  E1 Physical Interface Specification, September 1996
- 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.

- ATM

  AF-PHY-0086.001: Inverse Multiplexing for ATM (IMA) Specification Version 1.1.

  ATM Forum af-phy-0064.000.

  STR-PHY-FN64-01.00: ATM on Fractional E1/T1.

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 CDMA 1X Spread Spectrum System.

VI. Self-defined standard: CDMA 1X Abis interface high layer protocol

8.4 Lightning Protection

The BTS3606A is compliance with the following lightning protection standards:

- 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 Overvoltage and Overcurrent.

- 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 centres.

8.5 Safety

The BTS3606A is compliance with the following safety requirements:

- GB4943-2000: Safety of information technology equipment.
- 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).
- GOST 30631-99. General Requirements to machines, instruments and other industrial articles on stability to external mechanical impacts while operating.
- GOST R 50829-95. Safety of radio stations, radio electronic equipment using transceivers and their components. The general requirements and test methods.
- GOST 12.2.007.0-75. Electrotechnical devices. The general safety requirements.

8.6 EMC

The BTS3606A is compliance with the following EMC standards:

- TS 25.105; 3rd Generation Partnership Project; TSG RAN WG4; UTRA (BS) TDD: Radio transmission and reception89/336/EEC EMC directive Council directive of 3 May 1989 on approximation of laws of the Member States relating to electromagnetic compatibility.
- CISPR 22 (1997): Limits and methods of measurement of radio disturbance characteristics of information technology equipment.
- IEC 61000-6-1: 1997: Electromagnetic compatibility (EMC) - Part 6: Generic standards - Section 1: Immunity for residential, commercial and light-industrial environments.
- IEC 61000-6-3: 1996: Electromagnetic compatibility (EMC) - Part 6: Generic standards - Section 3: mission standard for residential, commercial and light industrial environments.
- IEC 61000-3-2 (1995): Electromagnetic compatibility (EMC) - Part 3: Limits - Section 2: Limits for harmonic current emissions (equipment input current = 16 A).

- IEC 61000-3-3 (1995): Electromagnetic compatibility (EMC) - Part 3: Limits - Section 3: Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current = 16 A.
- IEC 61000-4-2 (1995): Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 2: Electrostatic discharge immunity test.
- IEC 61000-4-3 (1995): Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 3: Radiated, radio-frequency electromagnetic field immunity test.
- IEC 61000-4-4 (1995): Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 4: Electrical fast transient/burst immunity test.
- IEC 61000-4-5 (1995): Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 5: Surge immunity test.
- IEC 61000-4-6 (1996): Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 6: Immunity to contacted disturbances, induced by radio frequency fields.
- IEC 61000-4-11 (1994): Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 11: Voltage dips, short interruptions and voltage variations. Immunity tests.
- ITU-T Recommendation K.20: Resistibility of Telecommunication Switching Equipment to Overvoltages and Overcurrents.
- CFR 47, FCC Part 15: Radio Frequency Device.
- 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.
- GOST R 51318.22-99: Electromagnetic compatibility of technical equipment. Man-made noise from informational equipment. Limits and test methods.
- GOST 30429-96: Electromagnetic compatibility of technical equipment. Man-made noise from equipment and apparatus used together with service receiver systems of civil application. Limits and test methods.

8.7 Environment

The BTS3606A is compliance with the following environment requirements:

- GB4208 Degrees of protection provided by enclosure (IP code).
- GB4798 Environmental conditions for electrician and electronic products application.
- IEC 60529 "Degrees of protection provided by enclosure (IP code)"
- IEC 60721-3-1: Classification of environmental conditions- Part3: Classification of groups of environmental parameters and their severities-Section 1: Storage.
- IEC 60721-3-2: Classification of environmental conditions- Part3: Classification of groups of environmental parameters and their severities-Section 2: Transportation.

- IEC 60721-3-3 (1994): Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Section 3: Stationary use at weather protected locations.
- IEC 60721-3-4 (1995): Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Section 4: Stationary use at non-weather protected locations.
- ETS 300 019-2-1: Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 2-1, Specification of environmental tests Storage.
- ETS 300 019-2-2: Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 2-2, Specification of environmental tests Transportation.
- ETS 300 019-2-3: Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 2-3, Specification of environmental tests Transportation Stationary use at weather-protected locations.
- ETS 300 019-2-3: Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 2-3, Specification of environmental tests Transportation Stationary use at non-weather-protected locations.
- IEC 60068-2-1 (1990): Environmental testing - Part 2: Tests. Tests A: Cold.
- IEC 60068-2-2 (1974): Environmental testing - Part 2: Tests. Tests B: Dry heat.
- IEC 60068-2-6 (1995): Environmental testing - Part 2: Tests - Test Fc: Vibration (sinusoidal).
- GOST 15150-69: Machines, instruments and other industrial articles. Applications for different climatic regions. Categories, operating, storage and transportation conditions in compliance with the environmental factors.
- GOST 23088-80: Electronic equipment. Requirements to packing and transportation and test methods.

Chapter 9 Abbreviations and Acronyms

#	
1xEV-DO	Single 1.25MHz carrier Evolution - Data Optimized
1xEV-DV	Single 1.25MHz carrier Evolution - Data and Voice
3GPP2	3rd Generation Partnership Project 2
A	
AAA	Authorization, Authentication and Accounting
AC	Alternating Current
ACK	Acknowledgement
AN	Access Network
AT	Access Terminal
ATM	Asynchronous Transfer Mode
B	
BAM	Back Administration Module
BCIM	BTS Control Interface Module
BCKM	BTS Clock Module
BS	Base Station
BSC	Base Station Controller
BSS	Base Station Subsystem
C	
CC	Control Channel
CCPM	Compact-BTS Channel Process Module
CDMA	Code Division Multiple Access
CDDU	Compact-BTS Dual Duplexer Unit
CECM	Compact-BTS EVDO Channel Module
CFMM	Compact-BTS Fan Monitor Module
CHPA	Compact-BTS High power Amplifier
CIFM	Compact-BTS Intermediate Frequency Module
CN	Core Network
CPBM	Compact-BTS Power Backplane Module

CPU	Center Processing Unit
CRCM	Compact-BTS Radio Up-Down Convert Module
CSLM	Compact-BTS Serial port Lightning proof Module
CTBM	Compact-BTS Transceiver Backplane Module
CTRM	Compact-BTS Transceiver Module
D	
DC	Direct Current
DRC	Data Rate Control
E	
EIA	Electronics Industry Association
EIB	Erasure Indicator Bit
F	
F-CCCH	Forward Common Control Channel
F-DCCH	Forward Dedicated Control Channel
F-FCH	Forward Fundamental Channel
F-PCH	Forward Paging Channel
FPGA	Field Programmable Gate Array
F-PICH	Forward Pilot Channel
F-QPCH	Forward Quick Paging Channel
F-SCH	Forward Supplemental Channel
F-SYNCH	Forward Sync Channel
G	
GLONASS	Global Navigation Satellite System
GMSC	Gateway Mobile Switching Center
GPS	Global Positioning System
GSM	Global System for Mobile Communications
H	
HA	Home Agent
HLR	Home Location Register
HPSK	Hybrid Phase Shift Keying
I	
IMA	Inverse Multiplexing for ATM
IPOA	Internet Protocols over ATM

ISDN	Integrated Services Digital Network
L	
LMT	Local Maintenance Terminal
LNA	Low Noise Amplifier
M	
MAC	Media Access Control
MIP	Mobile Internet Protocol
MML	Man-Machine Language
MS	Mobile Station
MSC	Mobile Switching Center
MTBF	Mean Time Between Failures
MTTR	Mean Time To Repair
O	
ODU	OutDoor Unit
OML	Operation & Maintenance Link
P	
PCF	Packet Control Function
PDSN	Packet Data Service Node
PLMN	Public Land Mobile Network
PMRM	Power Measurement Report Message
PP2S	Pulses Per 2 Seconds
PPP	Peer-to-Peer Protocol
PSK	Phase Shift Keying
PSTN	Public Switched Telephone Network
PSU	Power Supply Unit
PSUDC	DC/DC Power Supply Unit
PTT	Push To Talk
Q	
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
R	
RA	Reverse Activity
RAB	Reverse Activity Bit

R-ACH	Reverse Access Channel
RC	Radio Configuration
R-DCCH	Reverse Dedicated Control Channel
R-EACH	Reverse Enhanced Access Channel
R-FCH	Reverse Fundamental Channel
RLDU	Receive LNA Distribution Unit
R-P	Radio-Packet
RPC	Reverse Power Control
RRI	Reverse Rate Indicator
R-SCH	Reverse Supplemental Channel
T	
TDM	Time Division Multiplexing
TIA	Telecommunications Industry Association
U	
UNI	User Network Interface