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 1X (CDMA 1X) technology, advocated by the 3rd Generation Partnership Project 2 (3GPP2), has been widely used for commercial purpose.

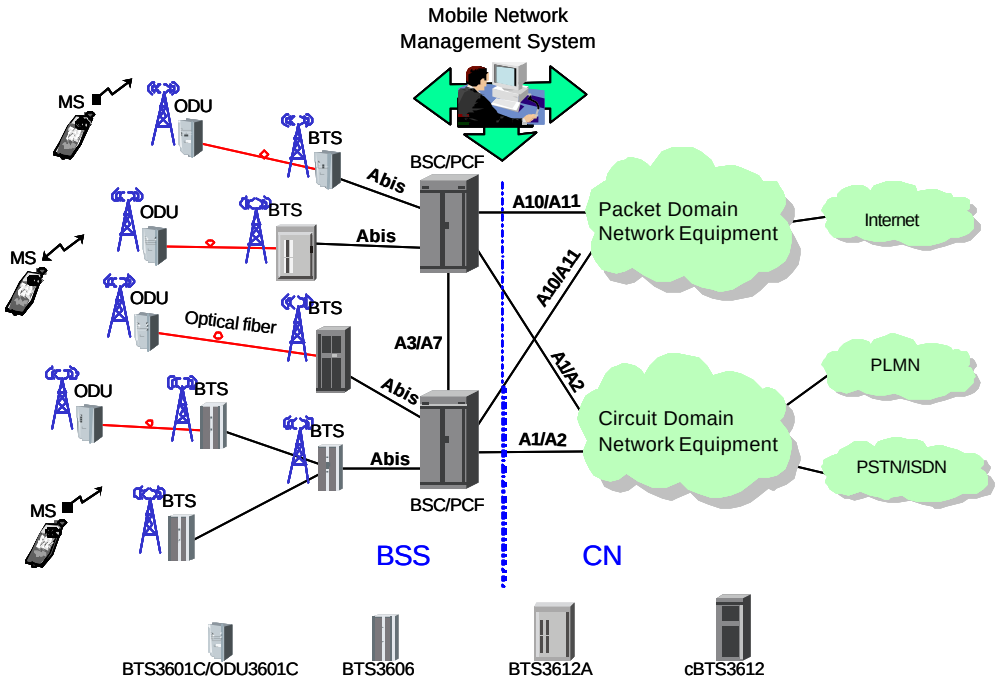
The CDMA 1X technology complies with IS-95A and IS-95B standards. The capacity of the CDMA 1X system has increased substantially because it adopts such technologies as reverse pilot, fast power control and transmit diversity.

This chapter first introduces the network solution of Huawei CDMA 1X mobile communication system, and then the market position of Huawei indoor BTS3606.

1.1 Network Solution of Huawei CDMA 1X System

The Huawei CDMA 1X mobile communication system comprises the Base Station Subsystem (BSS) and the Core Network (CN). Users can operate and maintain the system through an integrated mobile network management system.

Figure 1-1 shows the network of Huawei CDMA 1X system. This manual aims to introduce the Base Transceiver Station (BTS) of the BSS, thus, the following figure emphasizes the network structure of BSS.



MS: Mobile Station
BSC: Base Station Controller
PCF: Packet Control Function
CN: Core Network
PSTN: Public Service Telephone Network

BTS: Base Transceiver Station
ODU: Out Door Unit
BSS: Base Station Subsystem
PLMN: Public Land Mobile Network
ISDN: Integrated Service Digital Network

Figure 1-1 Network structure of Huawei CDMA 1X system

Note:

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

1.1.1 Brief Introduction to BSS

The BSS consists of the BTS, Base Station Controller (BSC), and Packet Control Function (PCF). The PCF is usually integrated with the BSC. The ODU3601C, a soft site, is also a part of the Huawei BSS.

I. BTS

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

- cBTS3612: Indoor BTS equipment. The maximum capacity of a single cabinet is 4 carriers and 3 sectors or 2 carriers and 6 sectors.

- BTS3606: Indoor BTS equipment developed based on the cBTS3612. The maximum capacity of a single cabinet is 2 carriers and 3 sectors.
- BTS3612A: Outdoor BTS equipment developed based on the cBTS3612. The maximum capacity of a single cabinet is 2 carriers and 3 sectors.
- BTS3601C: Outdoor one-carrier BTS equipment.
- ODU3601C: Outdoor one-carrier Soft equipment. It shares the baseband processing resource of its upper-level BTS. It also transmits and receives the radio signal 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 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

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

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

1.2 Position of BTS3606

The following presents the position of the BTS3606.

I. Position in the network

The BTS3606 is located between the BSC and the MS in the CDMA 1X system. Under the control of the BSC, the BTS3606 is the radio transceiver equipment serving one cell or multiple logical sectors.

Connecting with the BSC through the Abis interface, the BTS3606 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 indoor BTS3606 supports multi-cell configuration.

A single cabinet can supports three sectors, each of which can support at most two carriers.

The indoor BTS3606 has the following features:

- Moderate capacity
- Small size
- Easy installation
- Flexible coverage

The BTS3606 is suitable for the networking in the area with moderate traffic.

Complying with IS-95A/B and CDMA 1X, the BTS3606 is compatible with other CDMA BTS products of Huawei.

Chapter 2 Product Features

The BTS3606 is designed in consideration of customers' requirements for service, capacity, coverage, transmission, power supply, installation and maintenance. It adopts integrated design, which shows the customer-oriented service idea of Huawei.

2.1 Technical Features

I. The BTS3606 is designed with advanced architecture for the CDMA 1X EV-DO.

II. The adoption of the Channel Element (CE) pool improves the availability of the hardware resources and the error tolerance capability of the system.

III. The digital intermediate frequency technology enhances the signal processing capability.

IV. Intelligent control for the fan prolongs the service life and reduces noises.

V. It also supports inband adaptive filtering anti-interference.

VI. The BTS3606 can be cascaded with the ODU3601C to expand the coverage area of radio network flexibly.

VII. It can support bands of 450 MHz, 800 MHz, and 1900 MHz.

2.2 Large-scale Coverage

The BTS3606 can cover a wide area thanks to its excellent performance of transceiving.

I. Receiving sensitivity

The main/diversity receiving technology is employed to optimize the receiving performance. Upon RC3, the receiving sensitivity of the BTS3606 is better than -127 dBm.

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

The maximum average transmit power is 25 W.

After the high-power combiner is configured, the maximum average transmit power can reach 50 W.

III. ODU3601C cascading

When the BTS3606 is cascaded with the ODU3601C through optical fibers, the coverage area of the signals can be effectively spread.

2.3 Flexible Networking Mode

I. Networking interfaces

The BTS3606 supports the networking by using E1 and T1 links, and the interfaces of Inverse Multiplexing for ATM (IMA) and User Network Interface (UNI). The multiplexing rate on the Abis interface is greatly increased.

II. Networking modes

The BTS3606 supports networking modes in chain, star, and tree topologies.

It 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 ATM over Fractional E1/T1 mode.

III. Clock source

The BTS3606 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 BTS3606 can still keep clock synchronization for 24 hours when the external clock source signal is lost.

2.4 Convenient Operation and Maintenance

Users can operate and maintain the BTS3606 through the Local Maintenance Terminal (LMT) and the M2000 integrated maintenance console.

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 indication.

II. Data configuration

The BTS3606 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 covers:

- 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 crucial operation
- User group management
- Timeout locking

V. Test

The BTS3606 supports 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 BTS3606.

VII. Upgrade

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

Auto loading function is provided. When a board needs replacing, if the version of the new board is later than that of the old one, auto loading function can be used to upgrade the software for the new board.

VIII. Equipment operation

The BTS3606 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 BTS3606 is out of service owing to power failure or transmission faults, 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 Easy Upgrade and Expansion

I. Compatibility design

The BTS3606 is compatible with IS-95A/B and CDMA 1X. It can be upgraded to CDMA 1xEV-DO smoothly. Huawei BTS3606 saves the operators' investment when the network is upgraded from IS-95 to CDMA 1X, or from CDMA 1X to CDMA 1xEV-DO.

II. Flexible configuration

The BTS3606 supports the configuration of omni cell or three sectors.

It can be cascaded with ODU3601C.

The BTS3606 can realize flexible coverage through multi-cell configuration.

III. Smooth expansion

The modular structure allows the BTS3606 to be expanded simply by adding modules.

2.6 Serial Products for Seamless Coverage

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

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
cBTS3612	12	Large	Highly populated area and city.	Indoor
BTS3606	6	Medium	Medium and small cities, towns. Low requirement for equipment room.	Indoor
BTS3612A	6	Medium	Heavy traffic and limited equipment room space	Outdoor
BTS3601C	1	Small	Indoor, underground, highway and railroad.	Outdoor (also applicable to the indoor condition)
ODU3601C	1	Small	Indoor, underground, highway and railroad.	Outdoor (also applicable to the indoor condition)

Chapter 3 Product Architecture

3.1 Appearance and Configuration

3.1.1 Cabinet Appearance

I. Appearance

The BTS3606 cabinet is designed in conformity to the IEC297 standard.

The outer dimensions are 1400 mm × 600 mm × 650 mm (Height × Width × Depth).

Figure 3-1 shows the BTS3606 cabinet.

Figure 3-1 BTS3606 cabinet

II. Feature

The BTS3606 cabinet has the following features:

- 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

3.1.2 Cabinet Configuration

The BTS3606 cabinet is configured with CDDU, combined subrack, power supply subrack, switch box, fan box, cable trough, and tool kit. The combined subrack is designed for installing CTRM/CHPA and baseband boards.

The maximum capacity of a single BTS3606 cabinet is two carriers and three sectors, as shown in Figure 3-2.

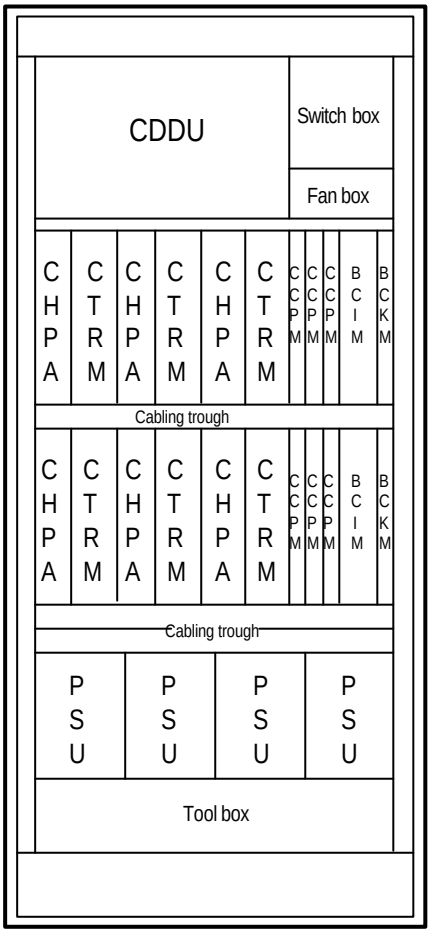


Figure 3-2 A fully-equipped BTS3606 cabinet

Table 3-1 lists the boards and modules of the BTS3606.

Table 3-1 Boards and modules of the BTS3606

Acronyms	Full name
BCIM	BTS Control Interface Module
BCKM	BTS Control and Clock Module
CCPM	Compact BTS Channel Process Module

Acronyms	Full name
CDDU	Compact-BTS Dual Duplexer Unit
CFMM	Compact-BTS Fan Monitor Module
CHPA	Compact-BTS High power Amplifier
CPCM	Compact-BTS Power Combination Module
CSLM	Compact-BTS Serial port Lightningproof Module
CTRM	Compact-BTS Transceiver Module
HPCM	Compact-BTS High Precision Clock Module
PSU	Power Supply Unit

3.2 System Structure

The BTS3606 system consists of baseband subsystem, Radio Frequency (RF) subsystem, power supply subsystem, and antenna and feeder subsystem, as shown in Figure 3-3.

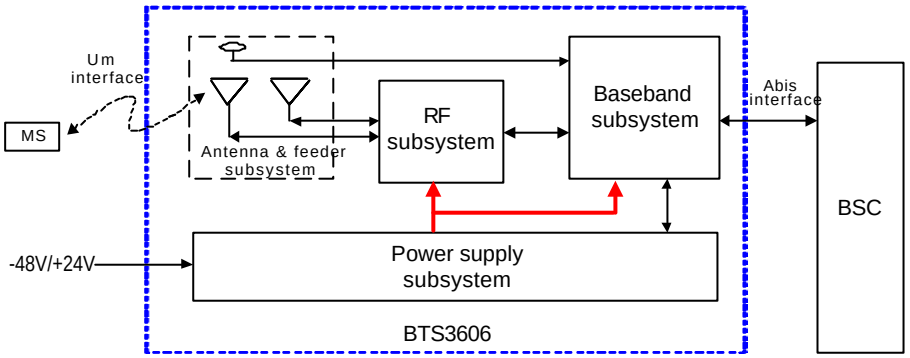


Figure 3-3 BTS3606 system structure

3.2.1 Baseband Subsystem

The baseband subsystem comprises the BCKM, the BCIM, and the CCPM. It can

- Provide Abis interface and process the Abis interface protocol.
- Provide a fiber interface to the RF subsystem, and process the Um physical layer and Common Channel (CCH) MAC layer protocols.
- Implement modulation/demodulation of 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.

3.2.2 RF Subsystem

The RF subsystem consists of the BTRM, the BHPA, the CDDU, and the CPCM. It performs the different functions in different directions:

I. In forward direction, the RF subsystem performs the following functions:

- Perform power-adjustable up-conversion.
- Implement linear power amplification.
- Complete power synthesis (optional).
- Filter the modulated transmission signals.
- Send the signals to the antenna & feeder subsystem.

II. In reverse direction, the RF subsystem performs the following functions:

- Filter the signals received by the antenna to suppress out-band interference.
- Fulfill low-noise amplification.
- Perform division.
- Implement noise factor–adjustable down-conversion.
- Perform channel-selective filtering.
- Send the signals to the baseband subsystem.

3.2.3 Antenna and Feeder Subsystem

The antenna and feeder subsystem of the BTS3606 includes two parts: the RF part and the satellite synchronization part.

- RF antenna and feeder

  This part covers the transmitting and receiving antennas, and feeders. It transmits and receives signals on the air interface.

- Satellite synchronization antenna and feeder

  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.

3.2.4 Power Supply Subsystem

When the -48V DC input is employed, the power supply subsystem comprises:

- Power Supply Unit (PSU)
- Power distribution unit
- Lightning protection unit

- Monitoring unit

The PSU is a DC/DC power supply with -48V DC input and +27V DC output.

The power supply subsystem has the following features:

- Current equalizing
- Hot backup
- Centralized management
- Distributed power supply

These features improve the security and reliability of the power system.

When the +24V DC input is adopted, there is no need to configure the PSU for the power supply subsystem.

3.3 Physical Interface

The BTS3606 provides the following physical interfaces.

Table 3-2 Physical interfaces on the BTS3606

Interface	Type	Quantity	Function
Abis interface	E1	8	Connect to the transmission system that connects to the BSC. Support IMA/UNI and cascading. When E1 is adopted, 75Ω and 120Ω load interfaces are available. When T1 is adopted, the 100Ω load interface is available.
	T1		
ODU3601C cascading interface	Optical fiber	8	Each CCPM provides two optical interfaces. When the BTS3606 needs to be cascaded with ODU3601C, it can be cascaded with a maximum of three ODU3601Cs.
Clock interface	GPS/GLONASS	2	Provide reliable and stable clock signal.
	External synchronization clock input	1	Provide high-precision clock.
Maintenance interface	Ethernet interface	1	Provide local maintenance path.
Power supply and Protection Ground (PGND)	Power supply	1	Provide -48V/+24V DC power input
	PGND	1	Provide lightning protection for the BTS.
Monitoring interface	Environment monitoring interface	1	Connect to the environment monitor.
Antenna feeder interface	RF signal	6	Correspond to three sectors. Each sector corresponds to two DIN connectors, which can be used for both transmitting and receiving.

Chapter 4 Main Functions

The Um interface of the BTS3606 supports the TIA/EIA IS-2000 Rel.A standard. It is compatible with the TIA/EIA-95-A/B standard. The minimum performance satisfies TIA/EIA-97-D requirements.

The Abis interface complies with the 3GPP2 A.R0003 standard.

4.1 Power 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 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.

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.

I. Forward power control

Several methods can be applied 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 in accordance with 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 through 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 bit/s.

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

The forward fast power control can control the transmit power of forward channel accurately, reducing interference and improving the capacity.

II. Reverse power control

Reverse power control includes open-loop power control and close-loop power control. The close-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 received pilot signal strength.

- Close-loop power control

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

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

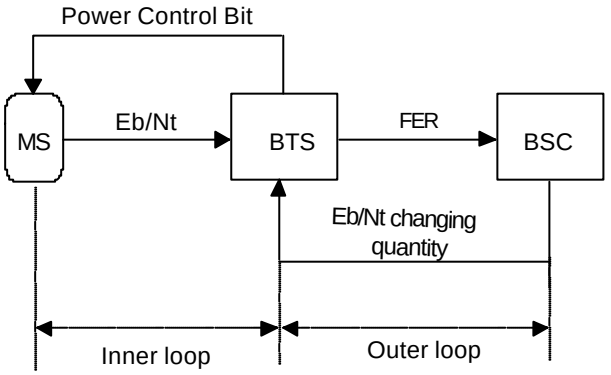


Figure 4-1 Close-loop power control

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

In the outer-loop power control mode, the BSC adjusts the Eb/Nt setting 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.

4.2 Handoff

When the MS 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 MS handoff helps to improve conversation quality and network performance, it is also possible to trigger the handoff procedure.

I. Soft handoff

The soft handoff happens between adjacent 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 adjacent sectors that serve on the same frequency and belong to the same BTS. In fact, 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. Hard handoff

In the hard handoff procedure, the MS firstly interrupts the connection with the previous cell, and then set 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 BTS3606 supports CDMA 1X. It is compatible with IS-95A/B standards. The spreading rate is 1.2288 Mcps.

The CDMA 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 BTS3606 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 CDMA 1X system varies with RCs. For example, the CDMA 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 include different types according to the channel features. Different RCs support different channels.

I. Forward channel

1) Forward Common Channel

- Forward Pilot Channel (F-PICH): It provides synchronization signals to the MSs working 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 working in the BTS coverage.
- Forward Paging Channel (F-PCH): It sends the system information and MS-specific message to the MSs working 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. Thus the MS battery energy can be saved.

2) Forward Dedicated Channel

- 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

1) Reverse Common Channel

Reverse Access Channel (R-ACH): The MS uses this channel to initiate the communication 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.

2) Reverse Dedicated Channel

- 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.

4.5 Receiving Diversity

The BTS3606 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.

4.6 Cell Breathing

The BTS3606 can control the coverage of a cell and balance the system load by adjusting the transmit power. This function has great significance for the CDMA system. The transmit power of the BTS3606 for cell breathing ranges from 0 dB to 24 dB. It can be adjusted at a step of 0.5 dB.

Chapter 5 Reliability Design

5.1 System Reliability

I. De-rating design

Lower the electrical stress and temperature stress on the high-power or heat-generating components to values less than the rated ones. In this way, users can delay performance degeneration and prolong the service life of these components.

II. Quality control 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 for selection.

All components are excellent 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 BTS3606 ensures that it can work reliably in a wide range of temperatures.

IV. EMC design

The design ensures that the BTS3606 keeps at an acceptable level owing to the Electro Magnetic Interference (EMI) from other equipment in the same electromagnetic environment. At the same time, the EMI generated by the BTS3606 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 does not fail unless the specified sets of units fail.

VI. Reliability design for input voltage

- The system is protected against reverse connection of power supply.
- The input voltage of the -48V DC power supply is checked 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 provides protection for 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, only the cable of this board is required to be removed. 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 BTS3606 system is equipped with the functions of self-detection and fault diagnosis. It can not only record, output and print various fault information, but collect environment condition information and generate alarms if there is any problem.

The hardware fault detection procedures include:

- Fault locating
- Isolating the faulty components
- Automatic switchover to the standby components that operate normally

The system will make a final confirmation on a hardware fault through repeated detection, thus avoiding the reconfiguration of the system or the degradation of QoS owing 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 notify the users of critical faults. In this way, users can operate and maintain the system with ease through maintenance console.

5.2 Hardware Reliability

I. Protection against wrong insertion of boards

When a board is inserted into a wrong slot, the special guide pins prevents 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 file data to the standby BCKM periodically. Once critical faults occur to the active BCKM, the original standby BCKM functions as the active BCKM to ensure normal operation of the BTS.

III. CE pool design of the CCPM

The CE pool design of the CCPM enhances the reliability of the system.

IV. Status monitoring and alarm report

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

V. 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, it sends the alarm to the BAM. It also supports online insertion and removal of boards.

5.3 Software Reliability

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

- Check the data consistency of different processing boards, restore the data consistency, 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 certain point.

IV. Fault isolation

In the BTS3606, when a fault occurs to one software module, other software modules can run normally.

In addition, the software has the capability of fault tolerance and correction. The minor operation exceptions will not cause the reset or reboot of the system.

V. Software backoff

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 users' operations and save them into a log file. When an unknown error occurs to the system, log files can help to trace the situation 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 (hereinafter briefed as M2000 system).

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

The basic structure and functions of the M2000 system are also briefed in this chapter. The detailed information is available in the related manual of M2000.

6.1 Structure

6.1.1 Local Operation and Maintenance System

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

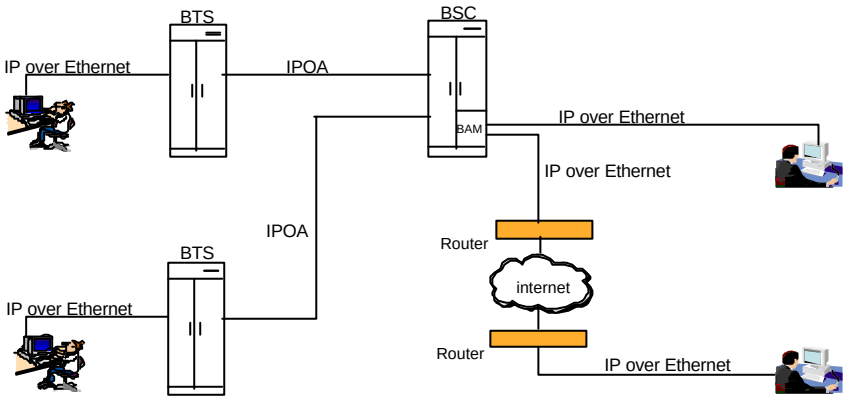


Figure 6-1 BSS local operation and maintenance system

I. Remote maintenance

The local operation and maintenance system of the BSS is designed in Client/Server (C/S) structure. The operation procedures are as follows:

1) The user inputs operation commands through Local Maintenance Terminal (LMT).
2) As the server, the BAM processes the commands from the Clients.
3) After the processing, the BAM sends these commands to the host (BSC or BTS) and then waits for the response.

4) Then 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 perform remote maintenance and monitor all the BTSs through the local operation and maintenance system. Meanwhile, users can collect information from these BTSs for network planning.

II. Local maintenance

- Users can implement local maintenance by logging in to the BTS through Telnet Client.
- Users can perform various operations and maintenance on the BTS using the MML commands.
- Users can use the reverse maintenance function to maintain the whole BSS on the LMT of the BTS.

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) are connected to the system through Local Area Network (LAN) or Wide Area Network (WAN).

The BSC is connected to the M2000 system through the BAM.

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

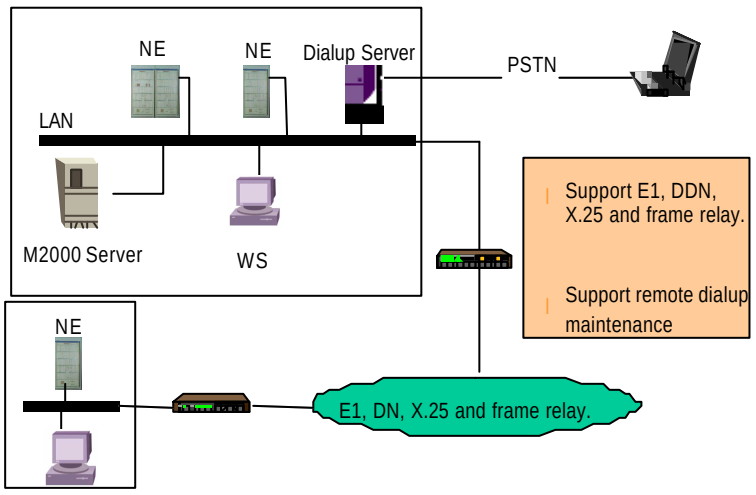


Figure 6-2 Networking of M2000 mobile integrated network management system

The M2000 system performs the following functions:

- Configuration management. Collect, store, query, and modify the NE equipment data within the network system.
- Performance management. User can register the traffic measurement tasks of the NEs on the Client, and can view the execution results of the registered traffic measurement tasks on the whole network.
- Fault management. User 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 BTS3606 provides powerful operation and maintenance functions to answer user's requirement. These functions include security management, alarm management, loading management, configuration management, equipment management, test management, and tracing management.

I. Security management

To prevent illegal operation, the system provides powerful security management function to control users' operations and the operating equipment.

Users need to log in for authentication before operating the BTS3606. The system provides multi-level authority mechanism so that only the authorized user can perform the operation of specified command sets.

In addition, the timeout locking function is provided. When there is no user operation for a long time, the system will automatically lock the screen. The user needs to enter the right password to go on operating the system.

Before the execution of important commands, the system displays the possible results upon the execution and prompts 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 BTS3606 drives status indicators and alarm box to give 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 together 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, facilitating the user to understand 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. It covers board loopback test, self-detection test, and Abis link test.

VII. Tracing management

The tracing management is implemented for the purpose of fault location and performance measurement analysis. The traced objects include various interfaces and BTS resources.

The tracing results of some resources (such as CPU resource and cell resource) can be displayed in graphics on real-time basis.

Chapter 7 Technical Specifications

7.1 Structure and Environment Specifications

Cabinet dimensions (Height × Width × Depth)	1400 mm × 600 mm × 650 mm
Power supply	-48 V DC (ranging from –40 V DC to –60 V DC) +24 V DC (ranging from +21 V DC to +29 V DC)
Weight	⩽ 250 kg
Power consumption	⩽ 3400 W
Ambient temperature	-5°C to 50°C
Relative humidity	5% to 90%
Equipment room noise	⩽ 70 dBA (The noise varies with the ambient temperature)
Reliability	Availability ⩾ 99.999% MTBF⩾ 100000 h MTTR ⩽1 h

7.2 Capacity Specifications

There are two types of CCPMs. One has two optical interfaces, while the other has no optical interface.

A maximum of four CCPMs can be configured in the BTS3606. The baseband processing capability is 12 sector carriers.

I. Capacity without ODU3601Cs cascaded

Max. number of sectors per cabinet	3
Max. number of carriers per sector	2
Max. number of sector carriers per cabinet	6

II. Capacity with ODU3601Cs cascaded

Each CCPM with optical interfaces can connect up to three ODU3601Cs, and each optical interface can be cascaded with three levels of ODCU3601Cs.

7.3 Transmitter and Receiver Specifications at 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	⩽ ± 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)

7.4 Transmitter and Receiver Specifications at 800 MHz Band

I. Transmitter specifications

Working band	869 MHz to 894 MHz
Channel bandwidth	1.23 MHz
Channel precision	30 kHz
Frequency tolerance	⩽ ± 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	824 MHz to 849 MHz
Channel bandwidth	1.23 MHz
Channel precision	30 kHz
Sensitivity of signal receiver	Better than -127 dBm (RC3, main and diversity receiving)

7.5 Transmitter and Receiver Specifications at 1900MHz

I. Transmitter specifications

Working band	1930 MHz to 1990 MHz
Channel bandwidth	1.23 MHz
Channel precision	⩽ 50 kHz
Frequency tolerance	± 0.05ppm
Transmit power	25 W (the maximum value measured at the feeder port 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	Better than -126 dBm (RC3, main and diversity receiving)

7.6 Specifications for ODU3601C Cascading

Max. distance of single cascading	10 km, 70 km
Max. number of cascading levels	3
Max. total distance of all cascadings	90 km