ZXG10 OB06

Integrated Outdoor GSM Base Station

Technical Manual

Version 1.0

ZTE CORPORATION
ZTE Plaza, Keji Road South,
Hi-Tech Industrial Park,
Nanshan District, Shenzhen,
P. R. China
518057
Tel: (86) 755 26771900 800-9830-9830
Fax: (86) 755 26772236
URL: http://support.zte.com.cn
E-mail: doc@zte.com.cn

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<table>
<tr><td>Document Name</td><td colspan="3">ZXG10 OB06 Integrated Outdoor GSM Base Station Technical Manual</td></tr>
<tr><td>Product Version</td><td>V1.0</td><td>Document Revision Number</td><td>R1.1</td></tr>
<tr><td colspan="2">Equipment Installation Date</td><td colspan="2"></td></tr>
<tr><td rowspan="3">Your evaluation of this documentation</td><td colspan="3">Presentation:
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<tr><td colspan="3">Accessibility:
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</table>

Contents

About this Technical Manual

The ZXG10 is a GSM mobile communication system independently developed by ZTE Corporation. It is composed of the ZXG10-MSS mobile switching subsystem and the ZXG10-BSS base station subsystem. The ZXG10-BSS Base Station Subsystem provides and manages radio transmission in GSM, and it is composed of the ZXG10-BSC Base Station Controller and the ZXG10-BTS Base Transceiver Station.

ZXG10 OB06 is one of the ZXG10-BTS series of base transceiver stations, and is an integrated outdoor BTS for GSM. Installed outdoors, the ZXG10 OB06 features high capacity, compactness, high reliability, high performance/cost ratio, complete functions, and powerful capability of service supporting.

Purpose of this Technical Manual

The *ZXG10 OB06 (V1.0) Compact Outdoor BTS for GSM—Technical Manual* introduces the working principle, functions and technical features of the ZXG10 OB06 (V1.0) compact outdoor BTS for GSM, enabling the user to have an all-around understanding of the technical features of the ZXG10 OB06 (V1.0).

The whole set of documents also include:

ZXG10 OB06 (V1.0) Compact Outdoor BTS for GSM Guide to Documentation

ZXG10 OB06 (V1.0) Compact Outdoor BTS for GSM Hardware Manual

ZXG10 OB06 (V1.0) Compact Outdoor BTS for GSM Installation Manual

ZXG10 OB06 (V1.0) Compact Outdoor BTS for GSM Maintenance Manual—Routine Maintenance

ZXG10 OB06 (V1.0) Compact Outdoor BTS for GSM Maintenance Manual—Emergency Handling

ZXG10 OB06 (V1.0) Compact Outdoor BTS for GSM Maintenance Manual—Troubleshooting

This manual includes five chapters.

Chapter 1 **System Architecture** introduces the background, major functions, architecture of the software and hardware of ZXG10 OB06 (V1.0), and standards it complies with. It gives the user a general idea of the system.

Chapter 2 **Technical Indexes** specifies the performance indexes of ZXG10 OB06 (V1.0).

Chapter 3 **Interfaces and Communications** outlines the external interfaces and main interface protocols for ZXG10 OB06 (V1.0)

Chapter 4 **System Functions** details the functions of the ZXG10 OB06 (V1.0).

Chapter 5 **Networking Modes and System Configuration** gives a detailed description of various networking modes, connection and configuration of the ZXG10 OB06 (V1.0).

Appendix A introduces the specifications cited in the manual.

Appendix B,FCC STATEMENT.

Appendix C, CE STATEMENT.

Abbreviations list all the abbreviations used in the manual.

Typographical Conventions

ZTE documents employ with the following typographical conventions.

TABLE 1 TYPOGRAPHICAL CONVENTIONS

Typeface	Meaning
Italics	References to other guides and documents.
"Quotes"	Links on screens.
Bold	Menus, menu options, function names, input fields, radio button names, check boxes, drop-down lists, dialog box names, window names.
CAPS	Keys on the keyboard and buttons on screens and company name.
`Constant width`	Text that you type, program code, files and directory names, and function names.
[ ]	Optional parameters
{ }	Mandatory parameters
|	Select one of the parameters that are delimited by it
	Note: Provides additional information about a certain topic.

Typeface	Meaning
	Checkpoint: Indicates that a particular step needs to be checked before proceeding further.
	Tip: Indicates a suggestion or hint to make things easier or more productive for the reader.

Mouse Operation Conventions

TABLE 2 MOUSE OPERATION CONVENTIONS

Typeface	Meaning
Click	Refers to clicking the primary mouse button (usually the left mouse button) once.
Double-click	Refers to quickly clicking the primary mouse button (usually the left mouse button) twice.
Right-click	Refers to clicking the secondary mouse button (usually the right mouse button) once.
Drag	Refers to pressing and holding a mouse button and moving the mouse.

Safety Signs

TABLE 3 SAFETY SIGNS

Safety Signs	Meaning
	Danger: Indicates an imminently hazardous situation, which if not avoided, will result in death or serious injury. This signal word should be limited to only extreme situations.
	Warning: Indicates a potentially hazardous situation, which if not avoided, could result in death or serious injury.
	Caution: Indicates a potentially hazardous situation, which if not avoided, could result in minor or moderate injury. It may also be used to alert against unsafe practices.
	Erosion: Beware of erosion.
	Electric shock: There is a risk of electric shock.
	Electrostatic: The device may be sensitive to static electricity.

Safety Signs	Meaning
	Microwave: Beware of strong electromagnetic field.
	Laser: Beware of strong laser beam.
	No flammables: No flammables can be stored.
	No touching: Do not touch.
	No smoking: Smoking is forbidden.

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Chapter 1

System Architecture

This chapter describes the background, the standards followed, major functions, system features, working principles and the general structure of both the software and hardware of the ZXG10 OB06 (V1.0).

System Introduction

System Background

ZXG10 OB06 is a high-capacity outdoor BTS for GSM, with a single cabinet supporting six carriers at the maximum. It is to be installed outdoors, integrating functions of transmission, power supply, environment monitoring and temperature control in one system. It is applicable to the following cases: The cost of a standard equipment room would be too high in the site selected for it, for example, in the center of a city; there is no equipment room in the site selected for it, for example, in the countryside or in the remote areas of a city.

The availability of ZXG10 OB06 adds another product to the ZXG10-BTS series and makes the ZXG10 system offer more flexible networking modes, hence more powerful market competition edge.

The appearance of the whole ZXG10 OB06 is shown in Figure 1

FIGURE 1 APPEARANCE OF THE ZXG10 OB06

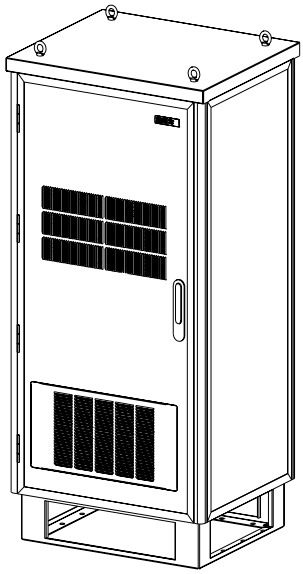
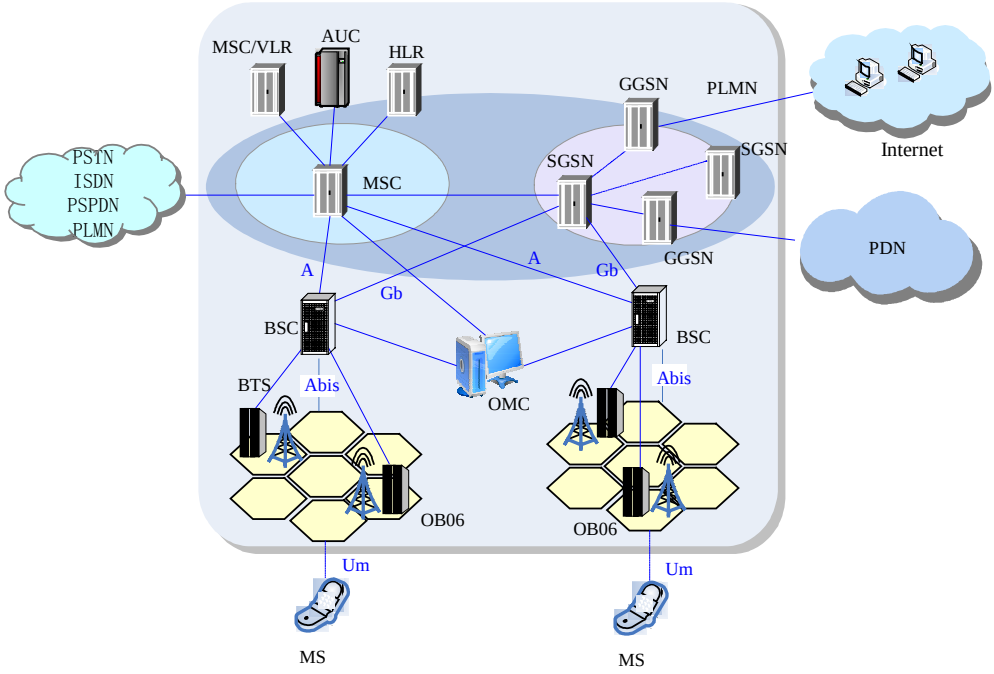


Figure 2 shows the position of ZXG10 OB06 (V1.0) in a GSM/GPRS network.

FIGURE 2 POSITION OF ZXG10 OB06 IN GSM/GPRS NETWORK



In the GSM/GPRS system, the ZXG10 OB06 is located between the BSC and MS, connected to the BSC through an Abis interface, and connected to the MS through an Um interface. The ZXG10 OB06 provides functions of

serving as a radio transceiver for a cell, converting between the BSC and a radio channel, wireless transmission with the MS and the related controlling function.

Applicable Standards

It supports GSM Phase I/ GSM Phase II/GSM Phase II + standards.

Its radio frequency (RF) interface complies with ETSI TS 101 087 Version 5.0.0 GSM05.05 and GSM11.21.

Its Abis interface complies with the ITU-T G.703/ITU-T G.704 interface standards.

Its high/low temperature indexes comply with the specifications in GSM11.21.

In terms of radio services, it complies with the following protocols and specifications.

GSM03.60 General Packet Radio Service (GPRS) Service description

GSM03.64 General Packet Radio Service (GPRS) Overall description of the GPRS radio interface

GSM04.04 Technical Specification Group GSM/EDGE Radio Access Net Work Layer 1 General requirements

GSM04.06 Mobile Station - Base Station System (MS - BSS) interface Data Link (DL) layer specification

GSM04.08 Mobile radio interface layer 3 specification

GSM04.60 General Packet Radio Service (GPRS) Mobile Station (MS) - Base Station System (BSS) interface Radio Link Control/ Medium Access Control (RLC/MAC) protocol

GSM05.02 Multiplexing and multiple access on the radio path

GSM05.08 Radio subsystem link control

GSM08.58 Base Station Controller - Base Transceiver Station (BSC - BTS) interface Layer 3 specification

The EMC complies with the ETSI 301489-8 specifications

R&TTE Directive 1999/5/EC

Major Functions

The ZXG10 OB06 (V1.0) has the following functions:

1. It supports GSM Phase I/ GSM Phase II/GSM Phase II + standards.

2. It supports GSM900, EGSM900, GSM850, GSM1800 and GSM1900 systems; it also supports modules of different frequency bands inserted in the same cabinet.
3. It provides the following TCH services:

   TCH/FS: Full-rate voice traffic channel

   TCH/HS: Half-rate voice traffic channel

   TCH/EFS: Enhanced full-rate voice traffic channel

   TCH/F9.6: 9.6 kbit/s full-rate data traffic channel

   TCH/F4.8: 4.8 kbit/s full-rate data traffic channel

   TCH/F2.4: 2.4 kbit/s full-rate data traffic channel

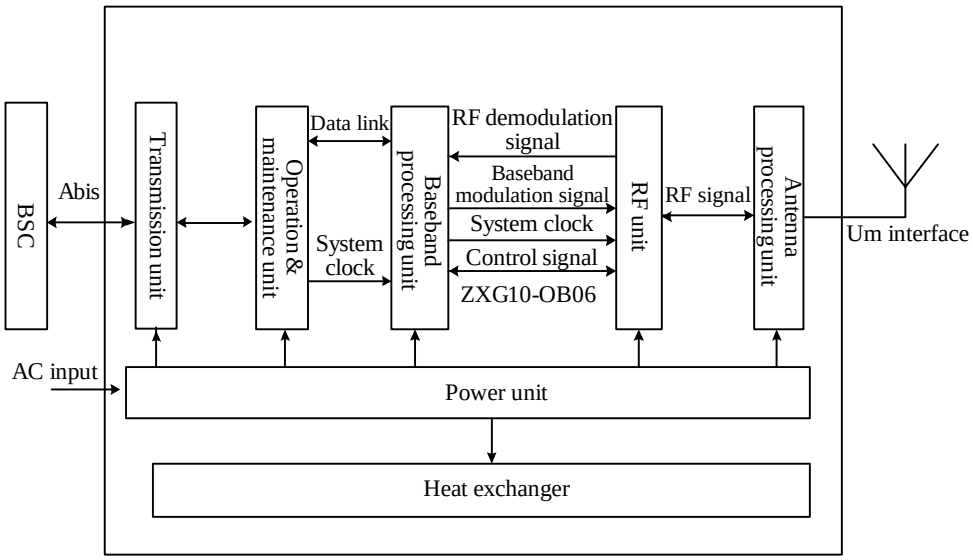
   It supports service channels related with GPRS service
4. It provides a diversity receiving function. Main diversity technologies are space diversity, frequency diversity, time diversity and polarization diversity.
5. The receiving end adopts the Viterbi soft decision algorithm, improving the channel decoding performance and increasing the system receiving sensitivity and anti-interference capability.
6. It supports frequency hopping, improving the system capability against Rayleigh fading.
7. It supports the discontinuous transmission (DTX) mode, only transmitting comfort noise in the voice non-activated period, and reducing the transmitter power and general interference level in the air signaling.
8. It can calculate the time advance.
9. For GSM 900 and EGSM 900 systems, it supports configurations with power consumption of 40 W or 80 W. For GSM1800, GSM1900 and GSM850 systems, it supports 40 W configuration.
10. One OB06 (40 W configuration, in this document, 40 W for the GMSK mode, and 25 W for the 8PSK mode) supports 6 TRXs, supports extension of 18 TRXs at the same site, and one site supports extension of S6/6/6.
11. One OB06 (80 W configuration, in this document, 80 W for the GMSK mode, and 50 W for the 8PSK mode) supports 3 TRXs, supports extension of 9 TRXs at the same site, and one site supports extension of S3/3/3.
12. It supports star, chain and tree configuration of Abis interfaces.
13. It supports satellite transmission links of Abis interfaces, with the unidirectional transmission delay of Abis interfaces being 260 ms.
14. It supports LapD signaling 1: 4 TEI multiplex of Abis interfaces, that is, having 4 pieces of LapD signaling multiplexed into one 64 Kb/s signaling timeslot through TEI.
15. When multiple OB06s are cascaded, the automatic crossover protection function is provided for the Abis interface link when any OB06 is powered off.

16. It supports preprocessing of the measurement reports on the OB06.
17. It supports BS power control: statically 6 levels and dynamically 15 levels.
18. It supports all paging modes defined in GSM specifications.
19. It supports synchronous handover, asynchronous handover, pseudo-synchronous handover, and pre-synchronous handover.
20. It has an overall timely alarm system.
    i. Available for implementing unattended BS and automatic alarming.
    ii. Providing power supply and alarm for the built-in tower amplifier system.
21. It supports EDGE service, realizing a higher data transmission rate by means of 8PSK modulation.
22. It supports GPRS and CS1 ~ CS2 channel encoding modes. It supports CS3 and CS4 through software upgrading, and it can adjust the channel encoding mode dynamically according to the monitoring and measurement results.
23. The Um interface supports A51/A52 encryption algorithm.
24. It supports ultra-distance coverage with a radius of 35 km~120 km.

System Working Principle

The working principle of ZXG10 OB06 (V1.0) is shown in Figure 3.

FIGURE 3 WORKING PRINCIPLE OF THE ZXG10 0B06 (V1.0)



The ZXG10 OB06 (V1.0) system is composed of an operation and maintenance unit, a baseband processor, an RF unit, an antenna feeder

processor, a transmission unit, a power unit and a heat exchanger. The working principle of the system is as follows:

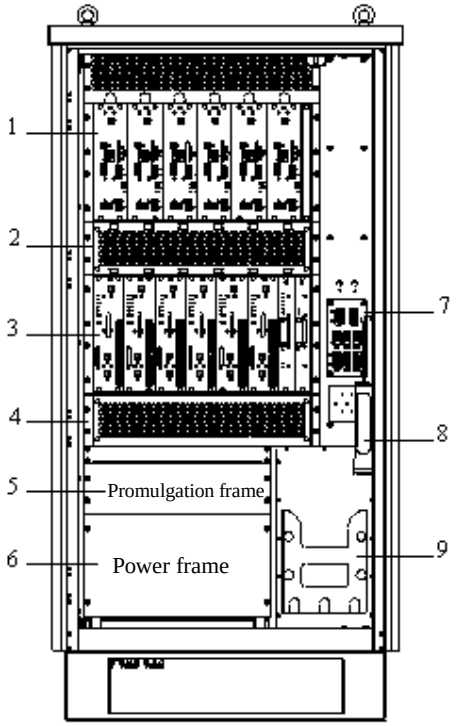
In the downlink direction, the ZXG10 OB06 (V1.0) receives data from BSC, including voice and signaling data. Here, the signaling data are sent to the control, operation & maintenance unit for processing. The voice data are first sent to the base band processor for processing such as rate conversion, encryption and interleaving, sent to the RF unit to be modulated to high-frequency signals, and then finally transmitted through the antenna feeder processor.

In the uplink direction, the antenna feeder processor receives the RF signals from the MS, and sends them to the RF unit to convert them into digital signals. Then, the signals are sent to the baseband processor for rate conversion, decryption and de-interleaving. Finally, after being converted to the code pattern suitable for long-distance transmission, the signals are sent to the BSC through the Abis interface.

Hardware Structure

The layout of the ZXG10 OB06 system is shown in Figure 4.

FIGURE 4 LAYOUT OF THE ZXG10 OB06 SYSTEM

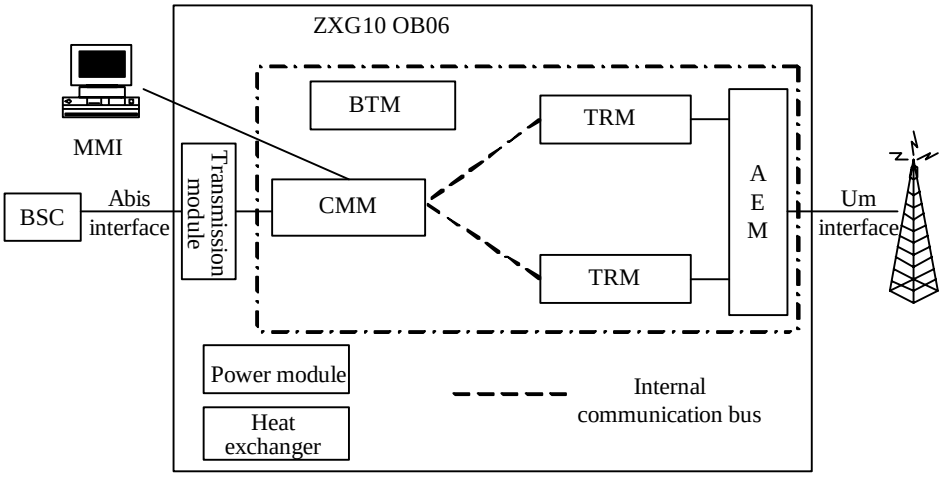


1. AEM module 2. AEM fan frame 3. Transceiver module
4. RTU fan frame 5. Transmission frame 6. Power frame 7. PDM panel
8. Emergency lamp 9. Battery frame

The ZXG10 OB06 hardware consists of a control and maintenance module (CMM), a transceiver module (TRM), an antenna feeder equipment module (AEM), a backplane transmission module (BTM), a power module and a heat exchanger.

The hardware structure of the ZXG10 OB06 is shown in Figure 5.

FIGURE 5 HARDWARE STRUCTURE OF THE ZXG10 OB06 (V1.0)



The main functions of each module are as follows:

1. Controller & Maintenance Module (CMM)

   CMM implements Abis interface processing, BTS operation & maintenance, clock synchronization and generation, internal/external alarm collection and processing and other functions.

2. Transceiver Module (TRM)

   TRM controls and processes the radio channels; transmits and receives the radio channel data; modulates and demodulates the base-band signals on the radio carrier; and transmits and receives radio carriers in the GSM system.

   The TRM is divided into three units by function:

   i. Transceiver Process Unit (TPU)

      The TPU implements all functions of base-band data processing of all duplex channels on a TDMA frame, and the conversion between the LapDm protocol and the LapD protocol. In addition, it provides GPRS data service, and supports CS1, CS2, CS3 and CS4 encoding modes.

   ii. Radio Carrier Unit (RCU)

      The RCU modulates baseband signals to carrier signals and up-converts frequency. At the same time, it down-converts the frequency of received carrier signals. In addition, it can control the power statically and dynamically in the downlink direction as required in GSM specifications.

iii. Power Amplifier Unit (PAU)

The PAU amplifies the power of the radio carrier to provide the BS equipment with sufficient transmission power.

In band GSM900 or EGSM900, ZXG10 OB06 features a transceiver unit with an output power of 80 W. The unit consists of two modules: STRG and SPAG: The former fulfills the functions of the TPU and RCU parts, while the latter accomplishes the functions of the PAU. The SPAG and STRG form the TRM of the GSM900 system or the EGSM900 system.

3. Antenna Equipment Module (AEM)

The AEM accomplishes functions of duplex and distribution of air signals. ZXG10 OB06 provides a Combiner Distribution Unit (CDU) and a Combiner Extension Unit (CEU):

i. The CDU supports one 2-in-1 combiner unit and one 1-to-4 distribution unit. It has two low noise amplifiers with extended receiving output and one built-in duplexer.

ii. The CEU supports two 1-to-2 power distribution units and two 2-in-1 combiner units.

The AEM can provide the ZXG10 OB06 (V1.0) with different configurations through combinations.

4. Backplane Transmission Module (BTM)

The BTM is responsible for transmitting messages between the CMM, TRM and AEM and at the same time provides interfaces for inputting and outputting external signals.

5. Transmission Management Module (TMM)

The TMM can be a product manufactured by a third party. In ZXG10 OB06 there is a standard 19-inch 3U-high shelf for accommodating transmission devices such as SDH and microwave.

6. Heat Exchanger (HEX)

The HEX is composed of four key components, namely, internal circulation fan, external fan, heat exchanging chip and heater. The HEX provides a function of dissipating heat in case of high temperature and heating in case of low temperature, so that suitable temperature will be ensured in the cabinet for normal operation of the system.

7. Power Module (PWM)

The PWM accomplishes lightning protection and rectification/filtration of AC power: It outputs AC 220 V power to the heat exchanger and the maintenance socket; converts AC power to DC –48 V power for the CMM, TRM, TMM and heat exchanger, and provides a function of overload/short circuit protection.

Software Architecture

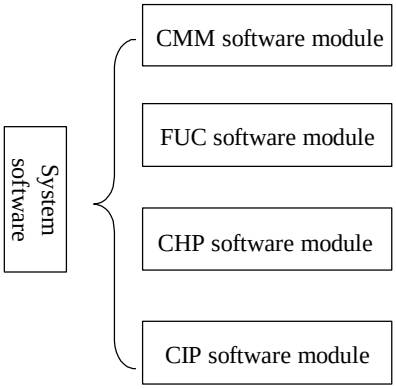
In software design, the ZXG10 OB06 (V1.0) adopts modular and hierarchical concepts to facilitate development and maintenance.

The software is distributed on boards. There is little correlation between pieces of software. The board software is independent in function and associates with each other through the internal interfaces.

The core software can be downloaded from the background, facilitating service upgrade and version maintenance. It also provides external interfaces, through which the software can be maintained, OB06 information can be collected, and OB06 local tests can be performed.

The internal software of ZXG10 OB06 (V1.0) is composed of four parts: Controller & Maintenance Module (CMM), Frame Unit Controller (FUC), Channel Codec Module (CHP) and Carrier Interface Processor (CIP). Different software platforms are adopted for the software according to their functions, as shown in Figure 6.

FIGURE 6 SOFTWARE MODULES OF THE ZXG10 OB06 (V1.0)



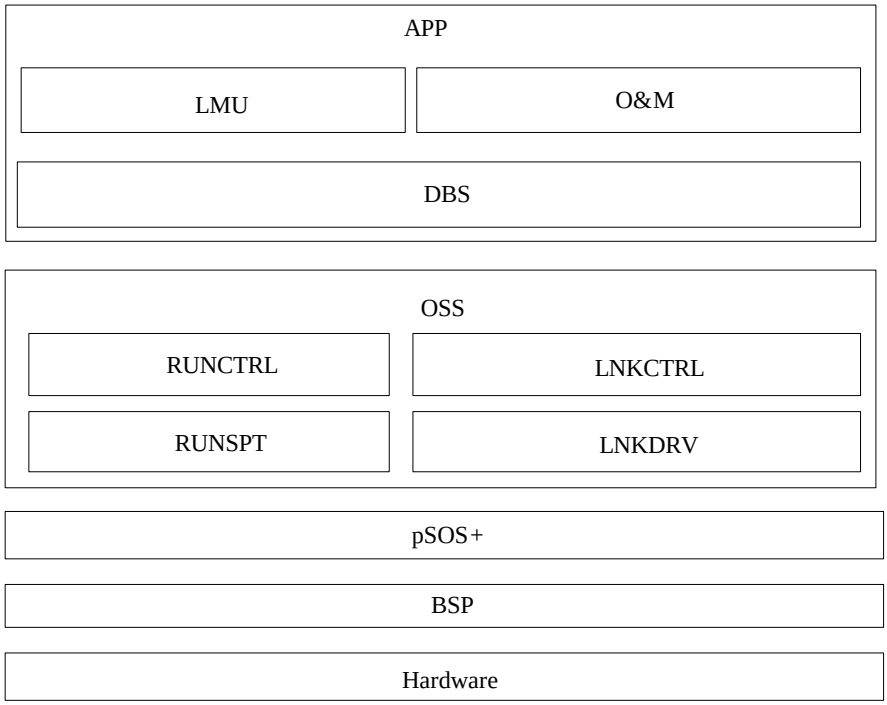
CMM

The CMM of ZXG10 OB06 (V1.0) provides the following functions:

- Status management;
- Configuration management
- Device management;
- Monitoring management
- Test management
- Database management
- Supporting local O&M function, including local parameter configurations and alarm query

The CMM software is designed in layers, as shown in Figure 7.

FIGURE 7 CMM SOFTWARE MODULE STRUCTURE



The five layers from the top downward are as follows:

1. Hardware

   The physical platform on which the CMM software is running.

2. BSP (board-level support package)

   BSP initializes CMM boards and provides drivers for the relevant parts of the equipment. It provides consistent operation interfaces for the specific details of the upper-level encapsulated hardware equipment and simplifies the OSS design.

3. pSOS + operating system

   It is a real-time multi-task operating system for commercial purposes and with superior performance. The operating system has been successfully applied to the next-generation BTS.

4. Operation support system (OSS) layer

   This layer consists of the following parts:

   i. RUNSPT

      It is the core layer of the OSS.

      It is a dispatch system of the state machine, providing process dispatch, process communication, memory management, timer management, process monitoring and abnormality capture.

ii. RUNCTRL

It is the operation control layer of the system.

It includes the system control module and implements the power-on sequence for application processes. In addition, this layer includes some miscellaneous functions of the operating system such as redirection of the printing messages.

iii. LNKDRV

It is the device driver.

Working with BSP, LNKDRV provides equipment-independent drivers for LNKCTR. At the same time, this part also includes a frame number synchronization module, implementing the frame number synchronization between active/standby CMMs, active CMMs of the base cabinet and the extension cabinet, and master CMM and TRMs.

iv. LNKCTRL

It is the communication link control layer module.

It consists of multiple communication link control modules, like LapD, HDLC, LMComm.

- LapD communication link control module

  LapD is the communication link control module of the Abis interface.

- HDLC communication link control module

  HDLC is the communication link control module inside the cabinet. They all communicate in a point-to-point way.

  Currently, there are three types of communication links:

  CCComm: It is the auxiliary communication link between the master CMM of the base cabinet and that of the extension cabinet. Physically, it is a 2 M PCM line, which facilitates the centralized data collection of LMU.

  CMComm: The communication link between the active and standby CMMs, implementing the data synchronization between them. Physically, it is a 1M HW.

  CTComm: As the communication link between the active CMM and 1 ~ 12 TRMs of its cabinets, the CTComm implements the parameter configuration of TRM and alarm collection. Physically, it uses a 64 Kbit/s timeslot in 4 M HW.

- LMComm

  Foreground/background link control module with RS232 as its physical interface. It is a self-defined point-to-point link control protocol and character-oriented single-bit stop and wait protocol.

5. APP layer

It is the application layer. It consists of three parts:

i. O&M

As the core of the application layer, it receives the O&M messages of the Abis interface and implements parameter configuration,

status and alarm management, software version management, device test and external alarm collection.

ii. DBS

The whole application layer is designed with the database as a core. The database coordinates to assign configuration parameters. It also synchronizes data between the active and standby CMMs and between the foreground and the background.

iii. LMU

It is the local O&M unit, including two parts: foreground agent and background operation interface.

It works with the database synchronization module to complete the local parameter configuration, equipment status and alarm collection. It also includes operating interface of equipment test to implement test functions of the local BTS.

The system tool part is a series of developer-oriented tools for system diagnosis and test to rapidly locate faults.

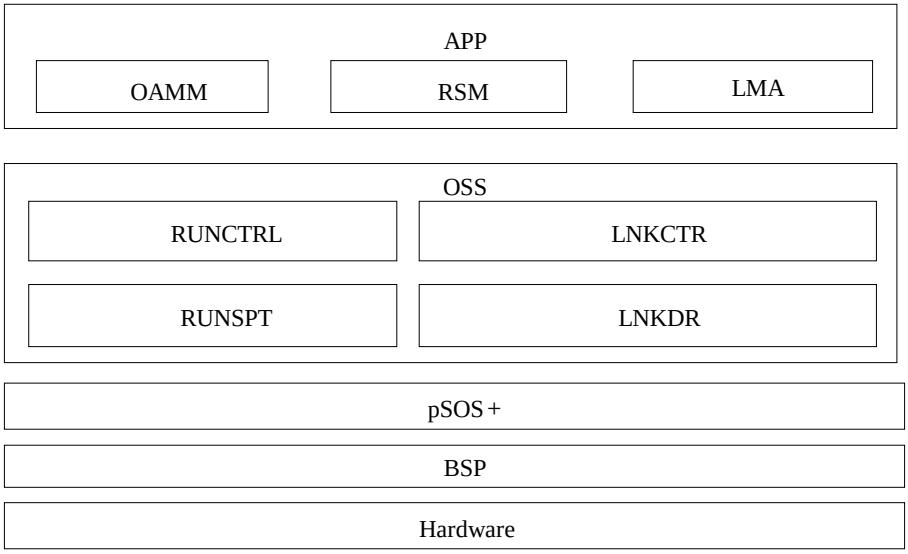
FUC

The FUC software module is located in the TPU of the TRM module. It processes the radio signaling over every radio carrier and signaling on the BSC interface and manages all channels. Its major functions are as follows:

1. It processes and converts GSM signaling protocols, including the layer-2 protocol LAPD with BSC, the layer-2 protocol HDLC with CMM, the layer-2 protocol LAPDm with the Um interface and the layer-3 radio resources management protocol of GSM.
2. It is responsible for the TDMA multi-frame framing on the Um interface, frame number (FN) receiving, frequency hopping calculation and management & control over CHP.
3. It manages OB06 and loads the FUC software and DSP program. It supports packet switching services (GPRS or PS for short).

The whole FUC software can be divided into two layers: system software and application, as shown in Figure 8.

FIGURE 8 FUC SOFTWARE MODULE



The concept of virtual operating system is adopted for the system software. Based on the commercial operating system pSOS+, the running support layer RUNSPT of the limited state machine is oriented to make the application irrelevant with the actual real-time operating system, simplify the application implementation and improve the application grafting.

RUNCTRL implements the power-on boot sequence of system's modules and some auxiliary functions of the operating system. It collects and redirects the output messages.

The drivers are also designed with a hierarchical structure, including equipment-dependent and equipment-independent drivers. All communications within the current equipment adopt the address transfer mode to reduce the overhead of the memory block copies.

The application layer contains the operation and maintenance module (OAMM), radio signaling processing module (RSM) and local O&M agent module (LMA). The OAMM configures and manages the software, parameters, status and alarms of the TPU board. The RSM can be divided into the FURRM (Radio Resource Management Module), PAGCHM (Paging Access Channel Message Processing Module) and FHM (Frequency Hopping Module). These modules implement the signaling flows of circuit switched service and packet switched service according to the GSM protocol, and they support frequency hopping. LMA is used for system debugging.

CHP

The CHP software module is located in the TPU of the TRM in the system.

It implements all baseband channel processing and some corresponding control functions, including channel encoding, channel decoding and demodulation.

CIP

The CIP software module is located in the TPU of the TRM in the system.

The functions of CIP software are GMSK (GSM modulation mode), 8PSK (EGPRS modulation mode), software modulation, power control and the collection and handling of AEM, amplifier, RCU and fan alarm information.

System Features

The ZXG10 OB06 (V1.0) is a compact outdoor BTS with a high capacity; a single cabinet may support 6 carriers at the maximum; customer requirements in terms of capacity, configuration, arrangement and maintenance are all taken into consideration in its design.

The main features of the ZXG10 BS21 are as follows:

1. High jumping-off point in technology

   The ZXG10 OB06 (V1.0) starts from the new generation of GSM technology, and the standards of GSM Phase II are adopted. It can be upgraded to GSM Phase II+ smoothly.

2. Advanced functions, covering all frequency bands and supporting flexible configurations

   The ZXG10 OB06 (V1.0) supports functions defined in GSM specifications and flexible configurations according to the customer's requirements. It also supports mixed insertion of modules of different frequency bands, such as GSM1900/1800, GSM900/1900. GSM850/1800, and GSM850/1900; it supports star, chain and tree connections of PCM links; it supports FH; it supports configurations with 40 W and 80 W power.

3. Strong environmental adaptability

   The ZXG10 OB06 (V1.0) allows normal operation in an adverse outdoor environment.

   The cabinet features a framework of double-layer section aluminum and a base of bended aluminum alloy plate, which are good in erosion resistance and electric conduction.

   Thanks to the sealing strips between the cabinet door and the racks, and between the HEX and the door plate, the cabinet is well sealed, and becomes a consecutive conductor as well, thus satisfying the requirements by the EMC.

   The integrated equipment permits protection of IP55 level.

4. Beautiful appearance and compact structure

ZXG10 OB06 (V1.0) looks concise, features compact structure, high performance of electromagnetic shielding and good heat dissipation. Both the front door and back door of the cabinet can be opened to facilitate maintenance.

5. Modular design in software/hardware.

   The software/hardware of the ZXG10 OB06 (V1.0) is of a modular design to reduce the types of its boards and modules, enhance the integration of the boards, facilitate installation and maintenance for the projects, and improve the reliability of the system.

6. Advanced software radio technology.

   With the advanced software radio technology, the ZXG10 OB06 (V1.0) ensures that the RF components would work stably and reliably. It improves the consistency of the equipment in batches and the massive production of the equipment.

7. Flexible and reliable Abis interface

   Advanced flow control algorithms and variable rate signaling link technology are used so that multiple logical signaling links can be configured on the 64 Kbit/s physical link to fully share the bandwidth.

   In case of ZXG10 OB06 (V1.0) cascading, if one ZXG10 OB06 (V1.0) is powered off, the Abis interface link can provide auto-bridging protection.

8. Secure and reliable power supply system.

   The power supply module of the ZXG10 OB06 (V1.0) provides such functions as lightning protection and electromagnetic filtration. The PSM provides AC input protection (overvoltage/undervoltage protection) and DC output protection (overvoltage/undervoltage protection), lightening/surge prevention, burst interference resistance, cycle drop prevention, conduction interference resistance and anti-electromagnetic radiation functions.

   Since there will be nobody on duty for an outdoor BTS, the power system is configured with an intelligent control function for equipment start to protect the system, that is, when the temperature is lower than -20°C, the DC output will be automatically cut off, and when the temperature is higher than -20°C, the DC output will be automatically restored.

   The power system accommodates external high-capacity batteries, and provides a function for management of secondary power down and batteries.

9. Perfect environment monitoring capability

   Internal smog, flood and over-high/over-low temperature can be detected automatically.

10. Good heat design

    The system features direct heat dissipation by wind. Fans of high wind pressure and large wind capacity are used, thus ensuring quick and effective heat dissipation for the modules.

    Independent air ducts are designed for the AEM and TRM, so that the distance of heat dissipation is shortened for higher efficiency.

High-capacity heat exchangers are used for more powerful heat dissipation capability of the system.

The cabinet features a double-layer top, thus effectively alleviating the influence of direct sunshine. The cabinet surface is covered with painting resisting infrared radiation.

11. Convenient local operation and maintenance

    Standard RS232 interface is used for connection with the local operation and maintenance terminal.

    The local operation and maintenance terminal is easy to learn and use since it is consistent with the OMCR interface.

    Perfect local operation and maintenance

    Rapid and reliable online software upgrade.

12. Abundant services

    The ZXG10 OB06 (V1.0) supports GPRS data services, HLR services, large area coverage and satellite Abis links.

Chapter 2

Technical Indexes

This chapter introduces the indexes of the ZXG10 OB06 (V1.0) system and indexes of the modules and components of the system.

Physical Performance

Dimensions, Color and Structure

The framework of the equipment is of section aluminum; the door plates are made of aluminum; the enclosure frame is in light grey, the 4 doors are in blue and the base is in black.

Overall dimensions of the equipment: 1800 mm×900 mm×780 mm (H×W×D).

Weight of Integrated Equipment and Weight Bearing Requirements of Equipment Room Ground

Weight of the equipment: <450 kg.

Weights of parts of the cabinet:

The main body of the cabinet (including the heat exchange and base): 230 kg

AEMs (6 in full configuration): 42 kg

Carrier module (6 in full configuration): 36 kg

CMM (2 in full configuration): 3 kg

Fiber slice tray: 1.5 kg

Transmission frame: 8 kg

Power subrack

Batteries (4): 75 kg

Bearing capacity of a single concrete platform: >800 kg

Power Supply

Power Supply Range of Power Supply System

Input voltage: 88 VAC~300 VAC, optional.

Power Consumption Indexes

The maximal power consumption of each module is as follows:

TRM (×6): 200 W per TRM

CMM (2 pieces): 15 W per CMM;

AEM (×6): 15 W per AEM

Internal mixed-flow fan (×3): 40 W per fan

Internal axial flow fan (×3): 20 W per fan

Fan for HEX: 60 W

Transmission: 100 W

Battery charging: 1500 W

Heater: 2500 W

Maintenance socket: 500 W

When fully configured, the power consumption of the whole system is < 6511W.

Ambient Conditions

Requirements for Grounding and Lightning Protection

OB06 outdoor BTS features a lightning-protection capability of B+C level.

There is a built-in induction-free lightning protector of B+C level in the AC input part of the ZXG10 OB06 system, while the internal modules of the power system provides a lightning-protection function of D level, thus preventing faults in most cases of lightning.

A 1/4 wavelength lightning-protector is used for the antenna system, installed at outlet of the antenna feeder in a position near the cabinet. The lightning protector is effective in preventing the antenna from suffering damage by lightning.

ZXG10 OB06 supports E1 transmission access. At the access interface of E1 there is a B-level signal lightning protector, and the internal E1 interface boards all support a D-level lightning-protection function, thus capable of preventing damage by lightning and surge.

All components inside the cabinet are well connected through metal screws; good grounding terminals are available and protection ground cables are well installed.

Requirements for Temperature and Humidity:

Temperature range: -40°C~+50°C

Humidity of the ambient environment: 5%~98%

Maximum wind speed: 54.68 yd/s

Requirements for Cleanness

For internal cabinet environment requirements, see Table 4.

TABLE 4 LIMIT TO INVASION OF DETRIMENTAL GASES

Name	Average (mg/m^3)	Maximum (mg/m^3)
SO_2	0.2	1.5
H_2S	0.006	0.03
NO_2	0.04	0.15
NH_3	0.05	0.15
Cl_2	0.01	0.3
HCL	0.2	1.5
CO	5.0	30.0
HF	0.01	0.5
O_3	0.005	0.1

It can endure rain, water, salt fog, dust and provides the anti-theft function. The IP protection level reaches IP55.

Requirements for Atmospheric Pressure

70×10^3~106×10^3 pa.

Interface Indexes

Abis Interface Indexes

The Abis interface adopts the standard E1 interface.

The performance of the Abis interface meets the requirements specified by ITU-T G.703 and ITU-T G.704. Details are as follows:

1. Prerequisites
   i. Nominal bit rate: 2048 kb/s
   ii. Bit rate error tolerance: $\pm50\times10^{-6}$
   iii. Signal code pattern: HDB3
2. Electrical features:
   i. Pulse shape: rectangle
   ii. Nominal peak voltage of pulse (mark):

   2.37V (75 ohm, a pair of coaxial cables).

   3 V (120 ohm, a pair of symmetrical cables).
   iii. Peak voltage when without pulse (vacant number):

   0±0.237V (75 ohm, one pair of coaxial cables).

   3 V (120 ohm, one pair of symmetrical cables).
   iv. Nominal pulse width: 244 ns
   v. The amplitude ratio between the positive pulse and the negative pulse

   The amplitude ratio of the positive pulse to the negative one at the midpoint of the pulse width is superior to 0.955–1.05.

   The amplitude ratio of the positive pulse to the negative pulse at the half of the nominal pulse amplitude is superior to 0.95–1.05.
   vi. Digital signal jittering features (1UI = 488 ns):

   1.5UI (peak-peak value, 20 Hz~100 kHz).

   0.2UI (peak-peak value, 18 kHz~100 kHz).
   vii. Input impedance features

   Corresponding to the nominal bit rate (2048 kb/s) 2.5% ~ 5%, that is, when it is 51.2 kb/s~102.4 kb/s, echo attenuation ≥12 dB.

   Corresponding to the nominal bit rate (2048 kb/s) 5% ~ 100%, that is, when it is 102.4 kb/s~2048 kb/s, echo attenuation ≥18 dB.

Corresponding to the nominal bit rate (2048 kb/s) 100%~150%, that is, when it is 2048 kb/s~3072 kb/s, echo attenuation ≥14 dB.

Um Interface Indexes

Main indexes are as follows:

1. Wireless channel

   Co-channel interference protection ratio C/I≥9 dB (static).

   Interference protection ratio of the adjacent channels ≥ - 9 dB

   Interference protection ratio the second adjacent channel ≥ -43 dB

   The wireless channel selection adopts the shared signaling channel mode.

2. Wireless RF modulation mode

   OB06 supports EDGE service. There are 9 modulation and coding modes, namely, MCS1~9. MCS1~4 retain the GMSK modulation mode, while MCS5~9 use the 8PSK modulation mode. 8PSK allows 3-bit data over each modulation signal on a wireless path, whereas GMSK allows only 1-bit data under the same conditions. So, 8PSK realizes a higher rate in data transmission; its transmission rate at the maximum is as high as three time that of GPRS.

   Different coding modes define different sizes of data blocks and channel redundancy codes. In comparison with GPRS that features a mono modulation technique, EDGE is capable of adapting to a more adverse and wider wireless propagation environment.

3. The performance of the transmitter

   i. The phase error of the transmitter

      The phase error of the transmitter is the error between the actual phase and the theoretical one.

      The Root Mean Square of the BS phase error is not greater than 5°and the peak value is not over 20°.

   ii. The frequency error of the transmitter

      The frequency error of the transmitter is the error between the actual frequency and the theoretical one.

      The BS frequency error is not over 0.05 ppm.

   iii. Average transmitted carrier power (requirement for the power amplifier output)

      40 W or 80 W.

      It is provided with the 6-level static power control function. Based on the maximum output power, it can adjust downwards 6 power levels with the step of 2 dB ± 1.0 dB. At the same time, BS has the downlink power control function. Based on the set power level, it can decrease the power from level zero to level-15 with the step of 2dB ± 1.5dB.

   iv. Transmitted RF carrier power/time envelop

Compliant with GSM 11.21 and GSM 05.05.

v. The inter-modulation attenuation of the transmitter

Compliant with GSM 11.21 and GSM 05.05.

vi. The inter-modulation attenuation in BSS

Compliant with GSM 11.21 and GSM 05.05.

vii. Transmitted adjacent channel power

Compliant with GSM 11.21 and GSM 05.05.

viii. The spurious emission of the transmitter

Compliant with GSM 11.21 and GSM 05.05.

4. The performance of the transmitter

i. The static layer-1 function of the transmitter (nominal error rate)

The static first layer functions of the receiver are the floorboard of such functions of RF part, multiplexing and multi-addressing, equalizer de-encryption, de-interleaving and the channel encoding.

The static layer-1 function is signified by the nominal error rate (BER) before channel decoding.

Compliant with GSM 11.21 and GSM 05.05.

ii. Static referential sensitivity level

The static referential sensitivity level means that when inputting a standard test signal under the static environment, the FER, RBER or BER performance of the data, generated after modulation and channel decoding, meets the specified requirements when the level is configured as the referential sensitivity level.

Compliant with GSM 11.21 and GSM 05.05.

- GMSK: Static sensibility level for reference ≤ -108 dBm
- 8PSK: Static sensibility level for reference ≤ -104 dBm

iii. Multi-path referential sensitivity

Input a standard test signal under the multi-path environment, the FER, RBER or BER performance of the data, generated after modulation and channel decoding, meets the specified requirements when the level is configured as the referential sensitivity level.

Compliant with GSM 11.21 and GSM 05.05.

iv. Referential interference level (interference and suppression of the same frequency and adjacent channels).

The referential interference level means the capability that the transmitter receives the expected modulation signal not over the given degraded quantity, which is caused by the unexpected modulation signal on the same carrier frequency (inference of the same channel) or any adjacent carrier frequency (inference of the adjacent channel).

Compliant with GSM 11.21 and GSM 05.05.

v. Block and spurious response suppression

The block and spurious response suppression is to test the capability that the BSS transmitter receives the GSM modulation signal when interferential signal exists.

Compliant with GSM 11.21 and GSM 05.05.

vi. Inter-modulation suppression

This index is for measuring the linear degree of the RF part of the transmitter. It indicates, when two or multiple unexpected signals which are relative to the expected signal in frequency exist, the transmitter's capability of receiving the respected modulation signal is not over the given degraded quantity.

Compliant with GSM 11.21 and GSM 05.05.

vii. AM suppression

AM suppression means the transmitter's capability of receiving the expected modulation signals is not over the given degraded quantity when an unexpected modulation signal exists.

Compliant with GSM 11.21 and GSM 05.05.

viii. Spurious emission

The spurious emission is the emission on the frequencies except that of the RF channel of the transmitter and adjacent frequencies.

Compliant with GSM 11.21 and GSM 05.05.

Capacity Indexes

A single cabinet of ZXG10 OB06 can be configured with 6 carriers at the maximum. One site supports 3 cabinets and 18 carriers at the maximum.

Clock Indexes

It provides a two-level clock, whose indexes are as follows:

Clock accuracy: $\pm 1.0 \times 10^{-9}$

Pull-in range: $\pm 1.0 \times 10^{-9}$

The maximum frequency offset: 1×10^{-9}/day.

The maximum initial frequency offset: 1×10^{-7}

Reliability Indexes

Mean Time Between Failures (MTBF): 63000 hours

Mean Time To Repair (MTTR):

Availability ratio A (%): 99.999%

Average time of suspensions per year: 4.2 minutes

The product successfully passed the CE certification. The personal safety, electromagnetic security, EMC and wireless frequency spectrum comply with international standards.

Chapter 3

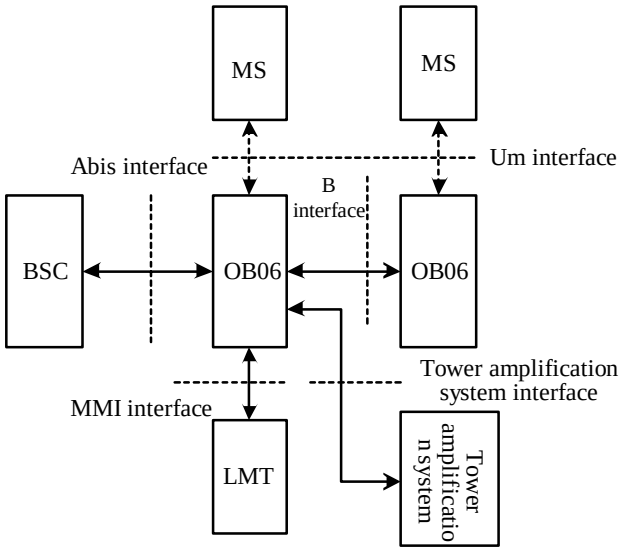
Interfaces and Communications

This chapter details different external interfaces of the ZXG10 OB06 (V1.0) and different interface protocols.

Overview

Figure 9 shows the positions of the main interfaces of the ZXG10 OB06 (V1.0) in the system.

FIGURE 9 POSITIONS OF ZXG10 OB06 (V1.0) EXTERNAL INTERFACES



The ZXG10 OB06 (V1.0) provides Abis interfaces and Um interfaces, as well the cascade interface (defined as B interface) between OB06s, interfaces of the tower amplification and local O&M interfaces.

The Abis interface is a communication interface between OB06 and BSC. The Um interface is the interface between OB06 and MS. The B interface is actually an extension of the Abis interface. The tower amplifier system

provides the power supply and the alarm interfaces. The man-machine interface (MMI) is an interface between the local O&M terminal (LMT) and OB06.

Interfaces

Abis Interface

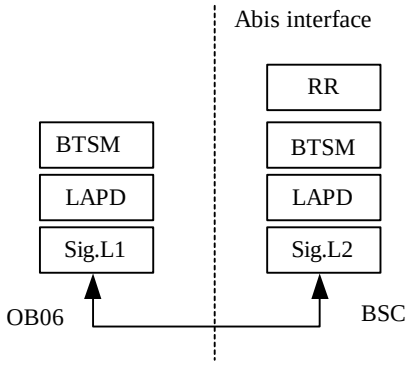
The Abis interface is defined as an interface between OB06 and BSC.

The Abis interface sends the signal from the BSC to the OB06, usually the standard E1 signal of PCM 2M. The signals are generally the standard PCM 2M E1 signals, transmitted physically over the 75ohm coaxial cable in the unbalanced mode or the 120 ohm cable in the balanced mode or through digital microwave, fiber transmission (SDH/PDH) or satellite link.

Physically, the Abis interface is an E1 interface and uses thin coaxial cables for connection.

Protocols on the Abis interface are hierarchical, and the protocol hierarchy of circuit service is shown in Figure 10. The Abis interface does not process the packet service protocol, and it is transparent for the packet signaling.

FIGURE 10 CIRCUIT SERVICE PROTOCOL LAYERED STRUCTURE OF ABIS INTERFACE



On the Abis interface, the circuit service protocols fall into three layers:

1. Layer-1 (physical layer) is the PCM digital link at the rate of 2,048 Kbit/s.
2. Layer-2 (data link layer) is based on the LAPD.
3. Layer-3 transparently transmits the layer-3 messages on the A interface and manages radio resources.

The protocols related to the Abis interface are as follows:

- GSM 08.52 presents the basic principles and rules of the other specifications for the Abis interface and how the service functions are divided between BSC and OB06.
- GSM 08.54 specifies the physical structure of the Abis interface.
- GSM 08.56 specifies the data link layer protocol for the Abis interface.
- GSM08.58 stipulates the layer-3 protocols of the Abis interface.
- GSM 12.21 specifies the O&M message transmission mechanism on the Abis interface.

The data format of Abis interface can be flexibly configured. Configuration examples of the Abis interface are shown in Figure 11.

FIGURE 11 EXAMPLE OF ABIS INTERFACE TIMESLOT CONFIGURATION

	0	1	2	3	4	5	6	7
TS0	SYNC							
TS1	TCH0		TCH1		TCH2		TCH3	
TS2	TCH4		TCH5		TCH6		TCH7	
TS3	TCH0		TCH1		TCH2		TCH3	
TS4	TCH4		TCH5		TCH6		TCH7	
TS5	TCH0		TCH1		TCH2		TCH3	
TS6	TCH4		TCH5		TCH6		TCH7	
TS7	TCH0		TCH1		TCH2		TCH3	
TS8	TCH4		TCH5		TCH6		TCH7	
TS9	TCH0		TCH1		TCH2		TCH3	
TS10	TCH4		TCH5		TCH6		TCH7	
TS11	TCH0		TCH1		TCH2		TCH3	
TS12	TCH4		TCH5		TCH6		TCH7	
TS13	TCH0		TCH1		TCH2		TCH3	
TS14	TCH4		TCH5		TCH6		TCH7	
TS15	TCH0		TCH1		TCH2		TCH3	
TS16	TCH4		TCH5		TCH6		TCH7	
TS17	TCH0		TCH1		TCH2		TCH3	
TS18	TCH4		TCH5		TCH6		TCH7	
TS19	FUL							
TS20	FUL							
TS21	FUL							
TS22	FUL							
TS23	FUL							
TS24	EAM3							
TS25	EAM2							
TS26	EAM1							
TS27	EAM0							
TS28	O&M3							
TS29	O&M2							
TS30	O&M1							
TS31	O&M0							

	0	1	2	3	4	5	6	7
TS0								
TS1	TCH0		TCH1		TCH2		TCH3	
TS2	TCH4		TCH5		TCH6		TCH7	
TS3	TCH0		TCH1		TCH2		TCH3	
TS4	TCH4		TCH5		TCH6		TCH7	
TS5	TCH0		TCH1		TCH2		TCH3	
TS6	TCH4		TCH5		TCH6		TCH7	
TS7	TCH0		TCH1		TCH2		TCH3	
TS8	TCH4		TCH5		TCH6		TCH7	
TS9	TCH0		TCH1		TCH2		TCH3	
TS10	TCH4		TCH5		TCH6		TCH7	
TS11	TCH0		TCH1		TCH2		TCH3	
TS12	TCH4		TCH5		TCH6		TCH7	
TS13	TCH0		TCH1		TCH2		TCH3	
TS14	TCH4		TCH5		TCH6		TCH7	
TS15	TCH0		TCH1		TCH2		TCH3	
TS16	TCH4		TCH5		TCH6		TCH7	
TS17	TCH0		TCH1		TCH2		TCH3	
TS18	TCH4		TCH5		TCH6		TCH7	
TS19	TCH0		TCH1		TCH2		TCH3	
TS20	TCH4		TCH5		TCH6		TCH7	
TS21	TCH0		TCH1		TCH2		TCH3	
TS22	TCH4		TCH5		TCH6		TCH7	
TS23	TCH0		TCH1		TCH2		TCH3	
TS24	TCH4		TCH5		TCH6		TCH7	
TS25	FUL							
TS26	FUL							
TS27	FUL							
TS28	FUL							
TS29	FUL							
TS30	FUL							
TS31	FUL							

An O&M timeslot on the Abis interface is multiplexed in each site, and the O&M signaling at different sites occupies the fixed timeslot on the Abis interface. During the CMM initialization, the CMM reads the ID signal from the cabinet top to locate the TS of the O&M signaling on the Abis interface. For detailed description of ID, refer to *ZXG10 OB06 (V1.0) Compact Outdoor BTS for GSM Hardware Manual*.

For example, the site that is directly connected to BSC occupies the TS 30 Link A for O&M signaling, while the level-1 cascaded site occupies the TS 28 Link A for O&M signaling. The rest may be deduced by analogy. If the previous-level faulty E1 interface is bridged, the next-level site can identify the O&M channel corresponding to the site. The level of the site can be read out on the DIP switch on the CMM board.

The Abis interface has four types of TSs: TCH TS for TRM service, FUL TS for TRM signaling, O&M TS and EAM TS for transparent environment monitoring channel.

The Abis interface processing is as follows:

1. Transparently transmit the TCH, FUL, O&M and EAM between cascaded sites.
2. Downlink direction inside a site: The TCH and FUL signaling are transparently transmitted to each TRM. The Q&M will be transparently switched to the QMC interface of CMM in each cabinet. The CMM will identify the O&M signaling according to TEI. EAM will be transparently transmitted by the base cabinet.
3. Uplink direction inside a site: The TCH signaling is transmitted transparently. The FUL signaling in the same cabinet is compressed and packed in the CMM. The O&M signaling is multiplexed based on TEI, and the EAM signaling is transmitted transparently in the base cabinet.

Um Interface

The Um interface is the interface between OB06 to MS, an important external interface of the OB06.

In the PLMN, MS connects the fixed part of the network through a radio channel to enable subscribers to access communication services.

To interconnect the MS and OB06, a series of stipulations are provided for signal transmission over the radio channel, and a set of standards is set up. This set of specifications about signal transmission over radio channel is the Um interface.

The Ums interface is designed with a hierarchical model. The circuit service protocol hierarchy is shown in Figure 12, and the packet service protocol hierarchy is shown in Figure 13. The packet service protocol is implemented in the BSC, so it is not introduced here.

FIGURE 12 CIRCUIT SERVICE PROTOCOL HIERARCHY OF THE UM INTERFACE

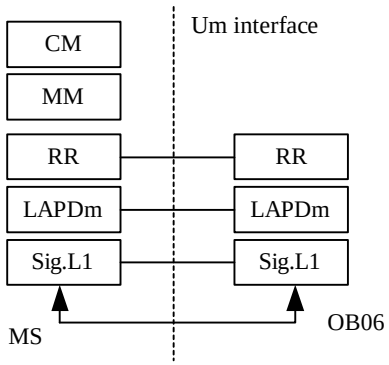
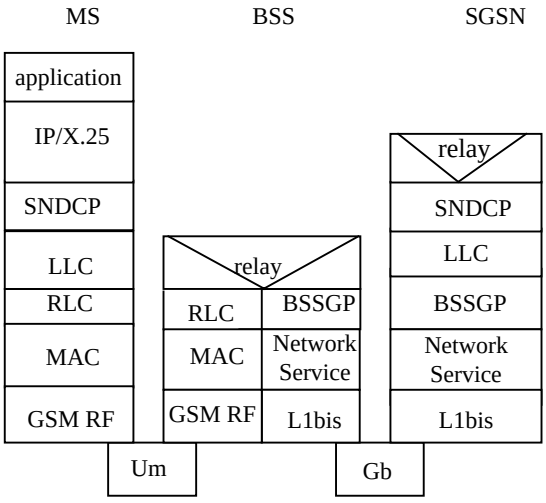


FIGURE 13 PACKET SERVICE PROTOCOL STACK STRUCTURE OF THE UM INTERFACE



On the Um interface, the circuit service protocols fall into three layers:

1. The first layer is the physical layer and also the bottom layer. It consists of various channels and provides the basic wireless channels for upper-level message transmission.
2. The second layer is the data link layer and also the medium layer, with the LapDm adopted. It comprises various data transmission structures and controls data transmission.
3. The third layer (L3) is the highest layer. It comprises various messages and programs and provides service control. L3 consists of three sub-layers: radio resource management (RR), mobility management (MM) and connection management (CM).

The relevant protocols of the Um interface are as follows:

- GSM 04.03 describes the channel structure and access capability of the Um interface.
- GSM 04.04 specifies the physical layer structure of the Um interface.
- GSM 04.05 specifies the data link layer protocol for the Um interface.
- GSM 04.08 stipulates the layer-3 protocols of the Um interface.

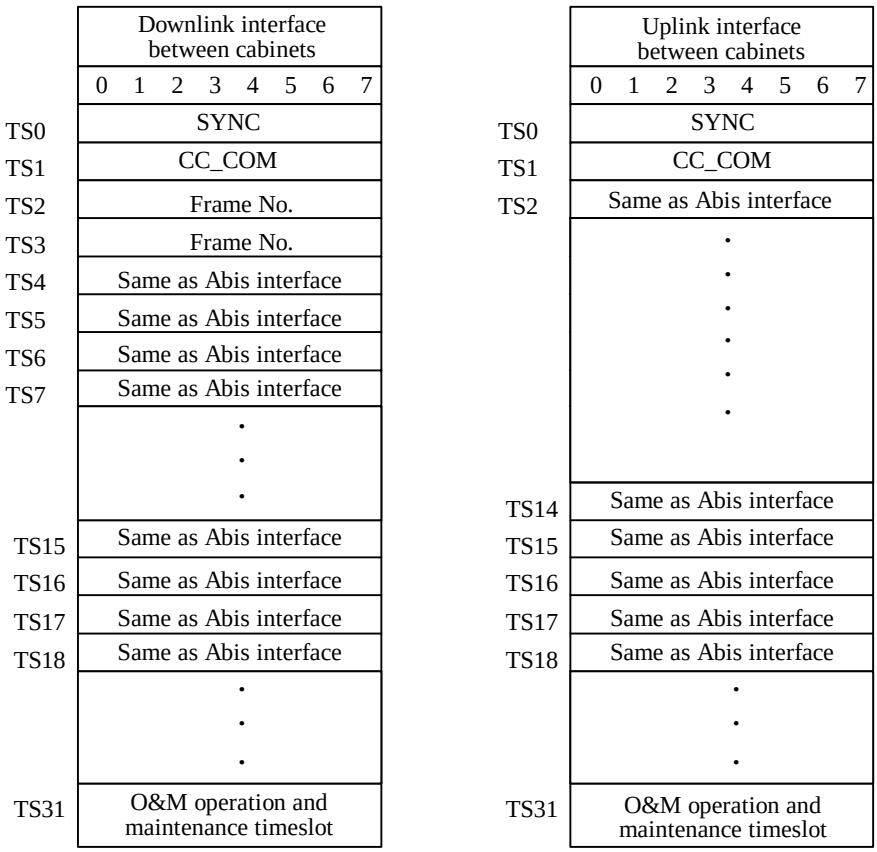
Inter-Cabinet Cascaded Interface of Same Site

Inter-cabinet star connection is supported at the same site (one site supports three OB06 cabinets at most).

The data interface between cabinets also employs the standard PCM 2M E1 signal to transfer service, TRM signaling, inter-cabinet O&M signaling and FN (Frame Number). Service signaling and TRM signaling will be transparently transmitted, while O&M and FN will be transmitted through the time division HDLC link.

The inter-cabinet data interface format is shown in Figure 14.

FIGURE 14 DATA INTERFACES BETWEEN IN-SITE CABINETS



After CMM is powered on, it reads the ID signal to locate the position of the O&M TS. The base cabinet generates and outputs FN and SYNCLK while the extension cabinet receives them. The cabinet category is read by the CMM from the cabinet top ID signal.

The inter-cabinet FN will be transmitted and broadcasted through the HDLC protocol, the inter-cabinet O&M TS through the HDLC protocol and inter-cabinet communication (CC_COM) through the HDLC protocol. Details are introduced as follows:

In the downlink direction, the CMM will transparently switch the O&M timeslot of the Abis interface to the processor of this board and other cabinets of the same site. The CMM will identify the O&M according to TEI.

Upstream, CMM compresses the O&M TSs of this cabinet and the next cabinet to send to the upper-level CMM. Thus, the base cabinet compresses the O&M messages of three cabinets into one O&M message to report to BSC.

Interfaces of the Tower Amplifier System

The interfaces of the tower amplifier system must be reserved during installation of the tower amplifier for OB06, including the power interface and the alarm interface of the tower amplifier. In general, they are interfaces for providing the DC feed and alarm monitoring, and the alarm is detected from the DC current.

OB06 can provide +12 V power supply and up to 300 mA current for the tower amplifier system through the power interface.

The tower amplifier alarm is accessed to the backbone node in the OB06 through the backbone node alarm mode, and it is monitored by the OB06. When two lines of the backbone node in OB06 are connected or connected at a low resistance, it indicates there is alarm output for the tower amplifier, and Alarm is ON. When two lines of the backbone node in OB06 are not connected or connected at a high resistance, it indicates there is no alarm output for the tower amplifier, and Alarm is OFF.

The tower amplifier power interface is located on the cabinet top, and one OB06 cabinet can provide 3 tower amplifier power interfaces.

Man-Machine Interface (MMI)

The MMI is a serial communication interface between the OB06 and local O&M terminal.

It is realized by the 10-BaseT network interface or RS 232 interface between the CMM and local O&M terminal.

It can be connected to the serial interface of a local O&M terminal computer or network interface through the ETP interface of the CMM panel.

Protocol Introduction

Two important external interfaces for the ZXG10 OB06 (V1.0) are the Abis and the Um interface.

On the Abis and the Um interface, the ZXG10 OB06 (V1.0) processes the LapD protocol, LapDm protocol and RR/MM/CM protocol. The following are descriptions of the three protocols in combination with the actual system circumstance.

LapD Protocol

LapD (link access procedure of "D" channel) is a data link procedure for signaling transmission between ZXG10 OB06 (V1.0) and BSC, with the purpose of using the D channel to transmit messages between Layer-3 entities.

LapD is a point-to-multipoint communication protocol that employs the frame structure.

In the ZXG10 OB06 (V1.0), LapD implements the following functions:

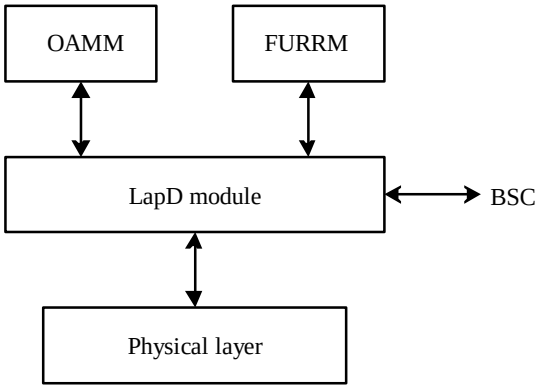
1. Providing one or multiple data connections in the D channel

   The data link connections are identified by the DLCIs in the frames. DLCI consists of the Terminal Equipment Identifier (TEI) and Service Access Point Identifier (SAPI), indicating the service and entity that are accessed.
2. Delimitation, location and transparency of the frame
3. Sequence control, ensuring sequential transmission of the frames
4. Error detection
5. Error recovering
6. Notifying the management entity of the un-recoverable error
7. Traffic control

Functions 1, 2 and 4 hereof are implemented automatically by the hardware, while functions 3, 5, 6 and 7 are implemented through the software.

In ZXG10 OB06 (V1.0), LapD is realized in the LapD module of RSL. The position of the LapD module in RSL is shown in Figure 15.

FIGURE 15 POSITION OF LAPD MODULE



The LapD module communicates with the physical layer and L3. The L3 protocol is processed in FURRM.

OAMM configures the parameters such as TEI and values of the timer necessary for the LapD module to run.

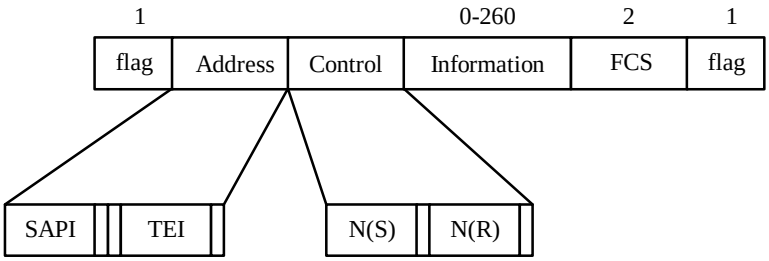
The LapD module provides two types of information transmission modes for the FURRM: I-frame multi-frame operation and UI frame operation.

1. I-frame multi-frame operation

   The L3 message is sent in the information frame mode which requires the confirmation from the receiver. This mode provides a whole set of control mechanism for error recovering and flow control, the establishment mechanism and release mechanism for multi-frame operations.

   The I-frame structure is shown in Figure 16, including the flag sequence, address field, control field, information field and check field.

FIGURE 16 FRAME STRUCTURE OF LAPD



The address field contains SAPI and TEI. It performs addressing for different units through TEI in the Abis interface link. Generally, a unit has multiple functional entities, and the logical physical links between different functional entities are identified by the functional address

SAPI. The LapD supports three types of information: signaling (including short message information), O&M information and LapD layer management information. Links of the three kinds of information are distinguished by SAPI. SAPI=0 represents the signaling link, SAPI=62 represents the O&M link, and SAPI=63 represents the management link of the LapD layer.

In the control field, N(S) represents the sending serial number and the I frame's serial number currently sent by the sending end; N(R) represents the receiving serial number, the expected sending serial number of the next I frame. N(R) is used to predict the instruction from the receiving end.

Frame Check Sequence (FCS) is used for error code detection.

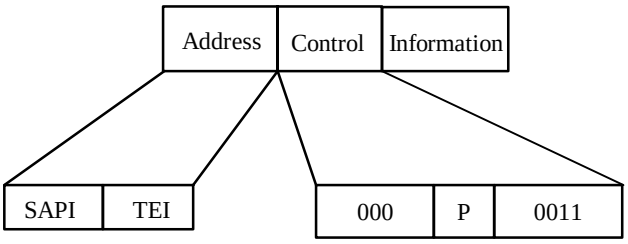
Flag is the beginning and the end token of a frame, namely, a 8-bit font containing six consecutive 1s.

2. UI frame operation

   The L3 message is sent in the no-serial-number frame mode, and the receiver is not required to send the received confirmation after receiving the UI frame. This operation mode does not provide flow control or error recovering mechanism.

   The UI frame structure is shown in Figure 17. It consists of the address field, control field and information field.

FIGURE 17 UI FRAME STRUCTURE OF LAPD



The address field contains SAPI and TEI. In the address field, P represents the query bit; if this bit is set to 1, it means to require the response frame from the peer entity.

LapDm Protocol

In GSM, LapDm is a data link protocol for signaling transmission between MS and ZXG10 OB06 (V1.0), with the purpose of using the Dm channel to transmit messages for entities of Layer 3 through the radio interface. LapDm is based on LapD, with some simplification and modification.

In the ZXG10 OB06 (V1.0), LapDm implements the following functions:

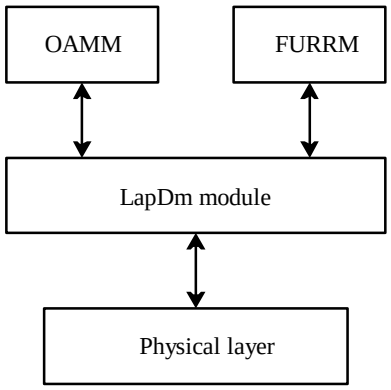
1. In a Dm channel, providing a point-to-point data link connection and multiple services for the upper layer. The data link connections are identified by the DLCIs in the frames. The DLCI only contains SAPI, indicating the service that is accessed.

2. Supporting the identification of diversified frame types.
3. Supporting the transparent transmission of the L3 message between L3 entities.
4. Sequence control, to maintain the sequence of frames connected through data link.
5. Checking the format and operation errors in the data link layer.
6. Notifying the L3 entities to process the unrecoverable errors.
7. Flow control.
8. Supporting access of the burst solution mode after the RACH channel access is instantly assigned.

In the ZXG10 OB06 (V1.0), LapDm is implemented in the LapDm module of RSL.

The position of LapDm module in RSL is shown in Figure 18.

FIGURE 18 LAPDM MODULES



The LapDm module communicates with the physical layer and L3. The L3 protocol is processed in FURRM. OAMM configures the value of the timer necessary for LapDm module to run.

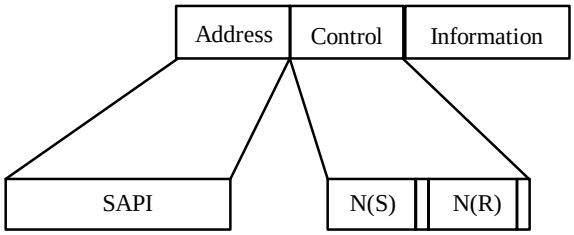
The LapDm module provides two types of message transmission modes for FURRM: I-frame multi-frame operation and UI frame operation. In terms of frame structure, LapDm cancels the frame delimiter flag (FLAG) and the FCS. In LapDm, the synchronization scheme of the radio interface can be used to transmit the boundary message without the corresponding start frame or end frame flags. The transmission scheme provided by the physical layer of the Um interface boasts the error check function, so FCS is not used for LapDm.

1. I-frame multi-frame operation

   The L3 message is sent in the information frame mode which requires the confirmation from the receiver. This mode provides a whole set of control mechanism for error recovering and flow control, the establishment mechanism and release mechanism for multi-frame operations.

The I frame structure of LapDm is shown in Figure 19.

FIGURE 19 I FRAME STRUCTURE OF LAPDM



The I-frame in LapDm consists of the address field, control field and information field.

The address field contains the SAPI. On the radio interface, LapDm supports two types of messages: signaling and short message service, distinguished by the SAPI. SAPI=0 represents the signaling link, and SAPI=3 represents the short message link.

The maximum length of a LapDm frame on the TCH is 23 bytes, and 21 bytes on the SACCH. The reason for this difference is that there are two special-purpose bytes in each SACCH block: Since the maximal length of the frame on the radio interface is of 21 or 23 bytes which cannot meet the need of most pieces of signaling, segmentation and regrouping are required to be defined in LapDm. Thus an "additional" bit is used to distinguish the last packet frame from other frames. Thanks to this mechanism, there will be no restriction to fix the packet length on the radio path, with the only exception when these messages must be transmitted on other interfaces, namely, 260 bytes mentioned in the radio interface specification.

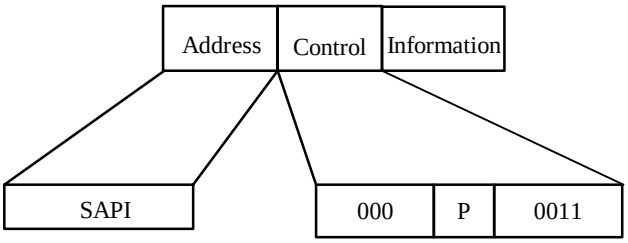
In the control field, N(S) represents the sending serial number and the I frame's serial number currently sent by the sending end; N(R) represents the receiving serial number, the expected sending serial number of the next I frame. N(R) is used to predict the instruction from the receiving end.

2. UI frame operation

   The L3 message is sent in the no-serial-number frame mode, and the receiver is not required to send the received confirmation after receiving the UI frame. This operation mode does not provide flow control or error recovering mechanism.

The UI frame structure of LapDm is shown in Figure 20.

FIGURE 20 UI FRAME STRUCTURE OF LAPDM



The UI frame in LapDm consists of the address field, control field and information field. The address field contains the SAPI. In the address field, P represents the query bit; if this bit is set to 1, it means to require the response frame from the opposite-end peer entity.

RR/MM/CM Protocol

The RR/MM/CM protocol, including three sub-layers of CM, MM and RR, is responsible for control and management; it groups and arranges the information of the subscriber and system control process into the designated logical channels according to certain protocol packets.

1. CM Layer: It is responsible for communication management. It establishes connections between subscribers, and holds and releases calls. This layer provides call control (CC), supplementary service management (SSM) and short message service (SMS).
2. MM layer: It is responsible for mobility and security management, namely, the necessary processing when the MS initiates location updating.
3. RR layer: It is responsible for radio resource management. It establishes and releases connections between the MS and MSC during the call process.

In ZXG10 OB06 (V1.0), the radio resource management module and paging module of RSL are used to implement the RR/MM/CM protocol, and perform the processing of transparent and non-transparent messages in L3.

Transparent messages: ZXG10 OB06 (V1.0) is responsible for transferring that kind of messages, without any analysis or change.

Non-transparent messages: They are only transmitted between the BSC and ZXG10 OB06 (V1.0), and are processed by the ZXG10 OB06 (V1.0) according to the specific message contents.

1. Um interface

   The signaling on the Um interface includes all messages of RR, MM and CM, and most of the messages are transparent to the ZXG10 OB06 (V1.0).

The L3 message structure on the Um interface is shown in Figure 21.

- The protocol indicator is used to indicate the protocol type (RR, CM or SMS).
- TI, a transaction identifier, is used to distinguish multiple concurrent CM connections.
- The message type indicates the function of the L3 message.

FIGURE 21 MESSAGE STRUCTURE ON THE UM INTERFACE

T1 flag	TI	Protocol Indicator
0	Message type	
Information cell (compulsory)		
Information cell (optional)		

2. Abis interface

On the Abis interface, most of the radio interface signaling messages are transmitted transparently in L3. It performs management over the physical and logical equipment of ZXG10 OB06 (V1.0), including equipment start, release, parameter control and performance monitoring, thus ensuring normal communication services. It divides the managed objects into four types: radio link layer, dedicated channel, control channel and transceiver.

The message structure of L3 on the Abis interface is shown in Figure 22

- The message discriminator indicates the message type (management message of the radio link layer, management message of the dedicated channel, management message of the common channel or management message of TRX).
- T indicates whether it is a transparent message.
- The message type indicates the function of the L3 message.
- The channel number indicates the channel combination type as well as marks the timeslot number.
- The link flag contains the contents such as SAPI and so on.

FIGURE 22 MESSAGE STRUCTURE OF L3 ON THE ABIS INTERFACE

Message identifier	T
Message type	
Channel No.	
Link ID	
Other information cells	

Chapter 4

System Functions

This chapter discusses the functions of the ZXG10 OB06 (V1.0), including RF, baseband processing, signaling processing, O&M, and ultra-distance coverage.

Overview

The OB06 receives the management and controls from BSC. It works with the BSC to manage radio resources and radio network, control the establishment, connection and disconnection of the radio connections between MS and OB06, control the access, handover and paging of MS, provide voice coding, transcoding and rate adaptation functions, provide the adaptation and interconnection functions of GPRS services, and implement the operation and maintenance functions of the BSS.

OB06 has the following four major functions to implement the above service functions:

1. RF function: Implementing the radio connections between the MS and BTS.
2. Baseband processing function: Providing voice coding, transcoding and rate adaptation functions, including the processing of the GPRS part.
3. Based on the BSC instructions, controlling the establishment, connection and disconnection of the radio connections between MS and BTS, and controlling the access, handover and paging of MS, including the processing of the GPRS part.
4. Operation and maintenance (O&M) function: Providing an O&M agent for the BSC, managing radio resources and radio network and implementing the O&M functions for OB06 subsystems.

Major RF Functions

The RF function of the OB06 meets the requirements of the GSM 05.05 protocol, featuring the advantages of high sensitivity, flexible configuration and easy O&M, as briefed below.

High Receiving Sensitivity

The static receiving sensitivity of the OB06 reaches up to -112dBm. The high sensitivity guarantees the uplink channel performance of the OB06, and is one of the prerequisites for a wide coverage of the OB06.

Flexible Configuration

The OB06 supports 1~6 carriers per site in omni-directional or directional coverage. It can support 1 ~ 3 sector configuration mode, which can be selected by the user as required. Through the adjustment of front-end gain (such as tower amplifier and low-noise amplifier), the loss in different length of feeder of the OB06 can be compensated to guarantee consistent receiving system gain.

Easy O&M

The RF part of the OB06 can be controlled remotely through OMCR, to change the transmitting power, transmitting/receiving frequency and more. The alarm signals generated from the RF part are reported to OMCR, so that the operators at the background can control the operation of the RF part and know about the operation statuses.

Diversity Receiving

The OB06 provides the diversity receiving function, which is implemented by two sets of independent receiving equipment at the same time, including antenna, tower top amplifier (optional), feeder, divider and receiver. The application of the diversity receiving function enhances the anti-fading capability of the BTS receiver, enabling excellent receiving performance of the BTS even in complex radio transmission environment.

Frequency Hopping

Frequency hopping is another important measure to enhance OB06 performance, which not only improves the anti-fading capability in the downlink channels, but strengthens the communication security. The OB06 supports two working mode: hopping or no hopping. With hopping on, the transceiver changes working frequencies according to a certain hopping sequence, while with hopping off, the transceiver locks a specified working frequency.

Power Control

The OB06 can provide static power control, dynamic power control and idle timeslot transmitting shutoff functions. The static power control range is up to 12 dB, 2 dB per step. The static power control enables the user to adjust the OB06 coverage. The dynamic power control range is up to 30 dB, 2 dB per step. The BSC can adjust the OB06 transmitting power according to the distance between MS and OB06. In case of idle timeslot, since there is no downlink signal, the BSC commands the OB06 to shut off the transmitting power of that timeslot. These power control functions

increase the efficiency of the transmitter and the reliability of the power amplifier, and minimize the transmitter interference.

Baseband Processing

The baseband processing implements the function of the physical layer on the Um interface, processing all full-duplex channel baseband data on one TDMA frame. In the downlink direction, the functions are rate adaptation, channel encoding and interleaving, encryption, and TDMA burst generation. In the uplink direction, they are digital demodulation, decryption, deinterleaving, channel decoding and rate adaptation.

Signaling Processing

The OB06 signaling processing implements the following two functions:

1. Interconnection between the MS and BSS/NSS on the Um interface layer
2. Management of some radio resources under the control of the BSC

Specifically, the OB06 signaling processing functions are wireless link layer management function, dedicated channel management function, common channel management function and TRX management function.

Wireless Link Management Function

This function supports the following procedures:

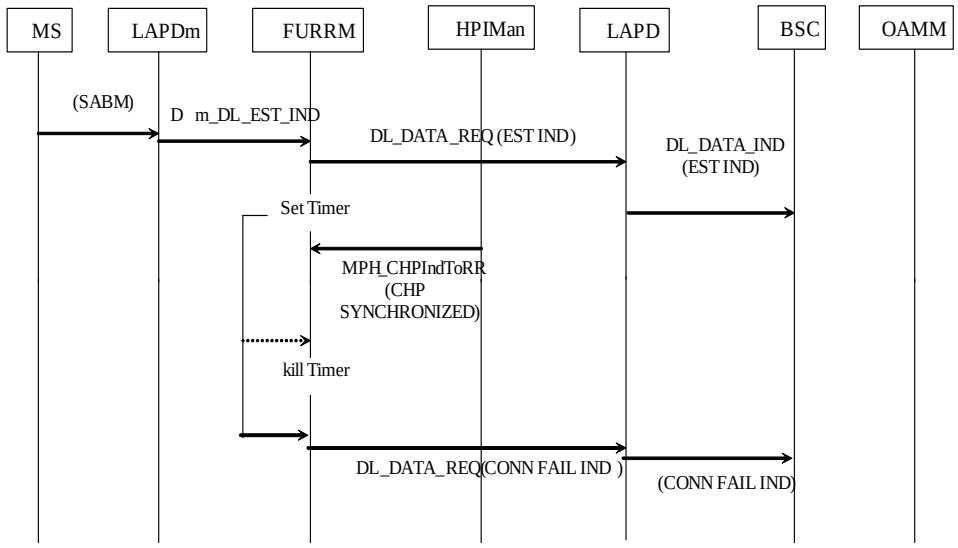
1. Link establishment indication procedure: This procedure allows the OB06 to give the BSC an indication that an MS-originated link in multi-frame mode has been established successfully. Through this indication, the BSC establishes an SCCP link to the MSC.
2. Link establishment request procedure: This procedure allows the BSC to request to establish a link in multi-frame mode on a radio channel.
3. Link release request procedure: This procedure allows the BSC to request the OB06 to release a radio link.
4. Link release indication procedure: This procedure allows the OB06 to give the BSC an indication that the MS-originated radio link has been released.
5. Um L3 message transparent forwarding procedure in acknowledgement mode: This procedure allows the BSC to request the OB06 to transparently forward a Um interface L3 message in the acknowledgement mode.
6. Um L3 message transparent receiving procedure in acknowledgement mode: This procedure allows the OB06 to give the BSC an indication that a Um interface L3 message is received transparently in the acknowledgement mode.

7. Um L3 message transparent forwarding procedure in non-acknowledgement-mode: This procedure allows the BSC to request the OB06 to transparently forward a Um interface L3 message in the non-acknowledgement mode.
8. Um L3 message transparent receiving procedure in non-acknowledgement mode: This procedure allows the OB06 to give the BSC an indication that a Um interface L3 message is received transparently in the non-acknowledgement mode.
9. Link error indication procedure: This procedure allows the OB06 to give the BSC an indication about the abnormity of a radio link layer.

Link Establishment

The procedure of the link establishment originated by MS is shown in Figure 23.

FIGURE 23 MS-ORIGINATED LINK ESTABLISHMENT



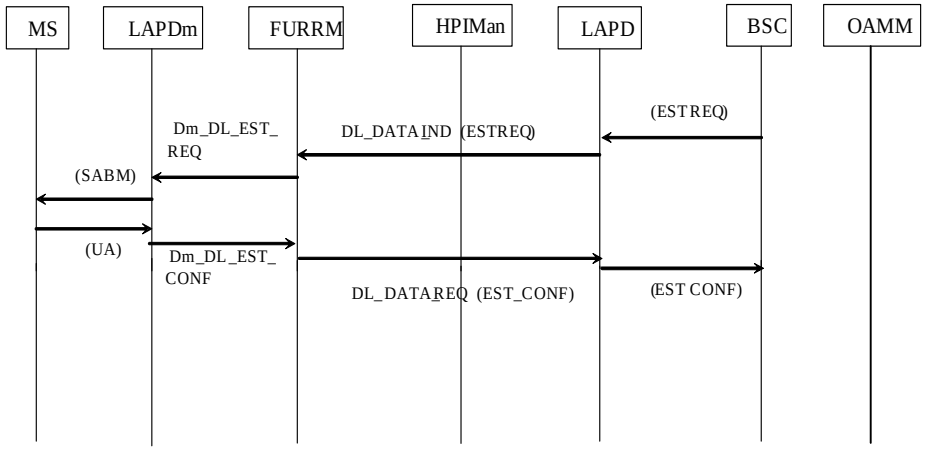
The OB06 gives the BSC an indication that one multi-frame-mode L2 link has been established on the wireless path.

During the paging, the GSM04.08 message PAGING RESPONSE will be contained in DL_EST_IND and sent to the FURRM module.

After the FURRM module sends the EST IND message, if the current channel is the TCH activated in the service mode, the synchronization timer will be enabled to wait for the synchronization between CHP and TC. If the synchronization is not implemented till the timer expires, the FURRM sends the CONN FAIL IND message to the BSC, to wait for the BSC to release the channel where the conversation cannot be established normally.

The procedure of the link establishment originated by the BSC is shown in Figure 24.

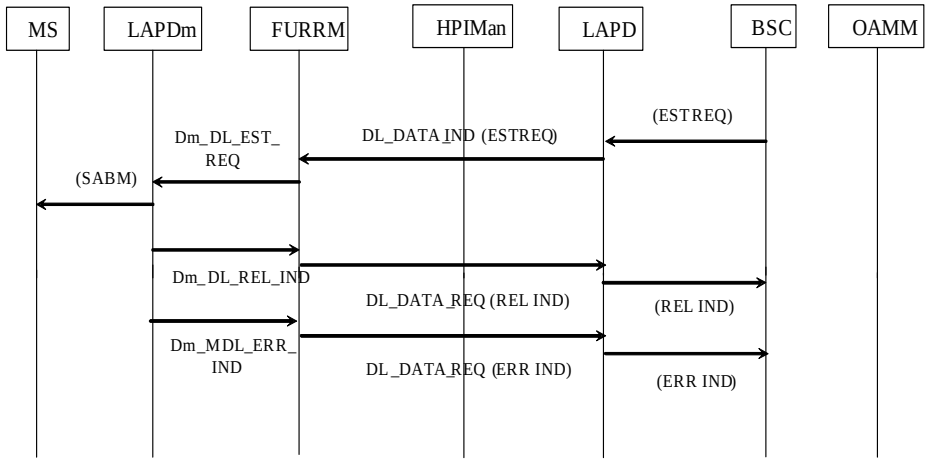
FIGURE 24 BSC-ORIGINATED LINK ESTABLISHMENT



The BSC requests the OB06 to establish a link for point-to-point transmission (SAPI=3) on the wireless path.

A link establishment failure is shown in Figure 25.

FIGURE 25 FAILURE OF LINK ESTABLISHMENT

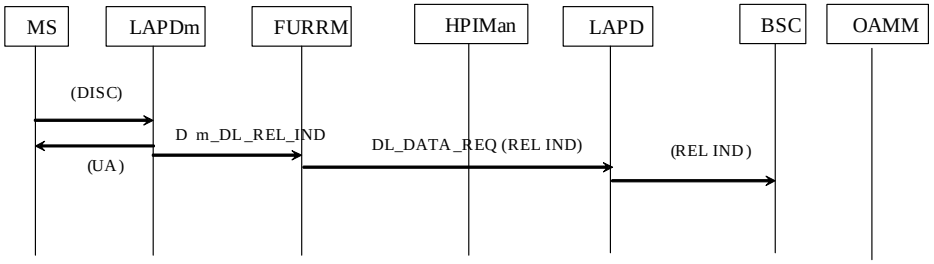


When the link connection fails, the FURRM receives the Dm_DL_REL_IND and Dm_MDL_ERROR_IND primitives from the data link layer. The latter primitive records the failure cause: "Timer T200 expires for N200 + 1 times: Execution is released abnormally" The FURRM attaches this cause in the ERROR REPORT message and reports it to the BSC.

Link Release

The procedure of the link release originated by an MS is shown in Figure 26.

FIGURE 26 MS-ORIGINATED LINK RELEASE

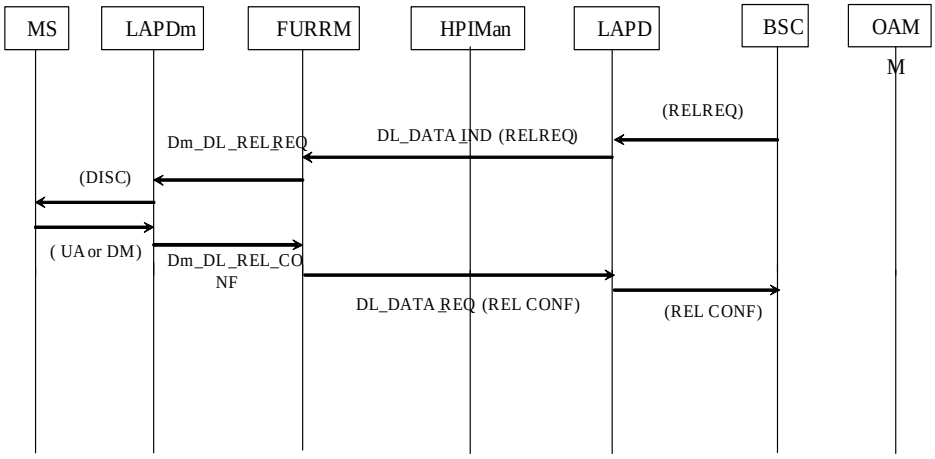


The OB06 gives the BSC an indication that the link-layer connection has been released on the wireless path.

If the link layer is in idle mode, the OB06 returns DM frame to MS but not notifies the BSC.

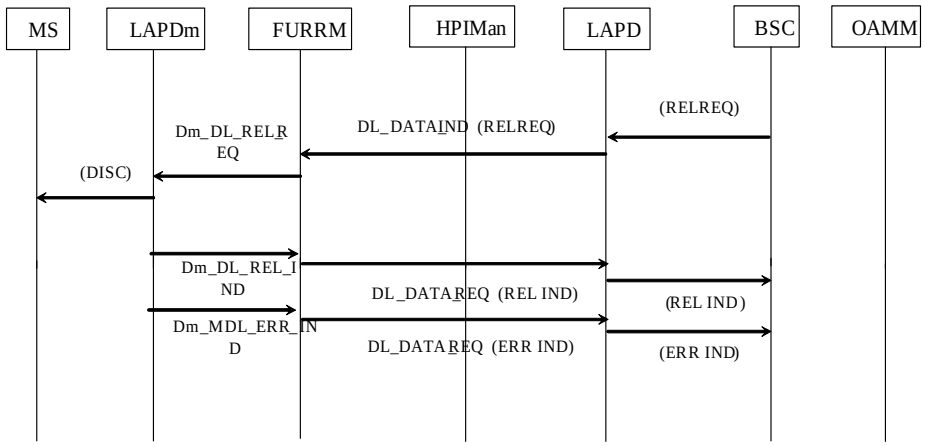
The procedure of the link release required by a BSC is shown in Figure 27.

FIGURE 27 BSC-REQUESTED LINK RELEASE



A link release failure is shown in Figure 28.

FIGURE 28 FAILURE OF LINK RELEASE



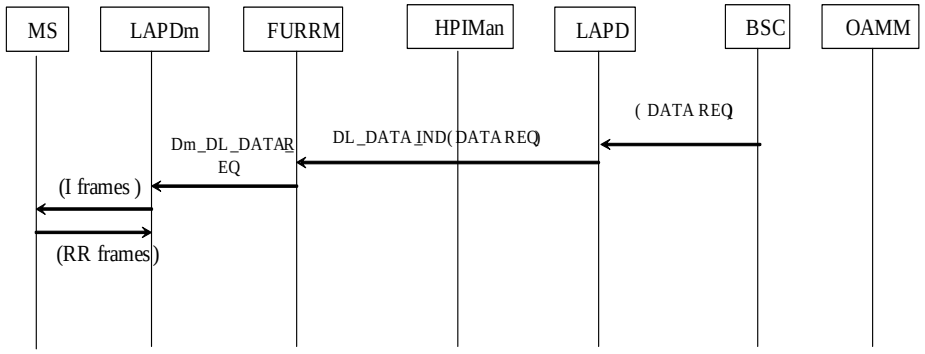
The BSC requests the release of one multi-frame-mode link layer connection (SAPI=3) on the wireless path.

The OB06 sends a DISC frame and starts the timer T200 at the same time. If the UA or DM frame is not received until T200 expires, the DISC will be resent and the resend times will increase by one. If the failure continues, the Dm_DL_RELEASE_INDICATION and MDL_ERROR_INDICATION primitives from the data link layer will be received in L3. The latter primitive records the failure cause: "Timer T200 expires for N200 + 1 times: Execution is released abnormally".

Sending and Receiving of Transparent L3 Message in Acknowledgment Mode

The transmitting is shown in Figure 29.

FIGURE 29 SENDING A TRANSPARENT L3 MESSAGE IN THE ACKNOWLEDGMENT MODE

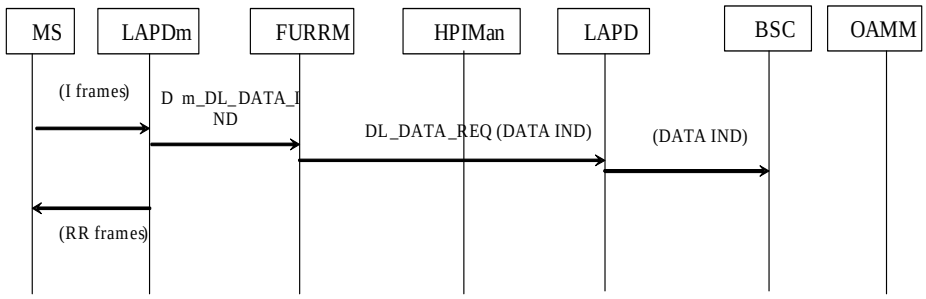


The BSC requests to send an acknowledgment mode L3 transparent message to the MS.

The DATA REQ message contains the complete acknowledgment mode L3 transparent message. At the time when the OB06 sends the I frame, the OB06 starts timer T200 and records the I frame resend times N200. When T200 expires for N200 times or the REJ frame is received, the OB06 sends the ERROR IND message to the BSC.

The receiving is shown in Figure 30.

FIGURE 30 RECEIVING A TRANSPARENT L3 MESSAGE IN THE ACKNOWLEDGMENT MODE

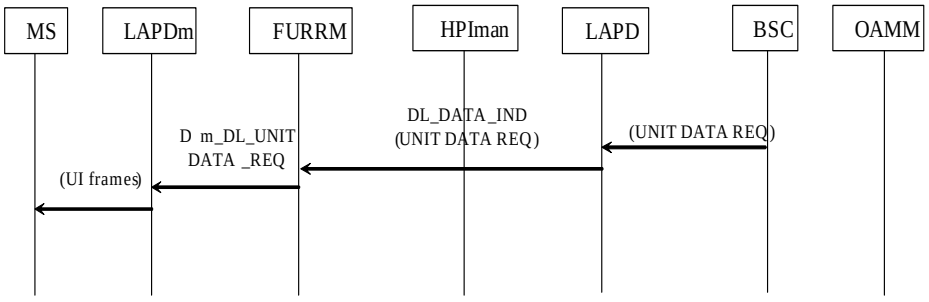


The BSC transfers to the BSC the acknowledgment mode L3 transparent message that is received from MS. The DATA IND message contains the complete transparent message.

Transmission and Receiving of Transparent L3 Message in Non-Acknowledgment Mode

The procedure of transmitting a L3 transparent message from the BSC is shown in Figure 31.

FIGURE 31 TRANSMITTING A L3 TRANSPARENT MESSAGE IN THE NON-ACKNOWLEDGMENT MODE

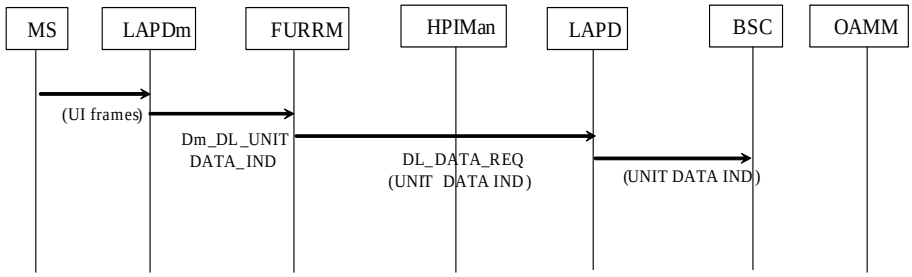


The BSC requests to send a transparent L3 message in the non-acknowledgment mode to the MS.

UNIT DATA REQ message contains the complete non-acknowledgment mode L3 transparent message.

The procedure of transmitting a L3 transparent message from the MS is shown in Figure 32.

FIGURE 32 RECEIVING A L3 TRANSPARENT MESSAGE IN THE NON-ACKNOWLEDGMENT MODE



The OB06 transfers to the BSC with the non-acknowledgment mode L3 transparent message that is received from MS.

UNIT DATA IND message contains the complete non-acknowledgment mode L3 transparent message.

Dedicated Channel Management Function

This function supports the following procedures:

1. Channel activation procedure: This procedure allows the BSC to make the OB06 activate a dedicated channel for an MS. When the channel is activated successfully, the MS is handed over to this channel through an assignment command or handover command.
2. Channel mode change procedure: This procedure allows the BSC to request the OB06 to change the mode of an activated channel.
3. Handover detection procedure: This procedure is used to check the access of a handed-over MS between the target OB06 and target BSC.
4. Encryption start procedure: This procedure is used to start the encryption procedure specified in TS GSM 04.08.
5. Measurement report procedure: It includes the mandatory basic measurement report procedure and the optional preprocessed measurement report procedure. These two procedures are used by the OB06 to report all the parameters related to the handover decisions to the BSC.
6. SACCH deactivation procedure: This procedure allows the BSC to deactivate SACCH channels of the TRX according to the requirements of the channel release procedure in TS GSM 04.08.
7. Radio channel release procedure: This procedure allows the BSC to instruct the OB06 to release a radio channel that will not be used any longer.
8. MS power control procedure: This procedure allows the BSS to control the transmitting power of the MS related to a specific activated channel.

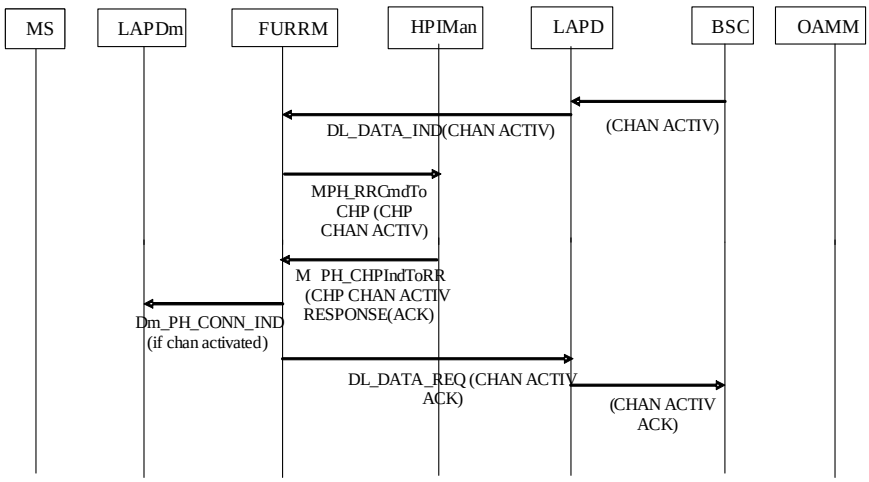
9. BS power control procedure: This procedure allows the BSS to control the transmitting power of an activated channel in the TRX.
10. Connection failure procedure: This procedure allows the OB06 to give the BSC an indication that an activated dedicated channel has been disconnected.
11. Physical environment content request/confirmation procedure: This procedure allows the BSC to obtain physical parameters of a specific channel, which generally happens before a change to the channel. This procedure is optional.
12. SACCH fill-in information change procedure: This procedure allows the BSC to instruct the OB06 to change the fill-in information (system message) on a specific SACCH.

Channel Establishment

1. Channel activation

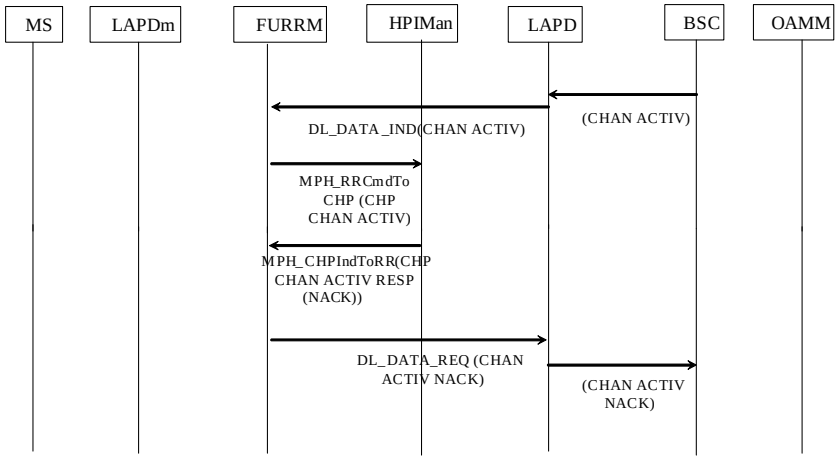
   The procedure of activating a channel successfully is shown in Figure 33.

FIGURE 33 SUCCESS OF CHANNEL ACTIVATION



A channel activation failure is shown in Figure 34.

FIGURE 34 FAILURE OF CHANNEL ACTIVATION



The TRX detects the MS random access request on the RACH, and activates a channel for the MS.

The BSC decides the channel to be used, and sends the CHAN ACTIV message to the TRX to enable that channel. This message contains the activation reason (immediate assignment, allocation, asynchronous /synchronous and additional allocation), channel ID and complete channel description (full/half rate, voice/data, code/rate adaptation, frequency hopping sequence, key, and so on). If there is encrypted information, it uses the encryption activation mode.

When the FURRM module receives the CHAN ACTIV message, it sends related information unit (activation reason, and so on) contents to the CHP for processing through the HPIMan module, and reports the results to the BSC when the response arrives.

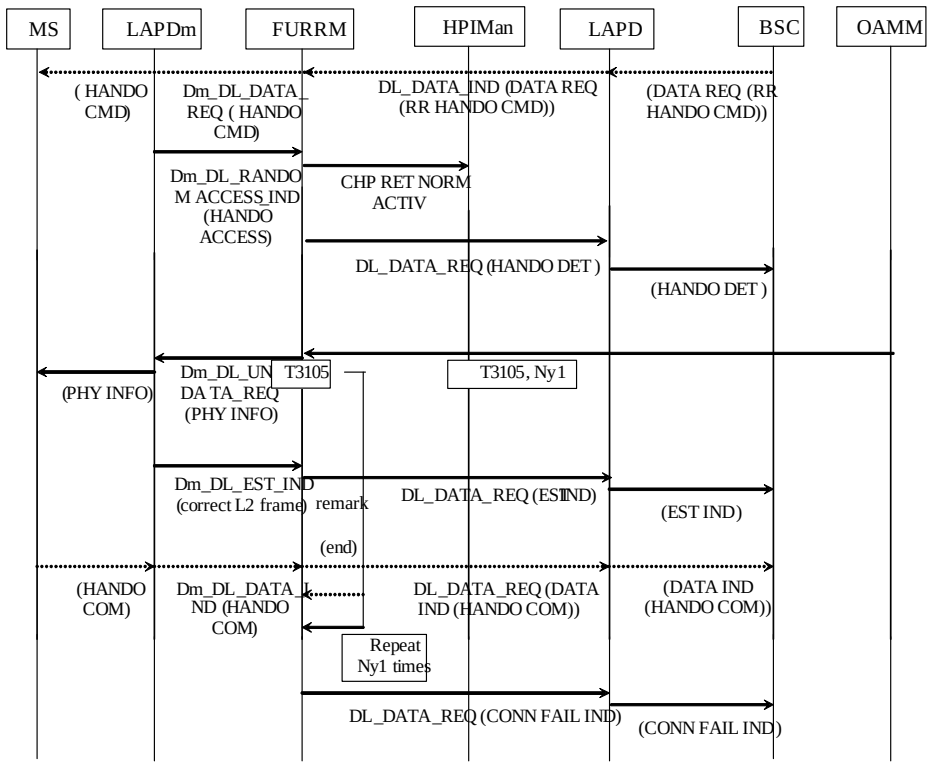
When the channel is activated, the TRX responds with the CHAN ACTIV ACK message that contains the number of the current frame with the OB06. The BSC uses this frame number to decide the Starting Time parameter in the immediate assignment message that will be then sent to the MS side.

If the TRX cannot activate the channel, it will return the CHAN ACTIV NACK message that contains the failure cause. Possible failure causes are O&M interference (channel blocked, for example), resource unavailability (without voice encoder, for example), equipment error, and channel activated.

2. Handover

The handover procedure is shown in Figure 35.

FIGURE 35 HANDOVER



The handover enables an MS in the dedicated mode to move into another channel of another cell.

When the BSC receives the HANDO REQ message from the MSC, the BSC enables the new channel activation procedure. The CHAN ACTIV message sent to the TRX contains Handover Reference, which will be used to detect the Handover Access message from MS.

When the channel for handover is activated, the FURRM uses the CHP RET NORM ACTIV message to notify the CHP to resume the normal mode.

The FURRM should save the Handover Reference in the CHAN ACTIV message, to compare it with the Handover Reference in the Handover Access message that is sent by the LAPDm.

The (RR) HANDOVER COMMAND message is sent on the active DCCH. This transparent message contains new channel characteristics, power command, physical channel establish procedure indication, handover reference, time lead (optional) and encryption mode setting (optional). It also controls whether to connect MS first in synchronous activation mode.

About the physical channel establishment, in case of synchronous handover, when MS is to be connected on the allocated channel, it will send four (RR) HANDOVER ACCESS messages on the active DCCH in one

access burst, whose content is the handover reference information unit. The OB06 starts immediately the send on the active channel in specified mode, with encryption if there is any encryption indication. If there are MS power and time lead, or only MS power, the OB06 will use the parameter to start the send on SACCH. When the OB06 receives one access burst with correct handover reference or one correct decoding frame, the OB06 starts the normal receiving procedure on the active channel and SACCH, and starts the handover detection procedure that is sent to the BSC. The measured access burst delay is contained in the HANDO DET message.

In asynchronous handover, when MS is connected to the allocated channel, the first half procedure is the same as that in the synchronous handover (see above). When the HANDO DET message is sent, the OB06 sends the (RR) PHY INFO message to MS in non-acknowledgement mode on the active signaling channel, and starts T3105 at the same time. If T3105 expires before a correct decoding frame is received, the message will be resent. If no correct decoding frame is received when the message has been resent for Ny1 times, the OB06 will send to the BSC a CONNECTION FAILURE message with the cause "Handover access failed". When the message is received, the network side will disconnect the new channel. At this stage, the RR session release procedure begins: Channel release and link release.

Pseudo-synchronous cell: The procedure is the same as that in a synchronous cell. When the bottom connection is established, the MS returns a (RR) HANDOVER COMPLETE message (transparent) on the active DCCH. If the bottom connection fails, the MS returns a HANDOVER FAILURE message. When the message is received, the network side will disconnect the new channel and enter the RR session release procedure.

The parameters T3105 and Ny1 are sent by the OAMM module to the FURRM during the system initialization.

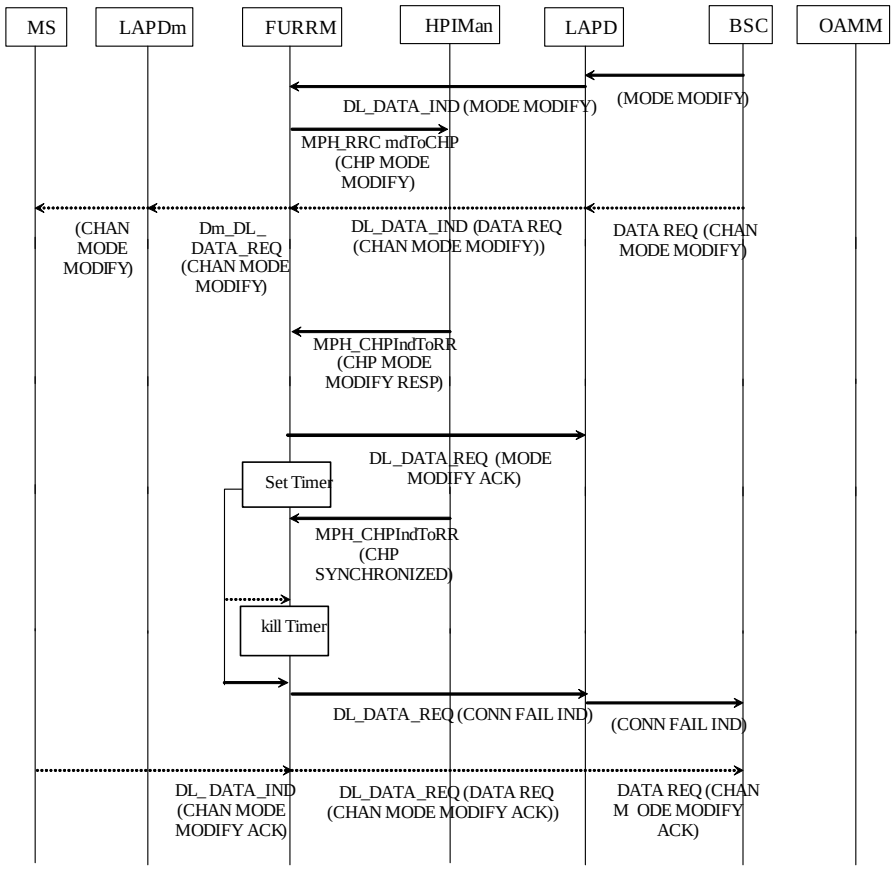
Remarks: Similar to the link establishment procedure, when a TCH channel in the service mode is set up, it waits for a synchronization message.

Channel Mode Change

1. Mode change

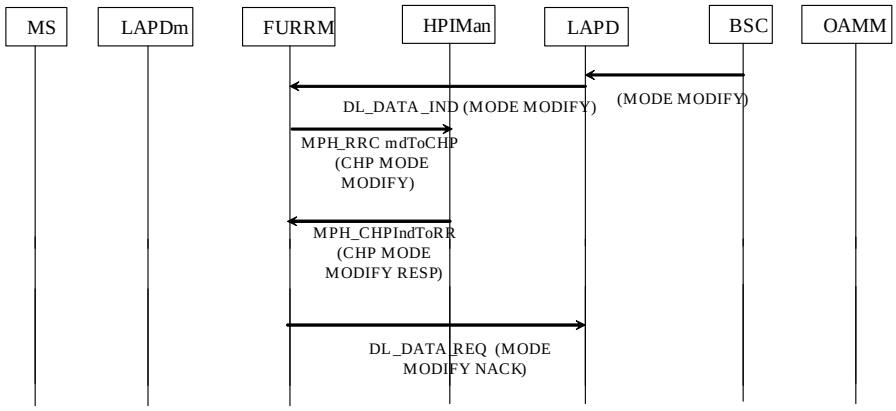
   The successful mode change is shown in Figure 36.

FIGURE 36 SUCCESS OF MODE CHANGE



The mode change failure is shown in Figure 37.

FIGURE 37 FAILURE OF MODE CHANGE



The BSC requests to change the channel mode of an activated channel.

The BSC sends a MODE MODIFY to the OB06 to trigger the reconfiguration of the OB06. When the OB06 receives the message, it modifies the encoding and decoding algorithms (the CHP module implements this operation), and modifies the inband mode of the OB06-TRAU frame. After it changes into the new mode, the OB06 returns a MODE MODIFY ACK message. If the TRX cannot change the mode for some reasons, it returns a MODE MODIFY NACK message.

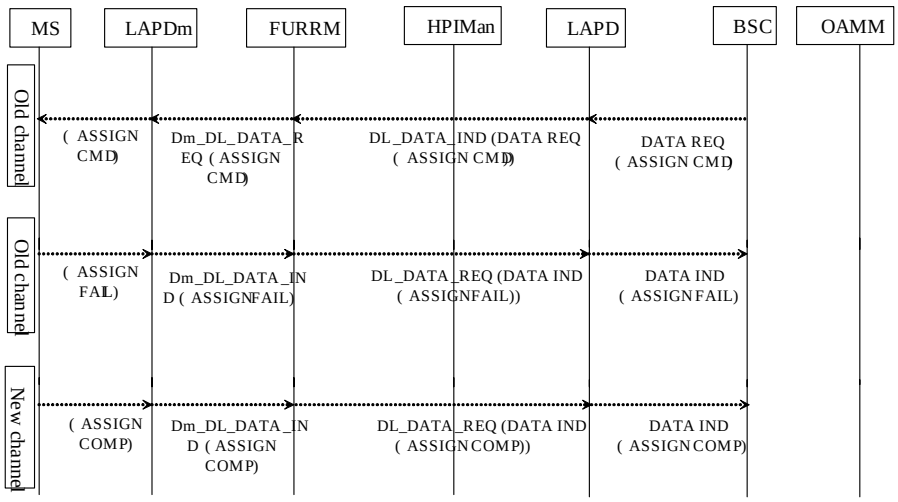
If the response message indicates the successful mode change and the TCH channel changes into the service mode, the FURRM starts the timer to wait for the CHP SYNCHRONIZED message for the synchronization between CHP and TC. If the message is not received when the timer expires, it sends the CONN FAIL IND message to the BSC.

At the same time, the BSC sends a (RR) CHANNEL MODE MODIFY message that contains the new mode to be used to trigger the reconfiguration of the MS. When it is implemented, the MS responds with the (RR) CHANNEL MODE MODIFY ACKNOWLEDGE message to the BSC through the OB06. If the MS does not support the channel to be modified, it will keep its original mode, and place related information in the CHANNEL MODE MODIFY ACKNOWLEDGE message. These two are transparent messages.

2. Connection allocation

   The procedure of connection allocation is shown in Figure 38.

FIGURE 38 CONNECTION ALLOCATION



The wireless link is changed in the same cell.

The BSC commands the OB06 activation through a simple request/acknowledgement procedure (see the CHAN ACTIV and CHAN ACTIV ACK of the "access" procedure). Once the OB06 is activated, the BSC commands the MS to perform channel change through the (RR) ASSIGNMENT COMMAND message. When the MS changes its settings according to the new information and establishes a new signaling link,

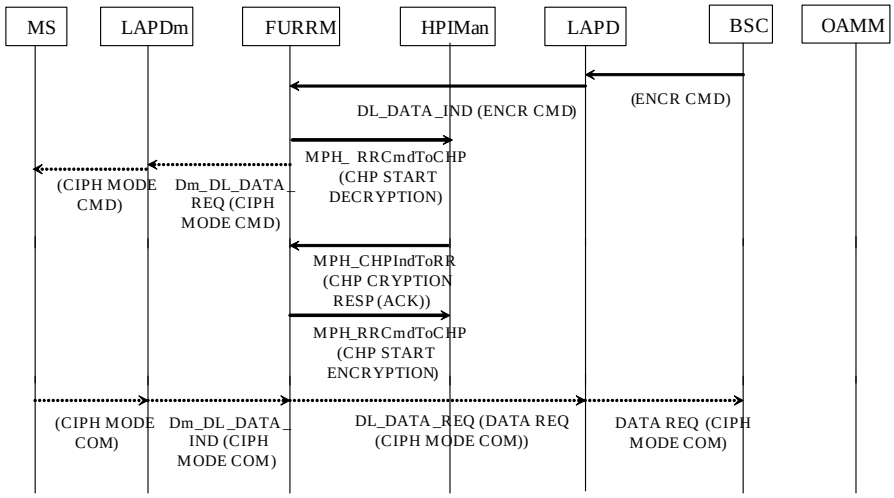
the MS sends an (RR) ASSIGNMENT COMPLETE message to the BSC. If the MS cannot implement the connection allocation for some reasons, it will send the (RR) ASSIGNMENT FAILURE message on the original channel.

The FURRM transfers transparently the (RR) ASSIGNMENT COMMAND, (RR) ASSIGNMENT COMPLETE and (RR) ASSIGNMENT FAILURE messages.

Encryption

The encryption is shown in Figure 39.

FIGURE 39 ENCRYPTION



To set an encryption mode for the network means specifying whether the transmission needs to be encrypted and which algorithm should be used.

This procedure is initiated after the BSC receives the CIPHER MODE COMMAND message from the MSC. The ENCR CMD message that is sent by the BSC to the TRX and related channel contains all information to be selected, loading user data, encryption equipment and the complete (RR) CIPH MODE CMD message that is sent to the MS.

When the ENCR CMD is received, the TRX sends the (RR) CIPH MODE CMD to the MS in the non-encryption mode, and begins the decryption at the same time (the CHP implements this operation). The OB06, in fact here, sends configurations in old mode, and receives configurations in new mode.

Upon receiving the (RR) CIPH MODE CMD, the MS is set to the new mode, and sends the (RR) CIPH MOD COM to the OB06. Whenever the OB06 receives a correct decoded message (in new mode), it indicates that the MS has been correctly changed into the new mode. Only after that, the OB06 changes into the new mode, and the sending is also in new mode (the CHP implement this operation).

If the TRX cannot implement encryption according to the ENCR CMD requirement for some reasons, the CHP sends the CHP CYPTION

RESPONSE (NACK) message to the FURRM, and then the FURRM returns an ERROR REPORT message, with the cause "Encryption algorithm cannot be executed" for example.

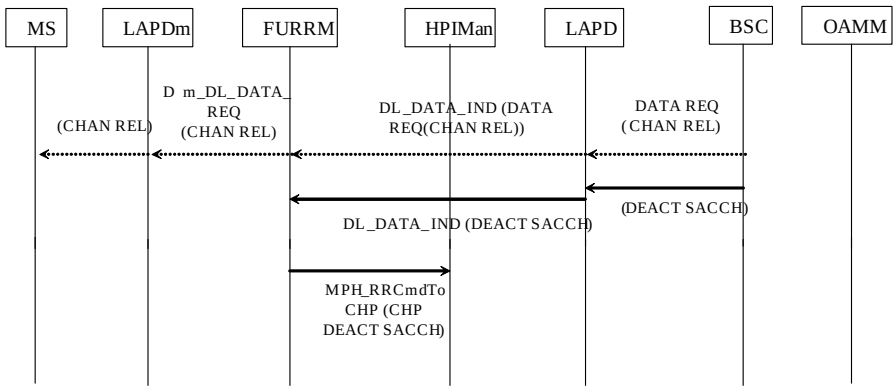
If the (RR) CIPH MODE CMD message is considered wrong, the MS returns a (RR) RR STATUS message with the cause "Protocol error unspecified" and performs no operation after that.

Channel Release

1. SACCH deactivation

   The procedure of SACCH deactivation is shown in Figure 40.

FIGURE 40 SACCH DEACTIVATION



The BSC releases the SACCH in the OB06 according to the (RR) CHANNEL RELEASE procedure.

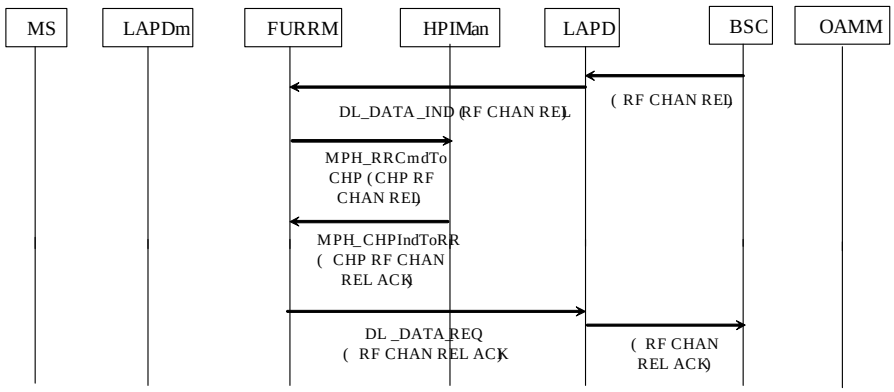
When the BSC sends the (RR) CHANNEL RELEASE, it sends the DEACT SACCH message to the OB06, to command the OB06 to stop transmitting downlink SACCH frame.

The FURRM module sends the related information in the DEACT SACCH message to the CHP for processing.

2. Wireless channel release

   The wireless channel release procedure is shown in Figure 41.

FIGURE 41 WIRELESS CHANNEL RELEASE



The BSC releases a wireless link that is not used any longer.

When an activated wireless channel is not used any longer, the BSC will send a RF channel release message (RF CHAN REL) to the related TRX and channel. The CHP module processes the channel release. When the related resources are released, the OB06 returns a RF channel release acknowledgement message (RF CHAN REL ACK) to the BSC. If the CHP cannot release the channel successfully, the FURRM will send the ERROR REPORT message to the BSC.

SACCH Procedure

1. Measurement report

   The data from the MS and OB06 measurement results are processed by the BSC and will be used for the transmission power control and handover preparation.

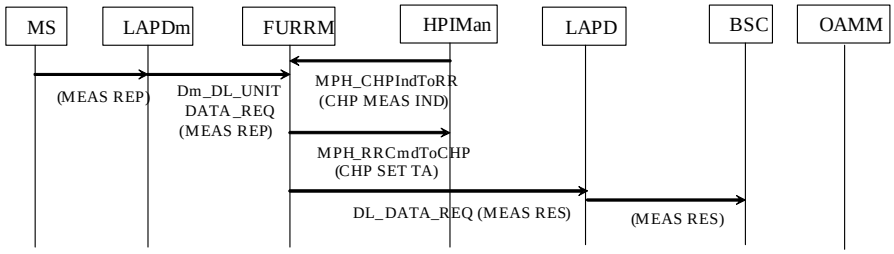
   The MS measurement result is in the (RR) MEASurement REPort message and will be reported once every SACCH block (480 ms), or if the SACCH is being used by other signaling, reported once every two SACCH blocks (960 ms). The TRX measures the level and quality of the received signals in the current uplink channel. The average time is the period of one SACCH block. The (RR) MEASurement REPort message that is sent by the MS to the OB06 contains the measurement results for the dedicated channel and adjacent cells.

   The OB06 and MS measurement results form basic original data that must be transmitted on the Abis interface. See "Basic measurement report" for details. In addition, the OB06 and BSC also support preprocessing for these basic measurement data in OB06, to lessen the signaling load on the Abis interface. See "Measurement report preprocessing" for details.

   The FURRM receives the CHP measurement report ahead of the MS measurement report. As a result, when the FURRM triggers group sending of the Abis MEAS RESULT according to the CHP measurement report, the problem of timing adjustment arises.

The basic measurement report is shown in Figure 42.

FIGURE 42 BASIC MEASUREMENT REPORT



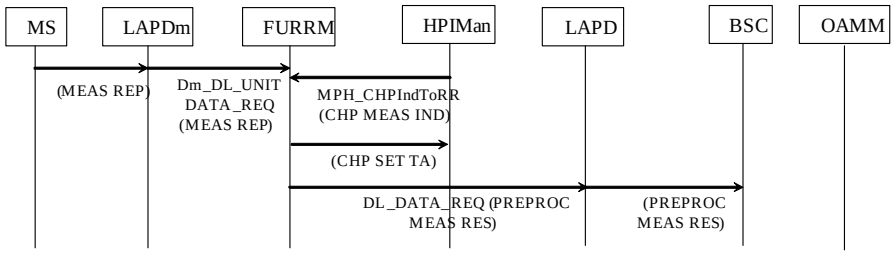
The OB06 reports the basic wireless measurement results (GSM 05.08 and GSM 05.05) that are generated by the MS and TRX.

This procedure is a default procedure, unless another plan (preprocessing, as described below) is used.

The TRS places these results in the MEAS RES message and reports to the BSC. The sending of this message is synchronous with the receiving of the SACCH block from the MS. If this uplink SACCH block does not contain the measurement report that is from the MS (in case of short messages, for example), the MEAS RES that is sent by the OB06 will indicate this.

The procedure of measurement report preprocessing is shown in Figure 43.

FIGURE 43 MEASUREMENT REPORT PREPROCESSING

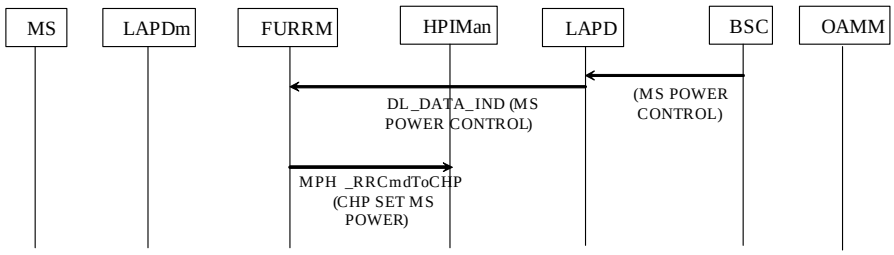


The OB06 first preprocesses the MS measurement report, and then sends it together with the OB06 measurement result to the BSC through the PREPROC MEAS RES message.

2. Power control

   The MS power control is shown in Figure 44.

FIGURE 44 MS POWER CONTROL



The BSC sets the MS power control parameters according to the TRX requirement.

The initial parameters are set in the CHAN ACTIV message by the BSC. If these parameters are to be changed, the BSC will send the MS POWER CONTROL message to the TRX.

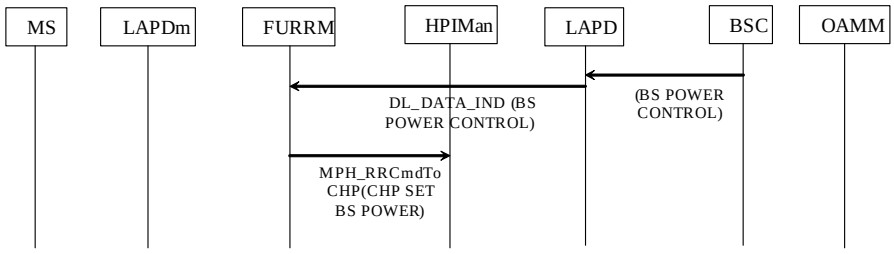
The OB06 power control is optional, which is indicated by the parameters in the MS POWER CONTROL or CHAN ACTIV message. By changing the frame header of the power level L1 that is sent to the MS, the TRX tries to control the power control parameter within certain range according to the message requirement (the CHP module implements this operation).

When the OB06 executes the MS power control, the BSC can change the MS power parameter during the connection (change by levels, for example).

The MS POWER CONTROL and CHAN ACTIV messages must contain an MS-allowed maximum power value.

The procedure of BS power control executed by the BSC is shown in Figure 45.

FIGURE 45 BS POWER CONTROL



This optional procedure can have the BSC set the TRX transmission power level or the parameter that the TRX uses to control the TRX transmission power.

The initial parameters are set in the CHAN ACTIV message by the BSC. If these parameters are to be changed, the BSC will send the BS POWER CONTROL message to the TRX.

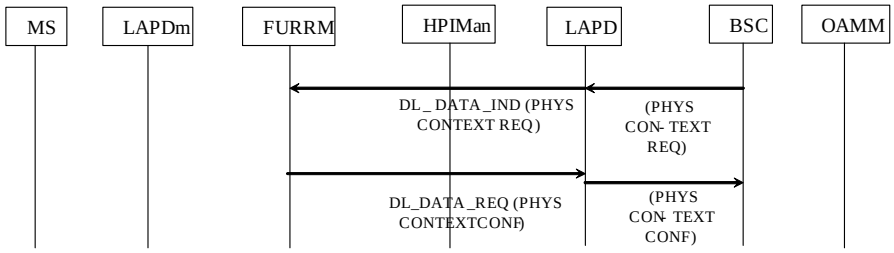
The OB06 power control is optional, which is indicated by the parameters in the BS POWER CONTROL or CHAN ACTIV message. By changing the transmission power, the TRX tries to control the power control parameter within a certain range according to the message requirement (the CHP module implements this operation).

The maximum power of the TRX is determined by the network design specifications, but the BSC can specify a smaller maximum power value in the BS POWER CONTROL and CHAN ACTIV messages.

3. Physical environment request/acknowledgement

   The procedure of physical environment request/acknowledgement is shown in Figure 46.

FIGURE 46 PHYSICAL ENVIRONMENT REQUEST/ACKNOWLEDGEMENT



This optional procedure enables the BSC to obtain the physical environment information before the channel change.

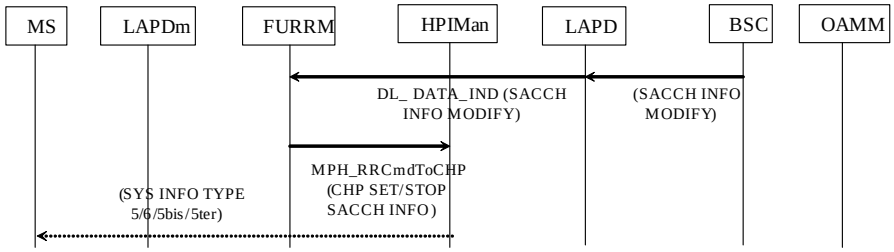
The physical environment information can be sent to a new TRX (which may be in another cell).

The PHY CONTEXT CONF message to be returned by the OB06 to the BSC contains the MS/BS power and TA that are obtained from the channel, and the OB06 does not process the physical environment information temporarily.

4. SACCH fill-in information change

   The procedure of modifying the SACCH fill-in information is shown in Figure 47.

FIGURE 47 SACCH FILL-IN INFORMATION CHANGE



The BSC instructs the OB06 that the new system message ((RR) System Information Type 5/5bis/5ter/6) will change the original system message that is filled in the SACCH.

The SACCH fill-in information in the SACCH INFO MODIFY message will be sent in the specified channel, till the channel is released or changed by another SACCH INFO MODIFY message.

When the OB06 receives the SACCH INFO MODIFY message, it extracts the system message ((RR) System Information Type 5/5bis/5ter/6) and sends it to the CHP module to change the original system information. If there is no system message content, it indicates that such system messages will no longer be sent on this channel.

Public Channel Management Function

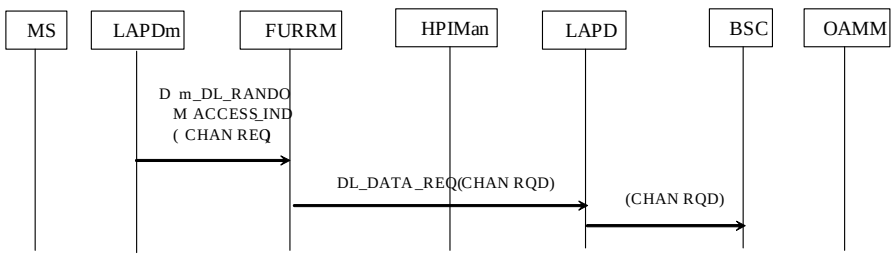
This function supports the following procedures:

1. MS channel request procedure: This procedure is triggered when the TRX detects the random access of an MS.
2. Paging procedure: This procedure is used to page an MS on the specified paging sub-channel. It is used for the mobile called, and is started by the MSC through the BSC. The BSC determines the paging team according to the IMSI of the called MS. The value of the paging team and the MS IMSI are sent to the OB06.
3. Immediate assignment procedure: This procedure allows the BSC to immediately assign a dedicated channel to the MS that accesses the OB06.
4. Indication deletion procedure: This procedure allows the OB06 to give the BSC an indication that an immediate assignment message is deleted due to the overload on the AGCH channel. CCCH load indication procedure:
5. This procedure allows the OB06 to give the BSC an indication about the load on the specified CCCH channel.
6. Broadcast information change procedure: With this procedure, the BSC instructs the OB06 to broadcast new system messages on the BCCH channel.
7. Short message cell broadcast procedure: With this procedure, the BSC requests the OB06 to send a cell broadcast short message.

Access Request

The procedure of access request is shown in Figure 48.

FIGURE 48 ACCESS REQUEST



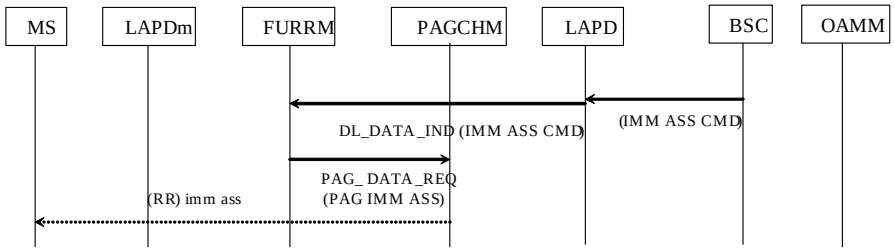
When the TRX receives the MS random access request, it sends the channel request message to the BSC.

The CHAN RQD message contains the Request Reference parameter (MS-selected random number, low-order bit of the TDMA frame number) and access burst pulse sequence measurement delay.

Immediate Assignment

The procedure of immediate assignment is shown in Figure 49.

FIGURE 49 IMMEDIATE ASSIGMENT



The immediate assignment message is transmitted in the downlink CCCH (AGCH) channel.

The immediate assignment message that is from the network side may be (RR) IMMEDIATE ASSIGNMENT, (RR) IMMEDIATE ASSIGNMENT EXTENDED or (RR) IMMEDIATE ASSIGNMENT REJECT. On the Abis interface, it is contained in the IMM ASS CMD message, which contains complete the "immediate assignment" message and where the "paging mode" unit is set as "unchanged". When this message is received, the FURRM sends it to the PAGCHMan sub-module of the PAGCHM module. That sub-module places the message in the buffer. When the trigger is received from the ISR, the PAGCHDaemon sub-module of the PAGCHM module forms the messages in the waiting queue into the (RR) IMMEDIATE ASSIGNMENT EXTENDED or (RR) IMMEDIATE ASSIGNMENT REJECT message and sends to the CHP. Before the send, the OB06 changes the "paging mode"

If no channel can be assigned, the BSC sends the (RR) IMMEDIATE ASSIGNMENT REJECT on the same CCCH timeslot where the channel request message is received.

If the downlink CCCH is overloaded, the FURRM sends the DELETE IND message to the BSC, notifying that an IMM ASS CMD command is deleted.

Paging

The paging procedure is shown in Figure 50, and the MS paging response is shown in Figure 51.

FIGURE 50 PAGING

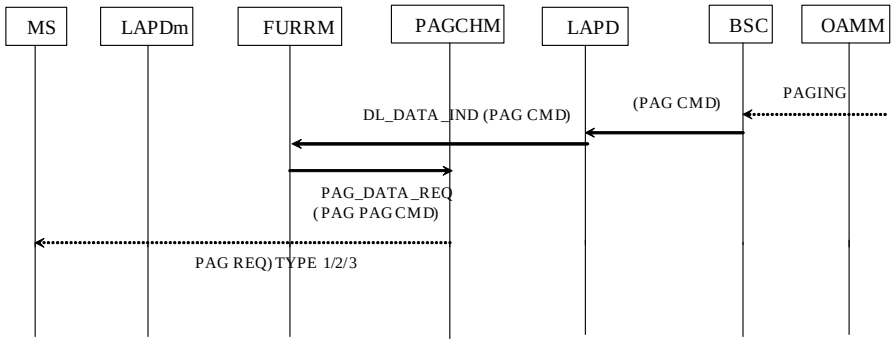
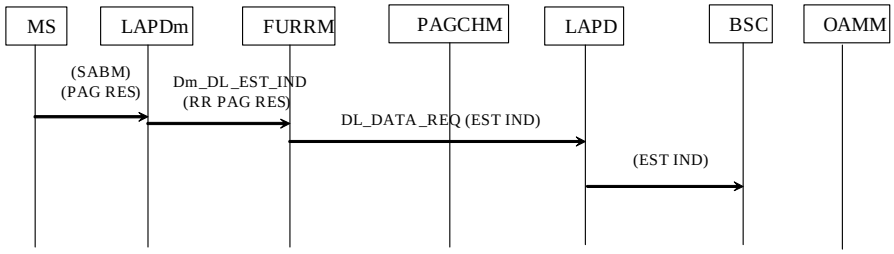


FIGURE 51 PAGING RESPONSE



Page an MS in the specified paging sub-channel.

The PAG CMD message contains the MS ID (TMSI or IMSI) and paging sub-channel number, or additional call-related channel combination that is indicated to the MS and will be used for follow-up processing.

The (RR) PAGing REQuest type 1/2/3 messages are buffered by the PAGCHMan sub-module of the PAGCHM module. The PAGCHDaemon sub-module combines and sends them, and calculates the correct DRX (paging message arrangement) paging block to correctly transmit them.

When the MS receives the (RR) PAGing REQuest message and is allowed to access the network, it triggers the immediate assignment procedure. The establishment of the main signaling link is triggered by SABM, and the SABM's information field contains the (RR) PAGing RESponse message.

Short Message Cell Broadcast

The short message cell broadcast procedure is shown in Figure 52 and Figure 53.

FIGURE 52 REQUEST FOR SHORT MESSAGE CELL BROADCAST

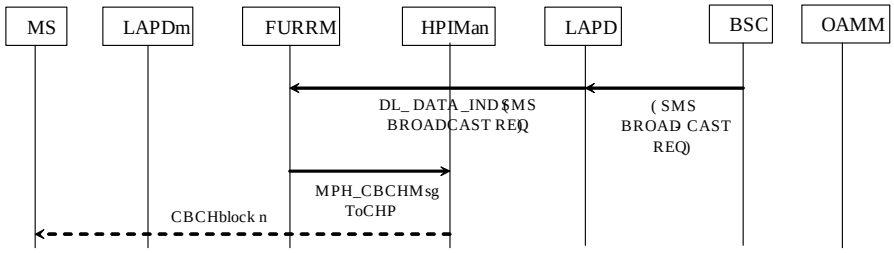
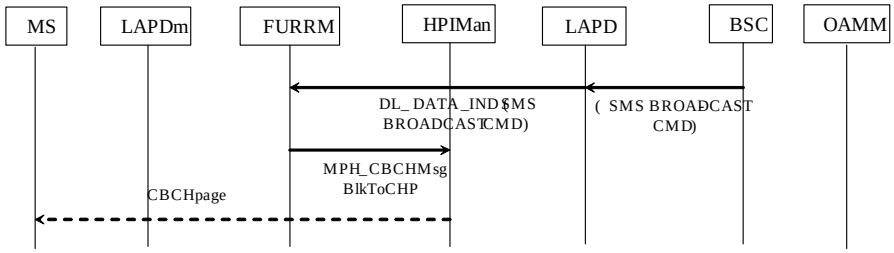


FIGURE 53 SHORT MESSAGE CELL BROADCAST COMMAND



The BSC sends the Short Message Service Cell Broadcast messages to the OB06.

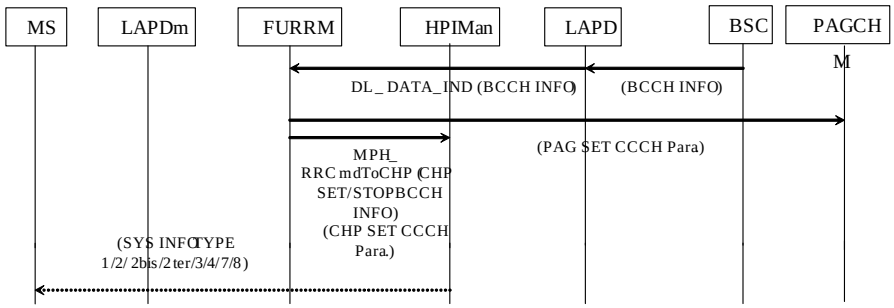
These messages are sent by the BSC to the OB06 with the SMS BROADCAST REQ or SMS BROADCAST CMD message. In these two messages, the BSC considers the CBCH capacity and then queues, repeats and transmits the messages. The BSC also splits the SMS Cell Broadcast message on the air interface. The difference between the two messages is that, the SMS BROADCAST CMD message can request broadcasting of a complete cell broadcast message (sent in every message by pages) and the OB06 splits it into blocks. For the SMS BROADCAST REQ message, it has been split by the BSC, 23 bytes per block.

With the SMS BROADCAST CMD message, the BSC can set the OB06 broadcast to the default mode. When there are no other messages to be broadcast in this mode, the OB06 will send a default message.

Broadcast Information 1 Change Procedure

The procedure of broadcast information 1 change is shown in Figure 54.

FIGURE 54 BROADCAST INFORMATION 1 CHANGE PROCEDURE



The BSC indicates to the OB06 that the new system messages (like (RR) System Information Type 1/2/2bis/2ter 3/4/7/8) will be broadcast on the BCCH.

When the OB06 receives the BCCH INFO message, the FURRM module will send the CHP SET BCCH INFORMATION message to the CHP if there is any system message. Then, the CHP sends it to the MS. If there is no system message, the FURRM module will send the CHP STOP BCCH INFORMATION message to the CHP, indicating to stop sending these system messages to the MS.

For easy observation of the system message sending, the TRU panel of the OB06 has a signal indicator marked as "MOD".

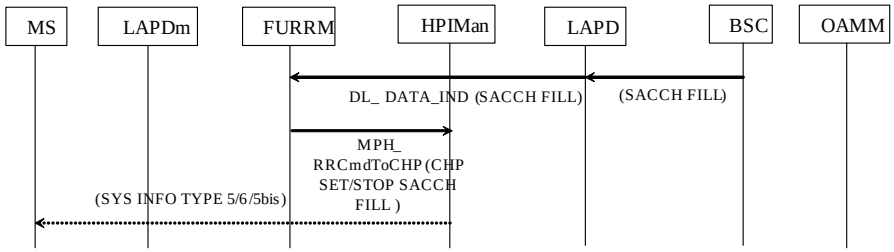
System Information Type 1 contains RACH control parameters and cell configuration; System Information Type 2 contains RACH control parameters and BCCH configuration of an adjacent cell; System Information Type 2bis and System Information Type 2ter are optional messages, containing BCCH extension configuration of an adjacent cell; System Information Type 3 contains information of other cells, such as identifier of a location area and cell identity; System Information Type 4 contains information of control over RACH, identifier of a location area and cell identity; System Information Type 7 and System Information Type 8 contain parameters of cell reselection.

The FURRM extracts three parameters (BS_PA_MFRMS, BS_AG_BLKS_RES and CCCH_CONF) from the Control Channel Description information unit of the System Information Type 3 message, and sends them to the CHP and PAGCHM modules.

Broadcast Information 2 (SACCH FILL) Change Procedure

The broadcast information 2 (SACCH FILL) change procedure is shown in Figure 55.

FIGURE 55 BROADCAST INFORMATION 2 (SACCH FILL) CHANGE PROCEDURE



The BSC indicates to the OB06 that the new system information ((RR) System Information Type 5/6/5bis/5ter) will be sent in the downlink SACCH as fill-in information, generally when channel connection starts (especially after a handover) and the channel changes.

When the FURRM receives the SACCH FILL message, it extracts the information unit and sends it to the CHP module for the system message transmission. If it does not receive the message, it indicates that the system message sending will stop.

The System Information Type 5 contains the adjacent cell BCCH frequency table. The System Information Type 5bis and System Information Type 5ter contain adjacent cell BCCH extended configuration information. The System Information Type 6 contains the location area ID and cell ID.

When the fill-in information uploaded in the SACCH needs to be changed, the BSC will send a SACCH INFO MODIFY message to the OB06. The SACCH fill-in information in this message will be transmitted in the specified channel, till the channel is released or changed by another SACCH INFO MODIFY message.

TRX Management Function

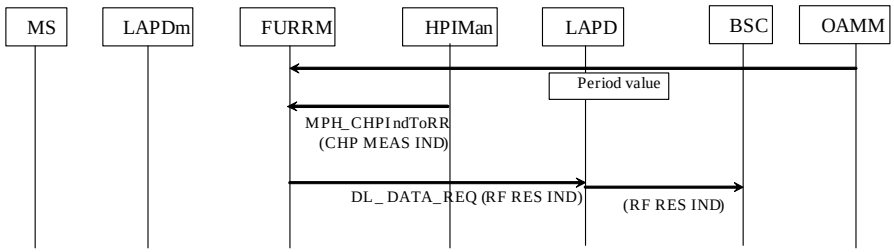
This function supports the following procedures:

1. Radio resource indication procedure: With this procedure, the OB06 gives the BSC an indication of interference level on the idle dedicated channel of each TRX.
2. Traffic control procedure: With this procedure, the FUC gives the BSC an indication about the overload of this TRX. The overload cause may be CCCH overload, ACCCH overload or processor overload.
3. Error report procedure: With this procedure, the OB06 reports to the BSC the detected downlink message error that cannot be reported with other procedures.

Radio Resource Indication

The radio resource indication is shown in Figure 56.

FIGURE 56 RADIO RESOURCE INDICATION



It notifies the BSC the interference level of the idle channel of one TRX.

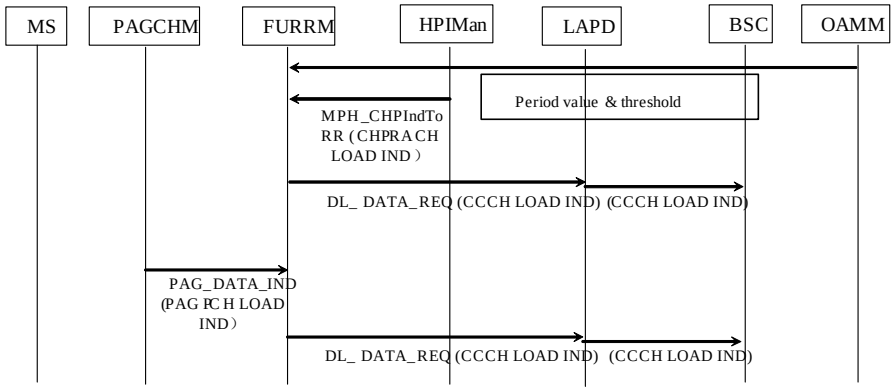
The interference level value of the idle channel is provided by the CHP, and reported in the CHP MEASUREMENT INDICATION message, just like the measurement report. This message is reported once every 102 frames (51 multiframes) or 104 frames (26 multiframes).

Load Management

1. Load indication

   The procedure of load indication on the common channel is shown in Figure 57.

FIGURE 57 PUBLIC CHANNEL LOAD INDICATION



The OB06 gives the BSC the load information in a specific CCCH timeslot, involving RACH and PCH loads.

The CHP calculates the exact load on the RACH. The PAGCHM calculates the load on the PCH. The thresholds and sending period are configured in the OAMM.

2. General overload

   The OB06 instructs the BSC that the receiver must reduce the traffic. According to the protocol, it can be used to indicate the TRX overload, downlink CCCH overload and ACCH overload.

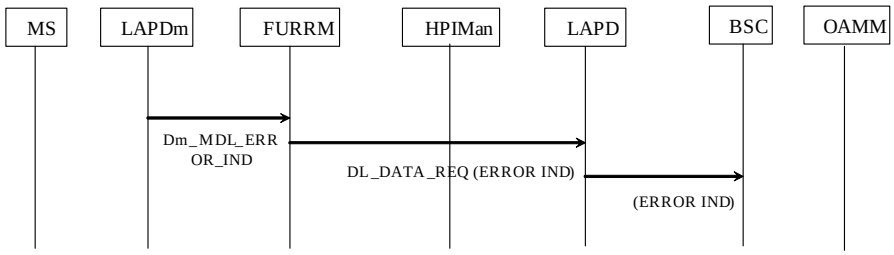
   The TRX processor provides data from the bottom running operating system. The downlink CCCH load calculation is just the same as the above-mentioned CCCH LOAD IND, the CHP provides the RACH load, and the PAGCHM provides the PCH load. The ACCH load calculation is not determined.

   According to the negotiation with the BSC, the current general overload (OVER LOAD) is only used to report the RACH load that is provided by the CHP.

Error Indication

The procedure of error indication is shown in Figure 58.

FIGURE 58 ERROR INDICATION



The ERROR IND message that is sent from the OB06 to the BSC indicates to the BSC that the following abnormities happen in the radio data link layer.

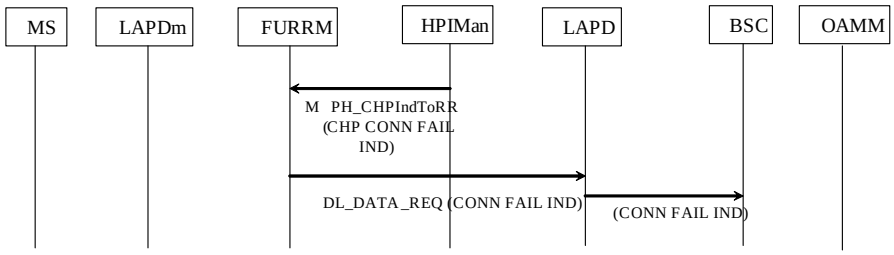
The ERROR IND message contains the related error cause information, including the following causes:

1. Protocol errors, as listed in Sections 5.6.4, 5.7.3 and Appendix G in TS GSM 04.06;
2. Error with one link layer. In other words, the I frame is repeated for N200 times but is not acknowledged.
3. The SABM or DISC frame is repeated for N200 times but is not acknowledged.
4. The SABM frame received in the multiframe establishment status

Connection Failure

The procedure of connection failure is shown in Figure 59.

FIGURE 59 CONNECTION FAILURE



The CONN FAIL IND message that is sent from the OB06 to the BSC indicates the BSC that one activated channel cannot be used as more for some reasons.

When this message is received, the network side will release the channel. The message contains the cause parameter, including the following causes:

1. Radio link fault (Section 5 in GSM 05.08). The OB06 judges whether there is any fault according to the uplink SACCH error rate or RXLEV/RXQUAL test.
2. Hardware error (decoder fault, for example).
3. Others

The CHP module will report the error to the FURRM module. In addition, in case of failed handover or mis-synchronization between CHP and TC, the FURRM also sends this message to the BSC.

Error Report

The OB06 sends the ERROR REPORT message to the BSC, notifying the following errors that cannot be reported with other procedures.

When the OB06 receives an error message, it ignores the message and reports to the BSC. Here, the ERROR REPORT is the message involving all error causes other than the CHAN ACTIV NACK for channel activation and the MODE MODIFY NACK for channel mode modification.

The error causes include message ID error, message type error, message sequence error, information unit error, and channel status mismatch.

O&M

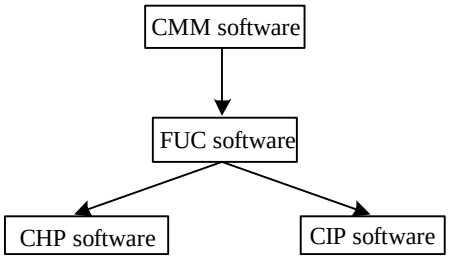
The OB06 provides powerful O&M functions to implement management and maintenance of the OB06 equipment. The functions fall into three parts: parameter configuration, alarm and status reporting, and online software loading.

Parameter Configuration

It supports the OB06 parameter configuration by the BSC.

The parameter configuration process is shown in Figure 60.

FIGURE 60 PARAMETER CONFIGURATION PROCESS



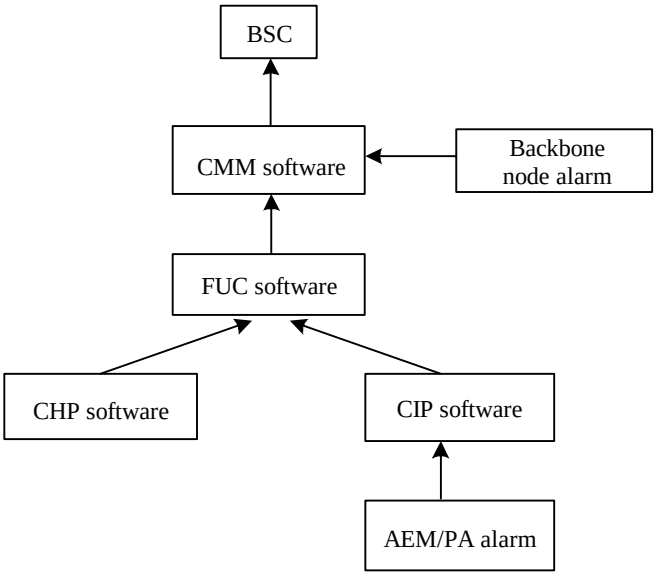
The messages from the BSC are sent to the CMM board through the BIE board through the LapD link, and then forwarded to application processes through the message distribution process of the Abis interface of the CMM software. The CMM configuration process processes the configuration messages and implements the OB06 static data configuration by the BSC. The CMM software distributes the BSC parameters, and through the HDLC, configures the data to the TRM board FUC software that is managed by the CMM software. After receiving the configuration message from the CMM software, the FUC software configures the board attributes, notifies the CMM software of the successful configuration message at the same time, and configures the CHP and CIP.

Alarm and Status Reporting

The ZXG10 OB06 (V1.0) supports reporting the alarms and status of the OB06 to the BSC.

The alarm reporting process is shown in Figure 61.

FIGURE 61 ALARM REPORTING PROCESS



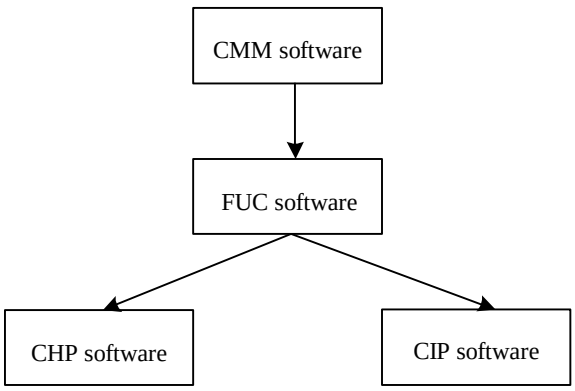
The CIP software collects the alarms of itself and the fan/AEM/PA alarms, and then reports them to the FUC software. while the CHP software collects the alarms of itself and reports them to the FUC software. The FUC software reports the collected alarms and its own alarms to the CMM software. The alarms of the backbone nodes are collected by the CMM software, which reports all alarms of this site to BSC through LapD, and implements some relevant alarm processing, such as power amplification shut-down.

Online Software Loading

It supports the OB06 software online loading by the BSC.

The software loading process is shown in Figure 62.

FIGURE 62 SOFTWARE LOADING PROCESS



All software versions are downloaded into the CMM's FLASH memory through the BSC. The CMM validates the versions, and loads the software to the FUC when it finds any difference with the TRM software.

The TRM software is stored in the FLASH memory on the FUC board. After DSP is restarted, the FUC software loads the CHP software to the CHP and CIP through the HPI interface.

The software loading procedure is described as follows:

1. The CMM sends to the FUC the "software loading initialization" message.
2. The FUC returns the CMM the "software loading initialization finished" message.
3. CMM divides the software versions into message segments and sends to FUC segment by segment.
4. When all software data are sent, the CMM sends to the FUC the "software loading finished" message.
5. The FUC returns the CMM the "software loading finished acknowledgement" message.

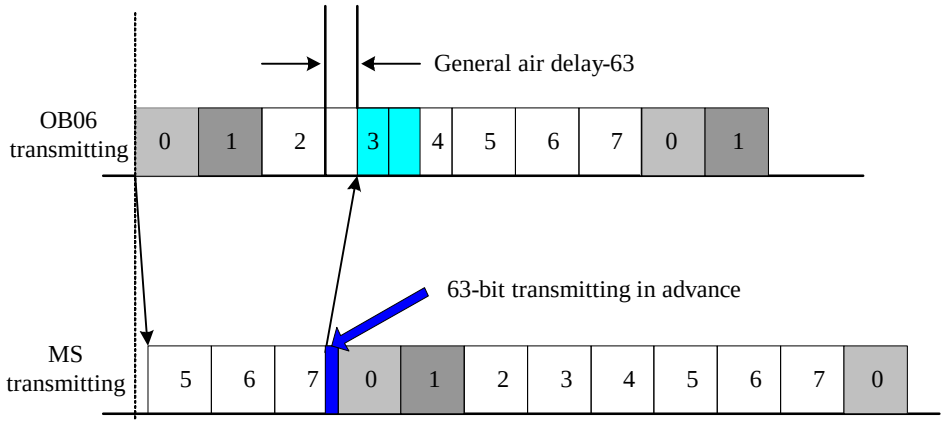
Ultra-Distance Coverage

Ultra-distance coverage refers to coverage by a BTS with a cell radius greater than 35 km, which is stipulated by the GSM standard.

According to the GSM protocol, the maximum access radius of the GSM system is 35 km, and the corresponding time advance (TA) is 63. This limit is made because, under normal conditions, and in a 900 M propagation environment, it is difficult to offer a coverage with a radius greater than 35 km. But, in some special propagation conditions, such as low propagation loss areas like coasts, deserts and grasslands, with the help of BTS of high-power output and high-gain antenna, it will be possible to offer coverage with a radius greater than 35 km.

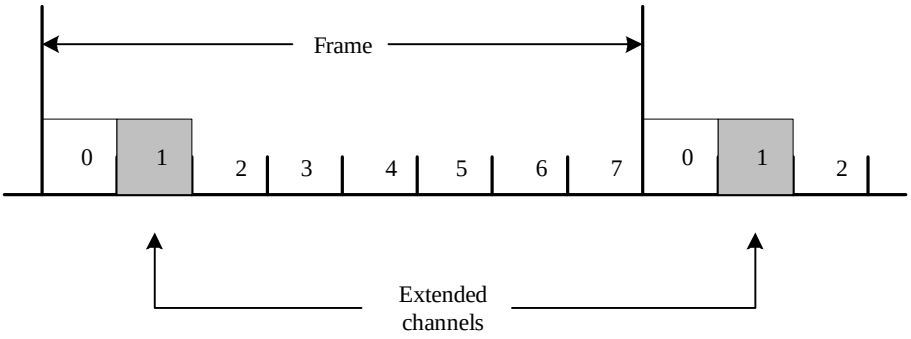
When the coverage distance is greater than 35 km, that is, when the air time delay is greater than 63, the time of arrival of a signal at the BTS will span two time slots, as shown in Figure 63, so a dedicated control channel and a service channel can be two physical channels, namely, two consecutive time slots.

FIGURE 63 TIME DELAY RELATIONSHIP



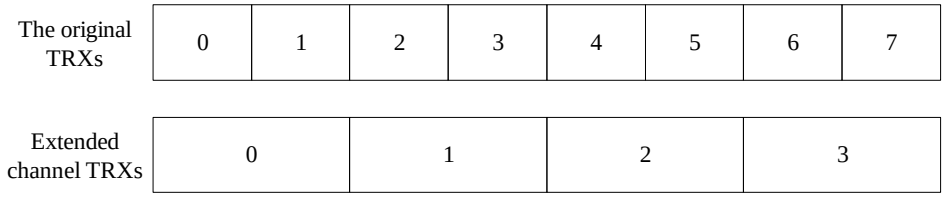
When the BTS uses two timeslots to process the data of one subscriber, the second timeslot is called the extended channel, a shown in Figure 64.

FIGURE 64 OB06 SIGNAL PROCESSING



The carrier frequency after channel expansion is shown in Figure 65: Originally a TRX may provide 8 physical channels; after channel expansion, one carrier frequency has 4 physical channels, while the carrier frequency capacity is reduced by half.

FIGURE 65 ACTUAL NUMBER OF PHYSICAL CHANNELS IN A CARRIER



With extended channels, the coverage of the OB06 is theoretically up to a radius of 120 km, and the maximum time advance is 219. Since the actual propagation loss of GSM900 is high, and due to the balance between upper and lower links, the actual coverage radius may be less than the theoretical value.

Chapter 5

Networking Modes and System Configurations

This chapter introduces the networking modes, system configurations, and networking examples of the ZXG10 OB06 (V1.0).

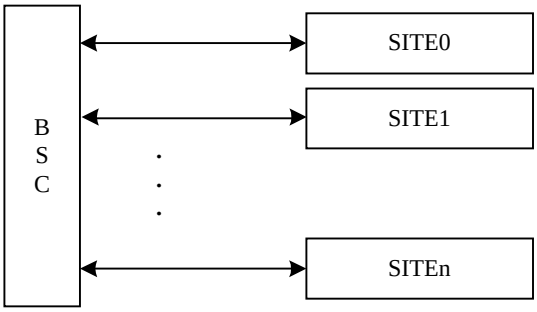
Networking Modes

The ZXG10 OB06 (V1.0) is connected to the BSC through the Abis interface, supporting networking modes of star, chain and tree.

1. Star networking mode

   Figure 66 shows the star networking node of the ZXG10 OB06 (V1.0). Each line denotes a bi-directional E1 connection; however, the actual related ID DIP switches at the BS side should be designed according to the relative configurations. For detailed principles, refer to *ZXG10 OB06 (V1.0) Compact Outdoor BTS for GSM Hardware Manual.*

FIGURE 66 SCHEMATIC DIAGRAM OF STAR NETWORKING

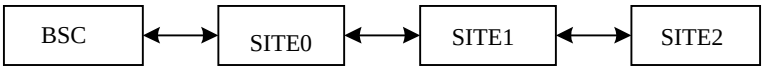


In star networking, n E1 PCM links are led into each SITE directly from BSC. The OB06 device on each site is a piece of end equipment. The networking mode is simple, accompanied by convenient construction and maintenance. Since the signals are transmitted through fewer intermediate links along the path, the reliability of transmission is higher. This networking mode is typically employed in densely populated urban areas.

2. Chain networking mode

   Figure 67 shows the chain networking mode of the ZXG10 OB06 (V1.0). Each line denotes a bi-directional E1 connection; however, the actual related ID DIP switches at the BS side should be designed according to the relative configurations.

FIGURE 67 SCHEMATIC DIAGRAM OF CHAIN NETWORKING

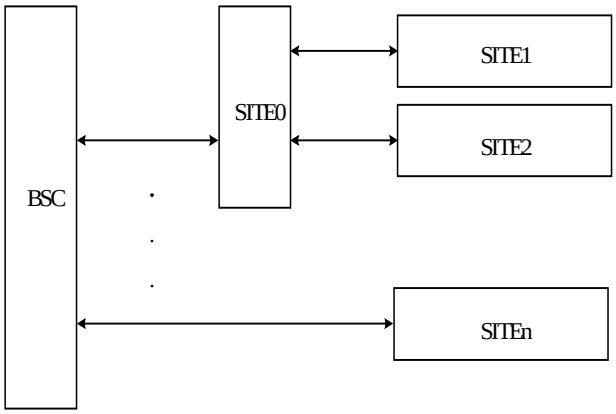


   Chain networking is also applicable to the one-site multi-OB06 situation. Since signals go through more links, the line reliability is relatively poor. This networking mode is applicable to stripe-like areas with a small population, thus saving a large number of transmission devices. To prevent the clock performance deterioration, it is recommended no more than four OB06s be cascaded in the chain networking mode.

3. Tree networking mode

   The tree networking mode of the ZXG10 OB06 (V1.0) is shown in Figure 68. Each line denotes a bi-directional E1 connection; however, the actual related ID DIP switches at the BS side should be designed according to the relative configurations.

FIGURE 68 SCHEMATIC DIAGRAM OF TREE NETWORKING



   The tree networking mode is applicable to large yet sparsely populated areas. This mode is complicated, in which signals have to pass many nodes and the line reliability is relatively low. And the fault from the upper-level SITE may affect the proper running of the lower-level SITE. In the tree networking mode, the OB06 connected with BSC is the central node, which may branch into three nodes, namely OB06 s.

   In actual networking projects, due to the decentralized sites, unlike basic networking modes, the transmission equipment is usually used for intermediate connection between BSC and OB06. Common transmission modes include: microwave, optical fibers, HDSL cables

and coaxial cables. Satellite links can be used for special transmission modes.

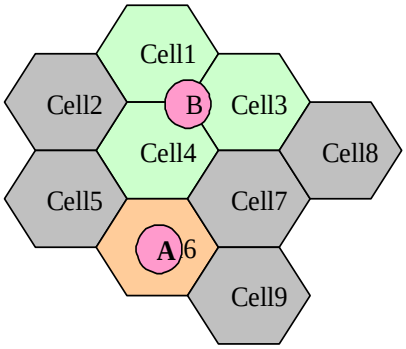
System Configuration

There are many ways of BS configuration. In general, a proper number and types of sites are selected to cater for the requirements of the operators as well as the concrete geographical environment, and a minimum hardware configuration should be used to meet the maximum traffic requirement.

Number and Types of Sites

A radio cellular mobile network, according to its frequency resources and cell planning, can be divided into a certain number of cells. The cells in a cellular system are adjacent to each other, as shown in Figure 69.

FIGURE 69 SCHEMATIC DIAGRAM OF CELLS



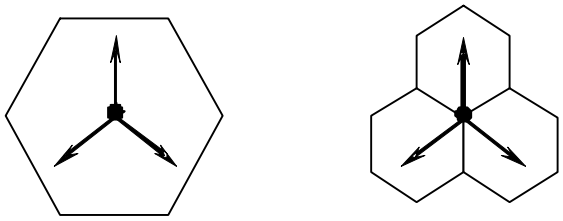
In the system, each cellular cell is covered by multiple radio channels. If an omni-antenna is employed, a base station will be set at the center of each cell (as A in the diagram). And if a directional sectorized antenna is used, the base station will be established at the intersection of three cells (as B in the diagram). Such a base station covers three adjacent cells, and in fact it contains at least three TRXs. Usually, a base station in this kind of network is called a site. The base site with an omni-antenna covers only one cell; while the base site with a directional antenna covers three cells.

Types of sites: O-type sites and S-type sites, and the models are shown in Figure 70.

- An O-type site is an omni-directional cell, that is, all the carriers of the site serve the O-type cell;

- An S-type site refers to a sectorized cell. Typically, a three-sector site is preferred; that is, each site has three sectors.

FIGURE 70 TWO TYPES OF SITES



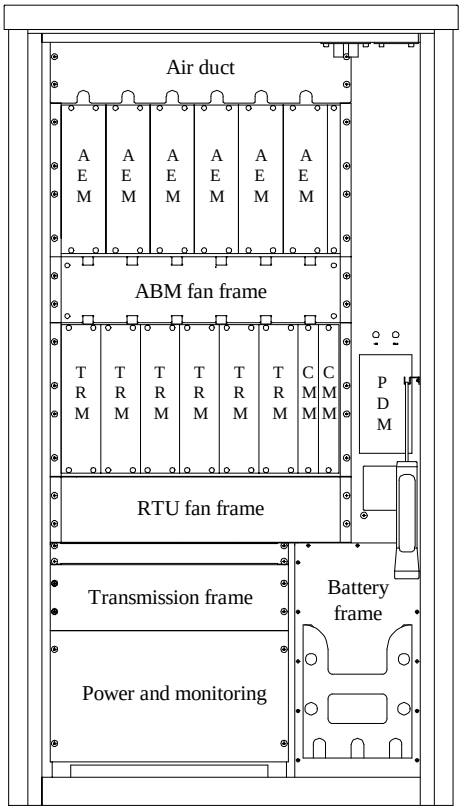
O-type sites S-type sites

BS Configuration Principles

Configuration of Standard Cabinet

For 40 W configuration, the installation positions of functional modules of the ZXG10 OB06 (V1.0) in the cabinet are shown in Figure 71.

FIGURE 71 BOARD LAYOUT OF 40 W STANDARD FULLY-CONFIGURED ZXG10 OB06 (V1.0) CARRIER FRAME

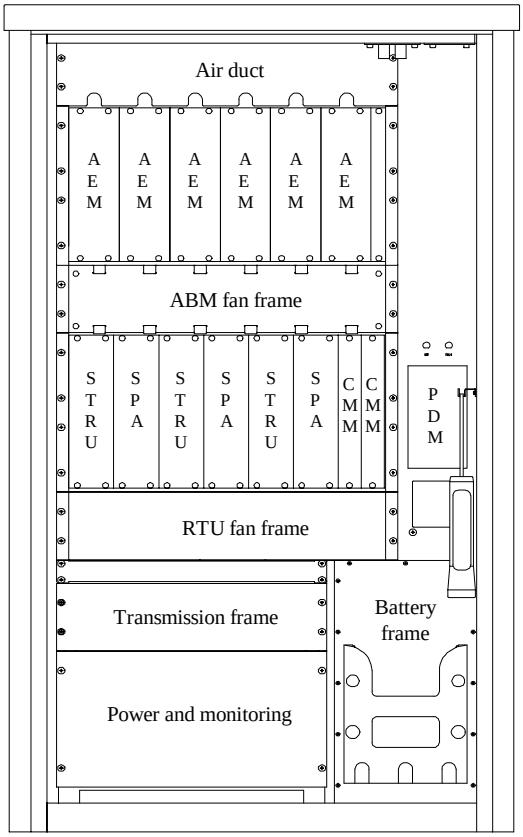


For 40 W configuration, a single cabinet of OB06 can be configured with a maximum of 6 TRMs.

For 80 W configuration, the installation positions of functional modules of the ZXG10 OB06 (V1.0) in the cabinets are shown in Figure 72.

For 80 W configuration, a single cabinet of OB06 can be configured with a maximum of 3 TRMs.

FIGURE 72 BOARD POSITION OF 80 W STANDARD FULLY-CONFIGURED ZXG10 OB06 (V1.0) CARRIER FRAME



Configuration of Carrier Frames and Antenna Interface Frames

Configuration of the carrier frame is listed in Table 5.

TABLE 5 CONFIGURATION OF CARRIER FRAMES

S.N.	Unit Name	Configurations	Description
1	TRM	Ntrx (total number of carriers)	A single cabinet is configured with 6 carriers at the maximum (namely, Ntrx≤6). TRMs fall into these types: 900 M, extended 900 M, 1800 M, 1900 M and 850 M.
2	CMM	2	Controller & Maintenance Module

For the carrier configuration, TRM in one cell should in principle be configured inside one ZXG10 OB06 (V1.0) cabinet to minimize the length of the cabinet-crossing RF connection cable and reduce the loss over

cables. The cabinet-crossing cables should be as short as possible in configuration.

Configuration of antenna feeder interface frame is shown in Table 6.

TABLE 6 CONFIGURATION OF ANTENNA FEEDER INTERFACE FRAME

S.N.	Unit Name	Configurations	Description
1	Combiner Distribution Unit (CDU)	2 × Number of sectors	Each sector is configured with 2 CDUs
2	Combiner Extension Unit (CEU)	2 ×Number of sectors whose numbers of carriers is greater than 4	Each sector whose numbers of carriers is greater than 4 is configured with 4 CDUs

Configuration Principle of AEM

Two types of AEM units are available: CDU and CEU. The ZXG10 OB06 (V1.0) allows configuration of various types of sites by means of different combinations of Combiner Distribution Units and Combiner Extension Units.

For GSM900 cells, GSM900 units are configured; for GSM1800 cells, GSM1800 units are configured; and so on and so forth for other GSM systems.

Each site may be configured as either an omni-directional cell or a multiple directional cell. Based on different field strength coverage modes, there are two types of base station antenna: omni-antenna and directional antenna. An omni-antenna can provide omni-directional coverage, thus saving site construction costs. However, the omni-antenna has low gain and poor anti-interference capability. The directional antenna is of directivity with high gain and strong anti-interference capability. To ensure the complete coverage of a service area, combination of multiple antennas is required.

Table 7 shows the number of configured carriers for all 40 W TRXs and the correspondence between CDUs/CEUs and antennas configured in one cell.

TABLE 7 NUMBER OF CONFIGURED CARRIERS FOR ALL 40 W TRXS AND THE CORRESPONDENCE BETWEEN CDUS/CEUS AND ANTENNAS CONFIGURED IN ONE CELL

TRX Quantity	Antenna Quantity and Configuration	CDU Quantity	CEU Quantity
1	2, TX/RX, RX	2	-
2	2, TX/RX, TX/RX	2	-
3~4	2, TX/RX, TX/RX	2	0 or 2
5~6	2, TX/RX, TX/RX	2	2

Table 8 shows the number of configured carriers for all 80 W TRXs and the correspondence between CDUs/CEUs and antennas configured in one cell.

TABLE 8 NUMBER OF CONFIGURED CARRIERS FOR ALL 80 W TRXS AND THE CORRESPONDENCE BETWEEN CDUS/CEUS AND ANTENNAS CONFIGURED IN ONE CELL

TRX Quantity	Antenna Quantity and Configuration	CDU Quantity	CEU Quantity
1	2, TX/RX, RX	2	-
2	2, TX/RX, TX/RX	2	-
3	2, TX/RX, TX/RX	2	-

For different configuration requirements of different site types, the combinations listed above can be used.

Expansion Configuration

In general, 1 to 3 cabinets may be configured in a site to enlarge subscriber quantity, and it is recommended to configure cabinets as few as possible. In case of 40 W configuration, the ZXG10 OB06 (V1.0) can be configured as S2/S/S at most. In case of 80 W configuration, the ZXG10 OB06 (V1.0) can be configured as S1/3/3 at most.

Configuration Examples

The ZXG10 OB06 (V1.0) has multiple configuration modes with different combinations, and all configurations are based on the user requirements and network planning. Therefore, system configuration modes vary with different application sites. A site is typically configured as an omni-directional site, 2-sector site or 3-sector site.

Configuration Examples of O-type Sites

Here is the configuration of 40 W and 80 W O1/O2/O4/O6-type sites.

Generally, the O2-type site is configured with 2 CDUs and 2 omni-directional receiving antennas. Figure 73 shows the configuration of the O1-type site, and Figure 74 shows the logical connection relationship.

FIGURE 73 CONFIGURATION OF 40 W AND 80 W O1-TYPE SITES

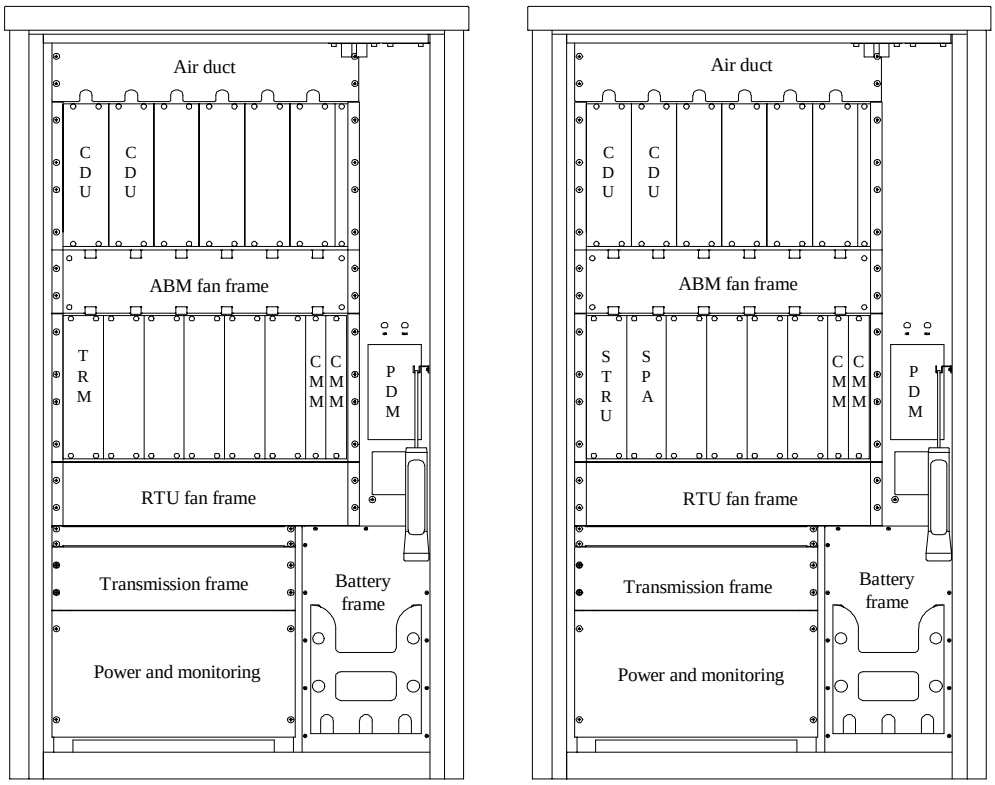
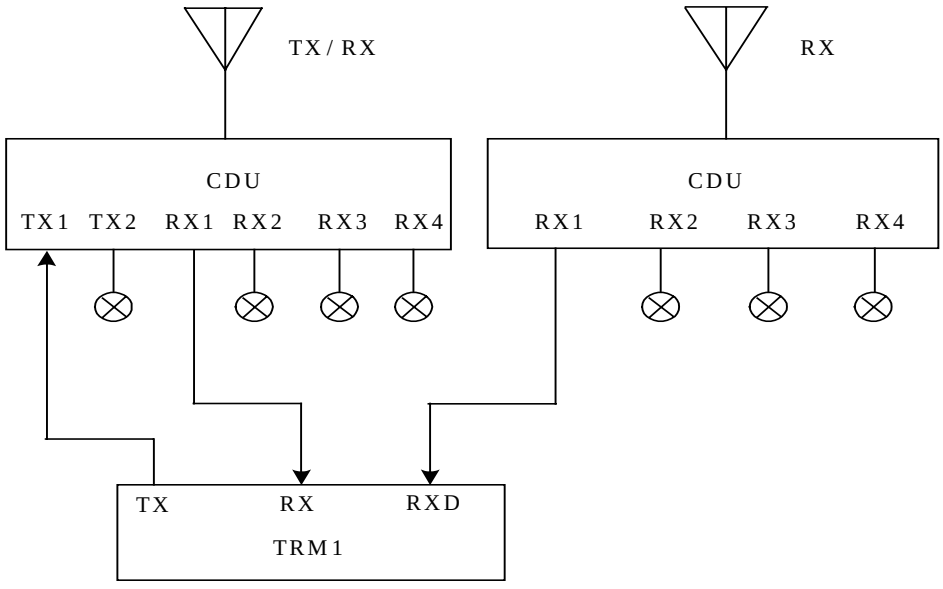


FIGURE 74 LOGICAL CONNECTION RELATIONSHIP BETWEEN THE COMBINER UNITS AND DISTRIBUTION UNITS OF THE O1-TYPE SITE



Generally, the O2-type site is configured with 2 CDUs and 2 omni-directional receiving antennas. Figure 75 shows the configuration of 40 W and 80 W O2 -type sites, and Figure 76 shows the logical connection relationship.

FIGURE 75 CONFIGURATION OF 40 W AND 80 W O2-TYPE SITES

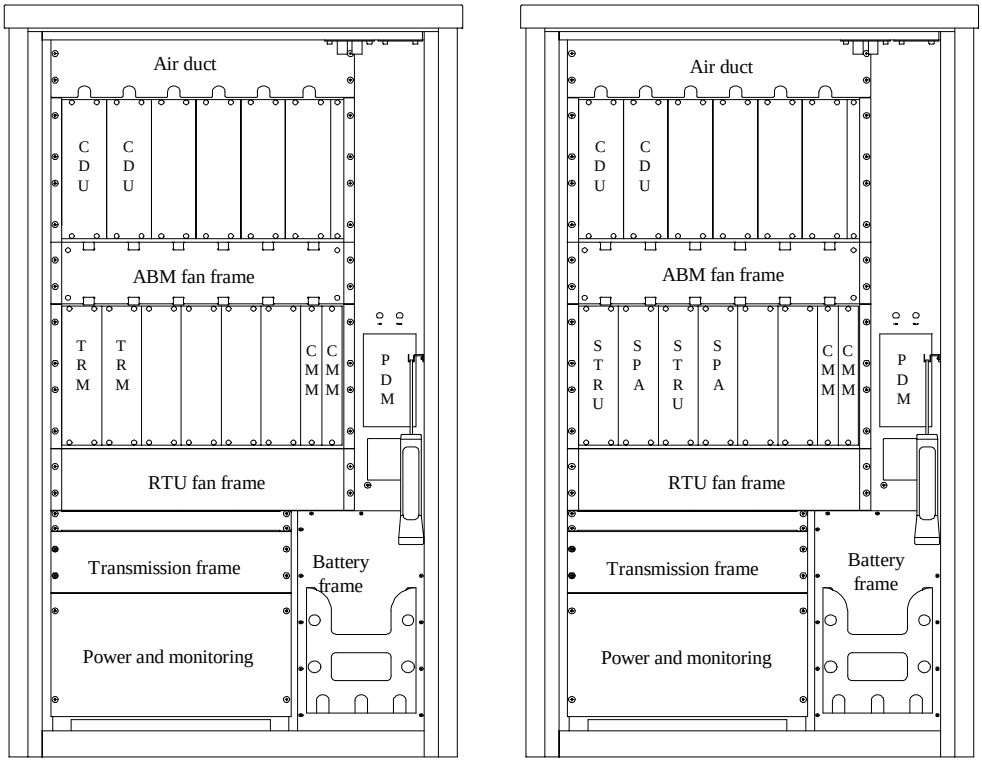
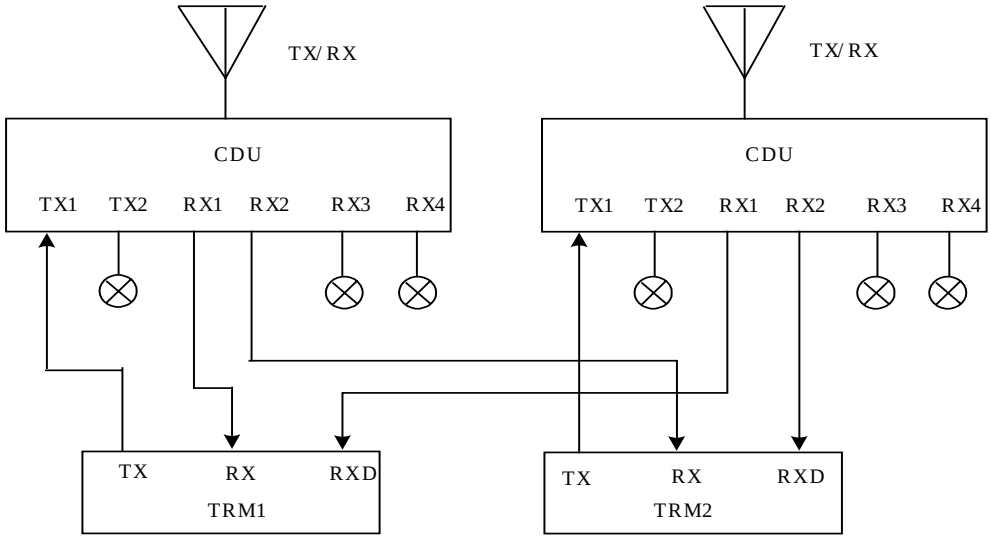


FIGURE 76 LOGICAL CONNECTION RELATIONSHIP BETWEEN THE COMBINER UNITS AND DISTRIBUTION UNITS OF O2-TYPE SITE



Generally, the O2-type site is configured with 2 CDUs and 2 omni-directional receiving antennas. Figure 77 shows the configuration of 40 W and 80 W O3 -type sites, and Figure 78 shows the logical connection relationship.

FIGURE 77 CONFIGURATION OF 40 W AND 80 W O3-TYPE SITES

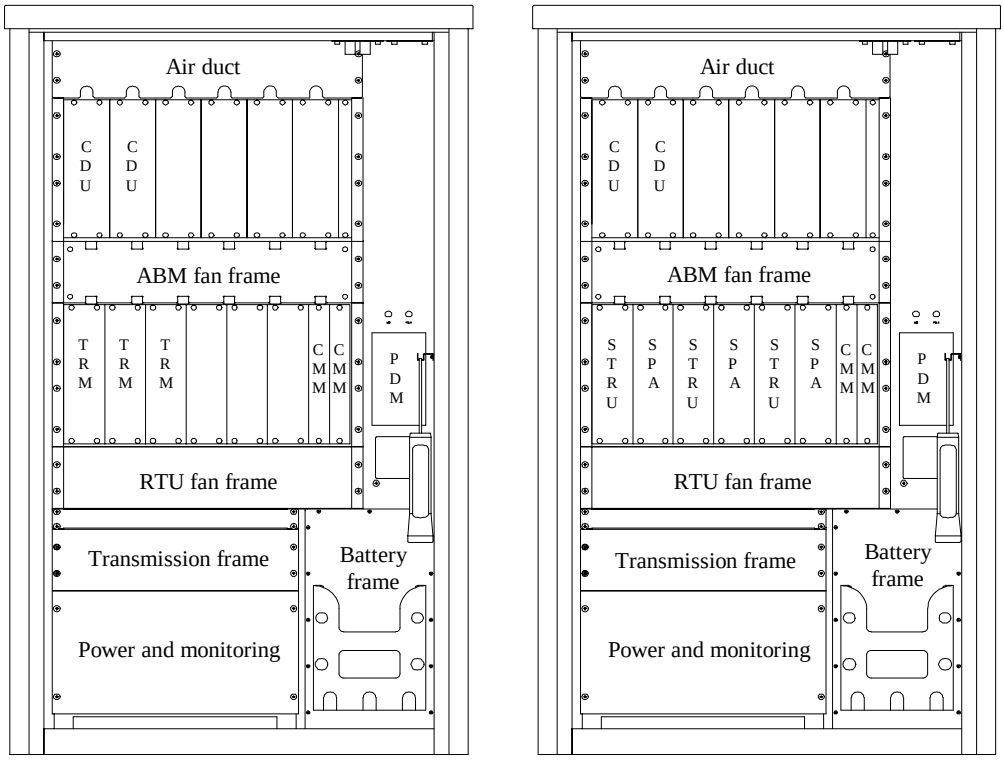
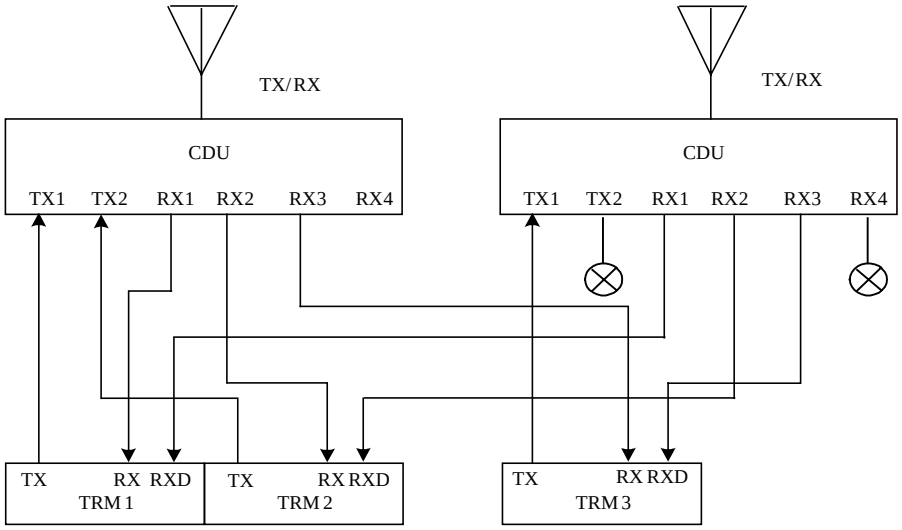


FIGURE 78 LOGICAL CONNECTION RELATIONSHIP OF 03-TYPE CDUS



Generally, the O4-type site is configured with 2 CDUs and 2 omni-directional receiving antennas. Figure 79 shows the configuration of 40 W and 80 W O4 -type sites, and Figure 80 shows the logical connection relationship.

FIGURE 79 CONFIGURATION OF 40 W AND 8W O4-TYPE SITES

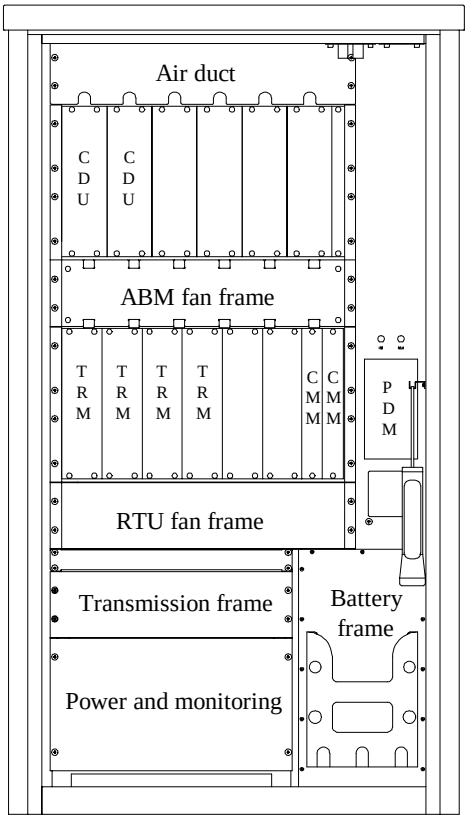
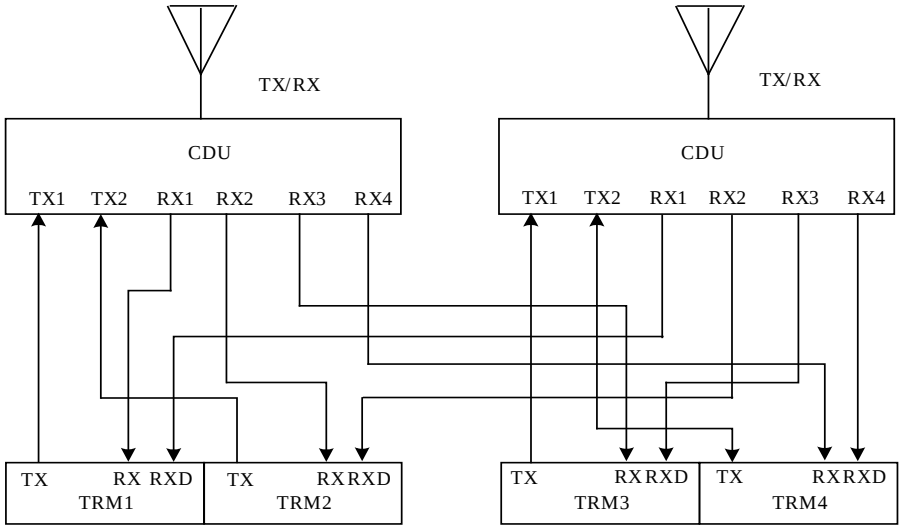


FIGURE 80 LOGICAL CONNECTION RELATIONSHIP BETWEEN THE COMBINER UNITS AND DISTRIBUTION UNITS OF O4-TYPE SITES



Generally, the O6-type site is configured with 2 CDUs, 2 CEUs and 2 omni-directional receiving antennas. Figure 81 shows the configuration of O6-type sites, and Figure 82 shows the logical connection relationship.

FIGURE 81 CONFIGURATION OF 40 W O6-TYPE SITES

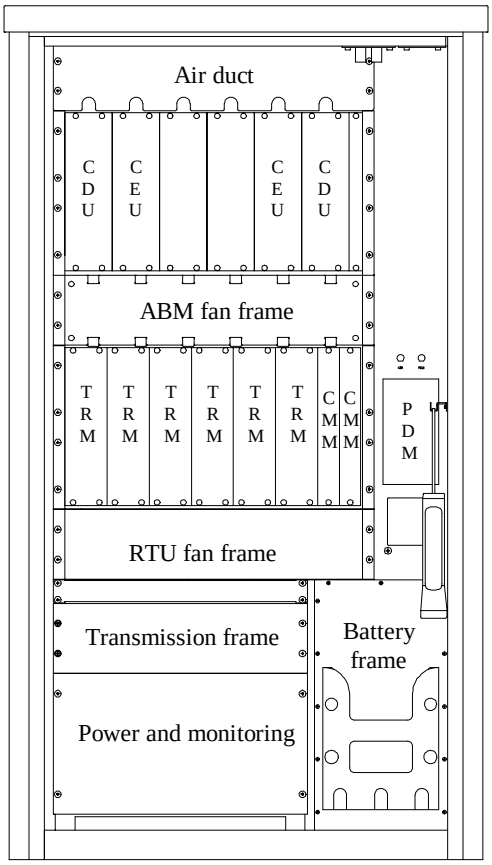
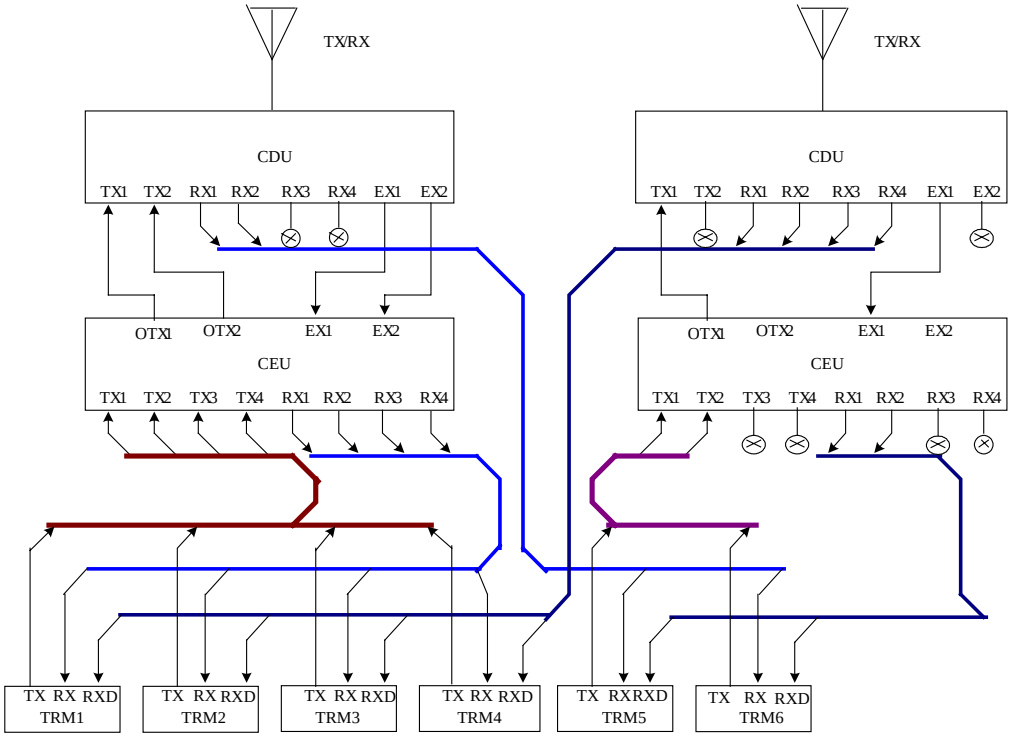


FIGURE 82 LOGICAL CONNECTION RELATIONSHIP BETWEEN CDUS/CEUS OF 06-TYPE SITES

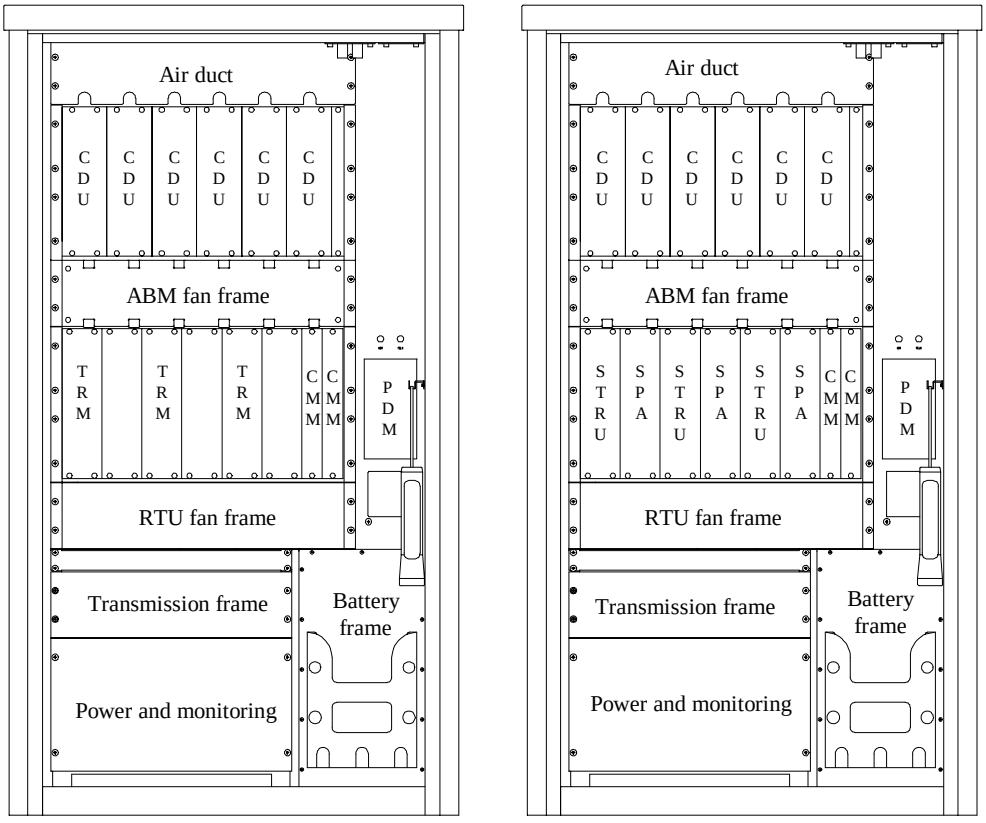


Configuration Examples of the S-type Site

The S-type site may serve either two-sector cells or three-sector cells. And the directional antenna is often employed.

Here is configuration of S1/1/1-type sites, usually configuration of 6 CDUs and 6 directional antennas. Configuration of S1/1/1-type sites is shown in Figure 83, and the logical connection relationship is similar to that of 02-type sites.

FIGURE 83 CONFIGURATION OF S1/1/1-TYPE SITES



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Appendix A

Pertinent Standards

The numbers and names of standards quoted in this manual are listed below.

ETSI TS 100 910 Version 3.16.0 European Digital Cellular Communication System (Phase One); Radio Transmitting and Receiving (GSM 05.05)

ETSI I-ETS 300 609 European Digital Cellular Communication System (Phase II); Equipment Specifications of BS; Part I: Wireless (GSM 11.21)

ITU-T G.703 Physical/Electrical Characteristics of System Digital Interfaces

ITU-T G.704 Synchronous Frame Structure used for the Rate Series of 1544, 6312, 2048, 8448 and 44736 kbit/s

GSM03.60 General Packet Radio Service (GPRS) Service description

GSM03.64 General Packet Radio Service (GPRS) Overall description of the GPRS radio interface

GSM04.04 Technical Specification Group GSM/EDGE Radio Access Network Layer 1 General requirements

GSM04.06 Mobile Station - Base Station System (MS - BSS) interface Data Link (DL) layer specification

GSM04.08 Mobile radio interface layer 3 specification

GSM04.60 General Packet Radio Service (GPRS) Mobile Station (MS) - Base Station System (BSS) interface Radio Link Control/ Medium Access Control (RLC/MAC) protocol

GSM05.02 Multiplexing and multiple access on the radio path

GSM05.08 Radio subsystem link control

GSM08.58 Base Station Controller - Base Transceiver Station (BSC - BTS) interface Layer 3 specification

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Appendix B

FCC STATEMENT

Before using this GSM Macro Base Transceiver Station, read this important RF energy awareness and control information and operational instructions to ensure compliance with the FCC RF exposure guidelines.

NOTICE: Working with the equipment while in operation, may expose the technician to RF electromagnetic fields that exceed FCC rules for human exposure. Visit the FCC website at www.fcc.gov/oet/rfsafety to learn more about the effects of exposure to RF electromagnetic fields.

Changes or modifications to this unit not expressly approved by the party responsible for compliance will void the user's authority to operate the equipment. Any change to the equipment will void FCC grant.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to the FCC Rules. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

For OUTDOOR use, a Directional Antenna with a maximum gain of 17dBi is authorized for use with this unit. Outside antennas must be positioned to observe minimum separation of 4M (13.12 feet) for 850MHz unit and 3M (9.84 feet) for 1900MHz unit from all users and bystanders. For the protection of personnel working in the vicinity of outside antennas, the following guidelines for minimum distances between the human body and the antenna must be observed.

The installation of an OUTDOOR antenna must be such that, under normal conditions, all personnel cannot come within 4M (13.12 feet) for 850MHz unit and 3M (9.84 feet) for 1900MHz unit from the outside antenna. Exceeding this minimum separation will ensure that the worker or bystander does not receive RF-exposure beyond the Maximum Permissible Exposure according to section 1.1310 i.e. limits for Controlled Exposure.

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Appendix C

CE STATEMENT

Before using this GSM Macro Base Transceiver Station, read this important RF energy awareness and control information and operational instructions to ensure compliance with the CE RF exposure guidelines.

The assessment of compliance boundary is performed by calculation in accordance with EN50383:2002.

Changes or modifications to this unit not expressly approved by the party responsible for compliance will void the user's authority to operate the equipment.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to the CE Rules. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

For OUTDOOR use, a Directional Antenna with a maximum gain of 11dBi is authorized for use with this unit. Outside antennas must be positioned to observe minimum separation of 4.2M (13.78 feet) for 900MHz unit and 3M (9.84 feet) for 1800MHz unit from all users and bystanders. For the protection of personnel working in the vicinity of outside antennas, the following guidelines for minimum distances between the human body and the antenna must be observed.

The installation of an OUTDOOR antenna must be such that, under normal conditions, all personnel cannot come within 4.2M (13.78 feet) for 900MHz unit and 3M (9.84 feet) for 1800MHz unit from the outside antenna. Exceeding this minimum separation will ensure that the worker or bystander does not receive RF-exposure beyond the Maximum Permissible Exposure according to section EN50383:2002 limits for Controlled Exposure.

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Abbreviations

Abbreviation	Full Name
A	
Abis	Abis
AEM	Antenna Equipment Module
AGCH	Access Granted Channel
ARFCN	Absolute Radio Frequency Channel No.
ATM	Asynchronous Transfer Mode
AUC	Authentication Center
B	
BBP	Base Band Processor
BCCH	Broadcast Control Channel
BER	Bit Error Rate
BFI	Bad Frame Indication
BIE	Base station Interface Equipment
BP	Burst Period (pulse)
BSC	Base Station Controller
BSIC	Base Station Identify Code
BSS	Base Station Subsystem
BTM	Backboard Transmission Module
BTS	Base Transceiver Station
C	
CCCH	Calling Control Channel
CCH	Common Channel
CDU	Combiner Distribution Unit
CELL	Cellular
CELP	Code Excited Linear Prediction Coding
CEU	Combiner Extension Unit
CHP	Channel Processor
C/I	Carrier to Interference Ratio
CIP	Carrier Interface Part
CLK	Clock

Abbreviation	Full Name
CM	Communication Management
CMM	Controller & Maintenance Module
CS	Circuit Switched
CU	Carrier Unit
D	
DB	Data Base
DBS	Data Base Subsystem
DLCI	Data Link Connection Identifier
DRX	Discontinuous Receiving
DSP	Digital Signal Processor
DTX	Discontinuous Transmission
E	
E1	E1
EAM	External Alarm Module
ECDU	"E"Combiner Distribution Unit
EDGE	Enhanced Data rates for GSM Evolution
EIR	Equipment Identity Register
EPLD	Erasable Programmable Logic Device
ETP	Extend Test Port
F	
FACCH	Fast Associated Control Channel
FB	Frequency correction Burst
FCCH	Frequency Correction Channel
FCLK	Frame Clock
FCS	Frame Check Sequence
FDMA	Frequency Division Multiplex Access
FN	Frame Number
FU	Frame Unit
FUC	Frame Unit Controller
G	
GGSN	Gate Way GPRS Support Node
GMSK	Gaussian Minimum Shift Keying
GPRS	General Packet Radio Service
GSM	Global System for Mobile communication
H	
HDB3	High Degree Bipolar coding
HDLC	High Level Data Link Controller

Abbreviation	Full Name
HEX	Heat Exchanger
HLR	Home Location Register
HPI	Host Processor Interface
HW	High Way
I	
ID	IDentification/IDentity
I/Q	In phase/quadrature
ISDN	Integrated Services Digital Network
L	
LapD	Link Access Procedure "D" Channel
LapDm	Link Access Procedure "Dm" (mobile "D") Channel
M	
MMI	Man-Machine Interface
MS	Mobile Station
MSC	Mobile Switch Center
MSS	Mobile Switch System
O	
OMC	Operation and Maintenance Center
P	
PAU	Power Amplifier Unit
PCM	Pulse Code Modulation
PLMN	Public Land Mobile Network
PSTN	Public Switched Telephone Network
PWM	PoWer Module
R	
RCU	Radio Carrier Unit
S	
SACCH	Slow Associated Control Channel
SMC	Short Message Center
SPA	Super Power Amplifier
STRU	Super Transceiver Unit
Synclk	Synchronous Clock
T	
TA	Time Advance
TCH	Traffic Channel
TDMA	Time Division Multiple Access
TMM	Transmission Management Module

Abbreviation	Full Name
TPU	Transceiver Process Unit
TRM	Transceiver Module
TRX	Transceivers
TX	Transmitter
U	
Um	Um
V	
VLR	Visitor Location Register
8PSK	8-Phase Shift Keying

Figures

Tables