A REVIEW OF RADIO BASE STATION (RBS2206) EQUIPMENT IN RELATIONS TO THE NEXT PHASE OF GSM TECHNOLOGY (3G) IN NIGERIA (CASE STUDY: ERICSSON AND VMOBILE)

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A REVIEW OF RADIO BASE STATION (RBS 2206) EQUIPMENT IN RELATIONS TO THE NEXT PHASE OF GSM TECHNOLOGY (3G) IN NIGERIA (CASE STUDY: ERICSSON AND VMOBILE)

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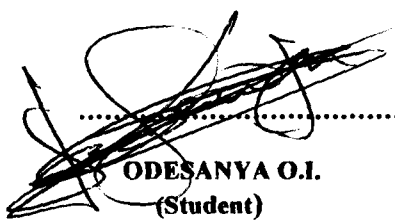
A Project Report Submitted in Partial Fulfillment of the Requirements for the Award of Bachelor of Engineering (B.Eng) Degree in Electrical/Computer Engineering, Federal University of Technology Minna, Niger State.

NOVEMBER, 2005.

DECLARATION

I **Odesanya Olanrewaju I.** hereby declare that this thesis "A Review of Radio Base Station (RBS 2206) Equipment in Relations to the Next Phase of GSM Technology (3G) in Nigeria" presented for the award of Bachelor of Engineering has not been presented either wholly or partially for the award of any other degree elsewhere.

Information derived from published or unpublished works have been duly acknowledged.



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DEDICATION

I will like to dedicate my final year project, which is required for my completion of B.Engr.programme in Electrical/Computer Engineering, to God Almighty, the Alpha & Omega of my life, who has seen me through in my academic pursuit.

ACKNOWLEDGEMENT

Before I acknowledge the contributions of some very important people that have greatly contributed to my future, I would like to show my gratitude to God for how far **HE** has helped me in my academic.

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At this junction "J", I tender my undeniable apology to every person whose name ought to appear but have not; your effort is highly appreciated, & thanks for being a part of my testimony in life.

ABSTRACT

Telecommunication has become the most exciting discovery of modern society especially with the introduction of GSM System Technologies. In the last two decades the wireless industry has gone through dramatic changes sparked by the ever growing demands of the wireless consumers. Until recently, the most advanced version of GSM circuit switched (CS) data services standard allowed for a data rate of 9.6kbps, which is found especially in the RBS 2202 equipment. In this version of GSM equipment, the user is allowed only one time slot per carrier and this limits the capacity to 9.6kbps – 16kbps. GSM has evolved to become a 3G network through several steps to make a "soft evolution", which is basically found in the RBS family of RBS 2206 equipment.

The RBS 2206 greatly supports the 3G system technologies. ***The Third Generation (3G) mobile systems*** allows for more wireless data applications, including wireless multimedia, e-mail, web infotainment and positioning services, for both subscribers and business users. It provides a fast, high-speed internet connection from just about anywhere, with no dial-up, which supports data rate of about 473kbps.

The powerful RBS 2206 is a 12-TRX (Transceivers) indoor GSM Radio Base Station (RBS). Keeping the successful characteristics of the existing RBS 2000 portfolio improving functionality as well as operation and maintenance makes the RBS 2206 the most cost effective solution for the "growing" GSM operators in Nigeria.

It is highly recommended that GSM operators in Nigeria fully go into the next phase of GSM technology (3G), in order to meet up with the yearning and thirst of the

subscribers, and to meet up with the world at large, where the technology is fully in operation.

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CHAPTER ONE

GENERAL INTRODUCTION

1.1 HISTORY OF GSM

The development of GSM started between **1982 and 1985**, when the Conference of European Posts and Telegraphs (CEPT) formed a study group called Groupe Special Mobile (the initial meaning of GSM).

The group was to study and develop a Pan-European public cellular system standard in the 900 MHz range, using spectrum that had been previously allocated, and this standard later became known as Global System for Mobile communication (GSM). At that time, there were many incompatible analog cellular systems in various European countries. Some of the basic criteria for their proposed system were:

- Good subjective speech quality;
- No terminal and service cost;
- Support for international roaming;
- Ability to support handheld terminals;
- Support for range of new services and facilities;
- Spectral efficiency;
- ISDN (Integrated Service Digital Network) compatibility.

In **1986**, field tests held in Paris, France to select which digital transmission technology to use either Time Division Multiple Access (TDMA) or Frequency Division Multiple Access (FDMA).And the combination of both TDMA and FDMA was selected as the transmission technology for GSM in **1987**.

Shortly after that, operators from 12 different countries signed a Memorandum of Understanding (MoU), committing to introduce GSM by the end of **1991**.

In **1988**, CEPT began producing GSM specifications for a phased implementation, another 5 countries joined in the signing of the MoU.

In **1989**, the responsibility for GSM was transferred to the European Telecommunication Standards Institute (ETSI), and the Phase I recommendations were published and the specifications were frozen which allowed manufacturers to develop network equipments in **1990**.

At that time, the United Kingdom requested a specification based on GSM but for higher user densities with lower-power mobile stations, and operating at 1.8GHz (1800MHz).The specifications for this system, called Digital Cellular System (DCS 1800) were published in **1991**.And the GSM 1800 standard was released. An addendum was later added to the MoU allowing more countries outside CEPT to sign. And commercial operation of GSM networks started in **mid-1991** in European countries.

In **1992**, the Phase I specifications were completed, and the first commercial Phase I GSM networks was launched. Also, the first international roaming agreement between Telecom Finland and Vodafone in UK was signed.

By the beginning of **1993**, Australia became the first non-European country to sign the MoU. The MoU was now having the signatories of 70 countries. The number of GSM subscribers reached one million.

In **1994**, the MoU was now having over 100 signatories covering 60 countries. Within this same year, more GSM networks were launched with the total number of subscribers exceeding over 3 million.

By the beginning of **1995**, GSM networks were felt in Europe, the Middle East, the Far East, Australia, Africa and South America, with a total of over 5.4 million subscribers, and with GSM subscribers increasing at the rate of 10,000 per day and rising.

In **April 1995**, there were 188 members of the MoU from 69 countries.

The first GSM 1900 systems became available by the **middle of 1996**,and this comply with PCS 1900 standard By the end of the year **1998**,the MoU was having a total of 253 members in over 100 countries and there were over 70 million GSM subscribers world-wide. GSM subscribers by then account for 31% of the world's mobile market.

In **1999**, GSM networks were now in existence in over 179 countries. Some functionality of GSM extended to incorporate EDGE, GPRS, and support for flexible positioning services were added by the year **2002**.

In **2003**, the total number of subscribers soared to over 1 billion.

1.2 BRIEF HISTORY OF GSM IN NIGERIA

The journey to success in Nigeria's Telecommunication has been long and tortuous. Telecommunication facilities in Nigeria were first established in 1886 by the colonial administration. Whatever uncomplimentary things, justified or not that may have to say about the present administration since its inception in May 1999, one thing has become incontrovertible; the government has successfully brought us a deregulated telecommunications sector by auctioning three GSM licenses in January 2001.

Two out of the three companies at the auction, ECONET Wireless (now Vee Networks Limited, trading as Vmobile) and MTN Communications were awarded full GSM licenses; the third company was refused license on the grounds that it did not meet payment deadline.

An underlining vision for the introduction of the GSM by the Nigerian government was to expand the Nigerian teledensity and directly make telephone communication cheap and accessible to the common man.

ECONET Wireless commenced operations August 6th, 2001; MTN Communications commenced operations August 8th, 2001.

Later Mobile Telecommunication services (M-tel), which is the digital mobile arm of NITEL was given license to also operate in the year 2001 as GSM operator.

The scenario was further spiced when the NCC (Nigeria Communications Commission) granted a license for Second National Operator (SNO) to Globacom, Nigeria on August 12th, 2002.Globacom license involves the following;

- National Carrier Services;
- Digital/Mobile Services;
- Long Distance Communication; and
- Fixed Wireless Access Service.

The evolution of GSM technology in Nigeria and its applications which extends to its use in enhanced facilities such as Multimedia Messaging Services (MMS), video conferencing, which are found in **2.5G** mobile system of Globacom Network, but this technology at present has been found to have its own limitations in terms of speed and reliability.

This necessitates the need for a better and enhanced form of technology that will provide a faster, higher-speed and cheaper option to the present GSM technology in Nigeria, and this is found in the **3G** (3^{rd} Generation) system of technology. With this technology, it enables new applications at higher data rates.

1.3 SCOPE OF THE PROJECT

The scope of this project is to describe the role of the powerful RBS 2206, which is a 12-TRX (Transceivers) indoor GSM Radio Base Station (RBS) in relations to the next phase of GSM Technology (3G) in Nigeria.

It's a new member of the highly successful RBS 2000 family in Nigeria, which guarantees a World-Class supply flow, fast installation and commissioning, reliable operation and maintenance and co-existence with other RBS 2000 products.

Being a member in the RBS 2000 family, RBS 2206 is to date one of the most powerful indoor RBSs in the world. Keeping the successful characteristics of the existing RBS 2000 portfolio improving functionality as well as operation and maintenance makes the RBS 2206 the most cost effective solution for the "growing" GSM operators in Nigeria.

1.4 IMPORTANCE OF THE PROJECT

The RBS 2000 family supports a wide range of features; however the followings are the key importance of RBS 2206 in relations to the next phase of GSM Technology (3G) in Nigeria:

i. extreme coverage, which is the keyword for RBS 2206;

ii. has to date the best output power and sensitivity in its class, thanks to the new double-capacity Transceivers and Combiners;

The double transceiver unit (dTRU) has the following features:

- An in-built hybrid combiner, possible to bypass, and supports TMA (Tower Mounted Amplifier) through internal gain adjustment;
- Improved radio performances means increased site-to-site distance, and therefore less site (BTS);
- Supported 121km Extended Range.

The Combiner Unit (CDU) has

- In-built duplex filter, saving feeders;
- Great reduction in the RF losses.

iii. Ready for GSM data services like GPRS (General Packet Radio Service), HSCSD (High Speed Circuit Switched Data), {EGPRS (Enhanced GPRS) (with the EDGE dTRU)};

iv. supports 3G technological services over EDGE;

v. cost efficient compact RBS on the market, with the RF performance best to minimize the number of needed sites;

vi. supports all frequencies (GSM 800, 900, 1800, 1900MHz).

1.5 METHODOLOGY ADOPTED IN CARRYING OUT THE PROJECT

After having the opportunity to work with L.M.Ericsson Nigeria, (Ericsson is the world leader in the design and manufacturing of BTSs for all GSM Standards) for my 6 months Industrial Training (IT), {mine lasted for 10 months}, I was given the free-hands make use of there facilities(even when I had left the place), and these facilities includes RBS 2000 library, RBS 2206 Installation and Integration Manuals, RBS 2206 Product Description Manuals, some Ericsson White Paper on EDGE, GPRS, etc.

Some softwares were given to me which includes the OMT (Operation and Maintenance Terminal), which is the software used in operating any of the RBS 2000 family, MSM (Minilink Service Manager), etc.

I was also given the opportunity to participate in a training programme on "GSM System Survey"; in the course of the (IT) with Ericsson; a copy of the certificate received is attached to this project.

I was also attached to some expatriates, who gave me the needed practical exposures to these equipments live on some Vmobile Nigeria Limited Base Transceiver Station (BTS) sites.

1.6 CONSTRAINT TO THE PROJECT

The major constraint I had was that it was quite difficult convincing L.M.Ericsson Nigeria to give me the opportunity to go to some of these BTS sites where these equipments are being used because I was not a staff of the Company.

Another constraint to this project was finance; I had to travel to some States where these equipments are being used.

1.7 OBJECTIVE OF THE PROJECT

The objective of this project is that this system allows communication, information and entertainment services to be delivered via wireless terminals at a very fast, high-speed connection from about anywhere.

It's an easy-to-implement, low-cost technology that can enhance mobile data services. And above all, it is to show to us that this is a technology with a difference which offers wireless broadband access to mobile phones, laptop users, via data cards providing up to 384Kbps data speed rate and theoretically of up to 473.6Kbps, as against the 115Kbps data speed rate provided by the 2.5G.

1.8 PROJECT LAYOUT

The first chapter gives a general introduction of the project paying attention to the history of GSM, brief history of GSM in Nigeria, scope, importance, methodology, constraint, and objective of the project work.

Chapter two is all about the literature review of the project discussing mainly on the GSM phases (generations), and GSM Network components.

A brief history of RBS 2000 family in Nigeria is detailed in Chapter three by dividing this into Micro, Macro and Pico base stations, with the hardware structures and diagrams of each RBS 2000 family.

Chapter four outlines the full details of the RBS 2206, its component parts, functions of each part, and its advantages over the other RBSs in the RBS 2000 family.

Chapter five discuss mainly on the future of GSM, the evolution of GSM to 3G, the 3G of mobile systems, services of 3G technologies, implementation of 3G technologies, and the network modification due to EDGE.

Lastly, chapter six is the general comments, recommendations and conclusion.

CHAPTER TWO

LITERATURE REVIEW

2.1 REVIEW

In relation to this project topic "A Review of Radio Base Station (RBS 2206) Equipment in Relations to the next Phase (generation) of GSM Technology (3G) in Nigeria", I will have to breakdown the topic into smaller and understandable units.

I will have to review the GSM Phases (generations) and the GSM Network Components for better understanding.

2.2 GSM Phases (generations).

The impact of GSM Mobile technologies has been immense. Mobile communication is now viewed as a necessity and is one of the fastest growing and most demanding technologies. Mobile systems have evolved overtime. When discussing different developments, I'm speaking of system generations (phases) technology.

The First Generation (1G) systems were analog with reasonably reliable networks but with limited service offerings.

Other services include:

- Voice telephony;
- Basic fax/data services (up to 9.6Kbits/s);
- Call forwarding;
- Call barring;
- Short Message Services (SMS).

The Second Generation (2G) mobile systems are digital and brings significant advantages in terms of service delivery, capacity and quality. GSM is a 2G technology.

Other services include:

- Advice of Charge;
- Calling line identification;
- Call waiting;
- Call holding;
- Conference calling;
- Additional data communications capabilities (up to 16Kbits/s).

The increasing demand for wireless access to the internet has led to further developments within 2G systems.

Thus, leading to what is termed as ***2.5G systems.***

General Packet Radio Services (GPRS) is an example of a 2.5G technology and is a standardized packet switched technology enabling "mobile use" of the internet. GPRS allows data rates of 115kbps and theoretically, of up to 160kbps.

Other services 2.5G technology offers includes:

- High Speed Circuit Switched Data (HSCSD), a technology for delivering higher data rates per subscriber by allocating an increased number of time-slot per call.
- Multimedia Message services, a technology for delivering short video clips of an event.

The Third Generation (3G) mobile systems allows for more wireless data applications, including wireless multimedia, e-mail, web infotainment and positioning services, for both subscribers and business users. It provides a fast, high-speed internet connection from just about anywhere, with no dial-up.

It is seen as an easy-to-implement, low-cost technology that can enhance mobile data services. Subscribers will be able to browse the internet on their mobile phones, personal digital assistants or laptops at the same speed as on stationary personal computers.

The foundation for these services has already been laid in 2G (Second Generation) systems, but in order to support such services we need higher capacity on the radio links as well as "Compatibility" between systems in order to provide smooth access worldwide. This is a technology with a difference that offers wireless broadband access to mobile phones, laptop users, via data-cards providing up to 384kbits/s data speed rate.

There is co-existence between 2G/2.5G/3G technology and this will have a major impact on the appearance and capabilities of the mobile phone handsets.

Examples of a 3G system are Universal Mobile Telecommunication Systems (UMTS), Enhanced Data for Global Evolution (EDGE).

EDGE only introduces a new modulation technique and new channel coding that can be used to transmit both packet-switched and circuit-switched voice and data services. EDGE is therefore an add-on to GPRS and cannot work alone.

2.3 GSM Network Components

The GSM Network is divided into two systems. Each system comprises a number of functional units in the mobile network.

They are:

- Switching System (SS);
- Base Station System (BSS).

In addition, GSM Networks are operated, maintained and managed from computerized centers.

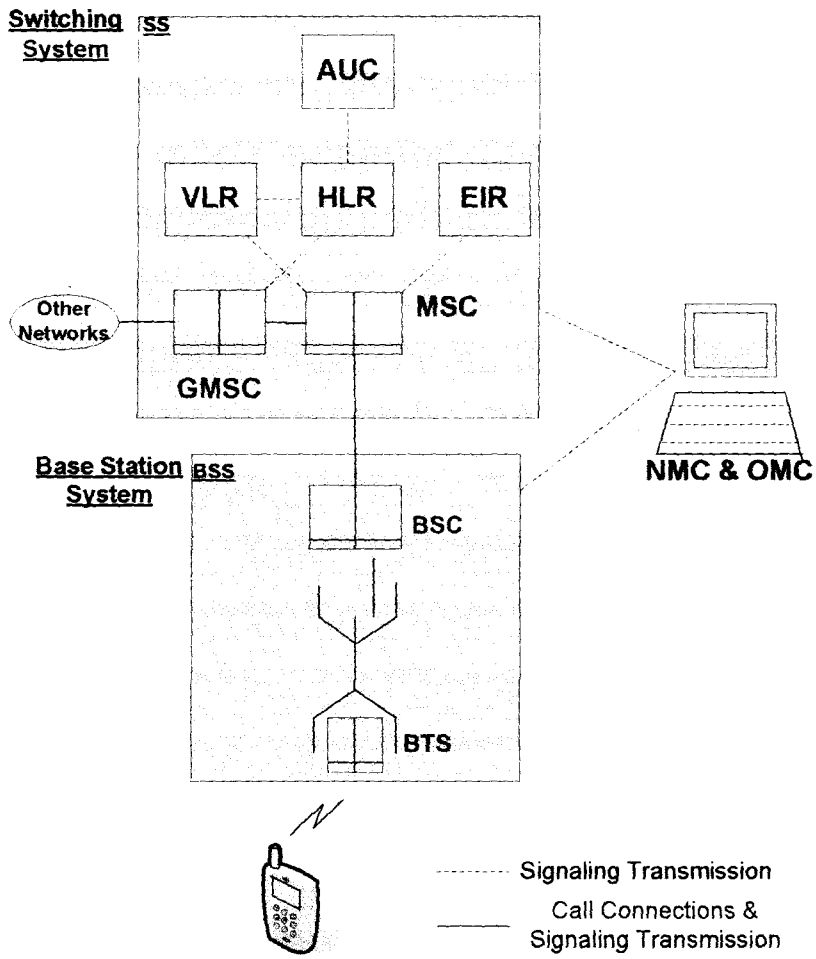


Figure 2.3.1: GSM Network Component

Abbreviations

- AUC = Authentication Center
- BSC = Base Station Controller
- BTS = Base Transceiver Station
- EIR = Equipment Identity Register
- HLR = Home Location Register
- MS = Mobile Station
- MSC = Mobile services Switching Center (a.k.a Mobile Switching Center)
- NMC = Network Management Center
- OMC = Operation and Maintenance Center
- VLR = Visitor Location Register

The ***Switching System (SS)*** is responsible for performing call processing and subscriber related functions. It includes the following functional units:

- MSC
- HLR
- VLR
- AUC
- EIR
- GMSC

The ***Base Station System (BSS)*** performs all the radio-related functions. The BSS is comprised of the following functional units:

- BSC
- BTS

The ***Operation and Maintenance Center (OMC)*** performs all the Operation and Maintenance tasks for the network such as Monitoring Network traffic and Network alarms. The OMC has access to both the SS and the BSS.

The ***Mobile Stations (MSs)*** do not belong to any of the systems.

2.5 SS Components

MSC:

- It controls calls to/from other telephony and data systems such as the Public Switched Telephone Network (PSTN);
- It controls calls between Mobile Stations (MSs).

GMSC:

- It enables an MSC to interrogate a network's HLR in order to route a call to a Mobile Station (MS);
- Handles calls to/from other networks.

- Centralized network database that stores and manages all mobile Subscriptions belonging to a specific operation;
- Acts as a permanent store for a person's subscription information until that subscription is canceled;

The information stored in the HLR includes:

- Subscriber identity;
- Subscriber supplementary services;
- Subscriber location information;
- Subscriber authentication information.

VLR:

- Database contains information about all the mobile subscribers currently located in the MSC service area. Thus, there is one VLR for each MSC in the network;
- It temporarily stores subscription information so that the MSC can service all the subscribers currently visiting the MSC service area.

AUC:

- It is to authenticate the subscribers attempting to use a network;
- It protects network and subscribers from fraudulent activities.

R:

- It identifies and verifies mobile equipment if stolen.

2.6 BSS Components

BSC:

- Manages all radio-related functions of a GSM network;
- It's a high capacity switch that provides functions such as MS handover, radio channel assignment;
- It generates the E1 needed by the BTS;
- It provides all control functions and physical links between the MSC and a number of BTSs;
- A number of BSCs may be controlled by each MSC.

BTS:

- It controls the radio interface to the MS;
- It comprises the radio equipment (RBS) such as transceivers and antennas, which are needed to serve each cell in the network;
- Processes signals before transmission and after reception;
- A group of BTSs are controlled by a BSC;

Most of the time the BTS is also referred to as Radio Base Station (RBS) and the RBS will be spoken of extensively later in this project work.

2.7 Network Monitoring Centers

OMC:

- It is a computerized monitoring center which is connected to other network components such as MSCs and BSCs via data networks links;
- In the OMC, staff is presented with information about the status of the network and can monitor and control a variety of system parameters;
- OMC can concentrate on long-term, regional issues.

NMC:

- The centralized control of the whole network is done at a NMC;
- Only one NMC is required for a network and this controls the subordinate OMCs;
- NMC can concentrate on long-term system-wide issues.

CHAPTER THREE

RADIO BASE STATION (RBS)

3.1 RBS 2000 GENERAL OVERVIEW

The RBS 2000 product family for Ericsson's second generation (2G) of Radio Base Stations (RBSs) developed to meet the GSM specification for Base Transceiver Stations (BTSs) and also it offers the most advanced technology available.

With Ericsson's wide range of RBS 2000 products, the most cost-effective alternative is chosen for each situation, depending on capacity, coverage, space and environmental requirements.

Some of the major features of this RBS 2000 family are:

- **Fast Roll-out and Expansion**

RBS 2000 Macro allows for easy installation with on-site testing and commissioning within one hour.

This is accomplished as the RBSs are pre-assembled, and software (SW) loaded and tested before delivery. The flexible design of RBS 2000 supports a number of site configurations and expansion paths as the network grows.

RBS 2000 sites are pre-defined as product packages, which guarantee a fast and cost-effective roll-out of typical RBS 2000 configurations.

Superior Coverage and Capacity

Ericsson provides superior radio performance thanks to the highest output power, combined with high receiver sensitivity for optimum coverage.

Better coverage means less RBSs in a given area, and therefore lower investments and fast roll-out. Ericsson RBS 2000 Macro supports three basic solutions: Standard Range, Maximum Range and High Capacity. Maximum Range is accomplished by the use of air combining and a Tower Mounted Amplifier (TMA).Standard Range and High Capacity are accomplished by hybrid and filter combiners.

- **Prepared for the Future**

The RBS 2000 family is prepared for GSM data services, including General Packet Radio Services (GPRS), High Speed Circuit Switched Data (HSCSD) and 9.6kbits/s timeslots.

- **Other key features are:**

  - Six transceivers
  - Superior radio performance
  - Fast roll-out
  - Indoor environment
  - Enhanced Full Rate and Half Rate speech coding
  - Dual band
  - Can be positioned at a variety of sites including outdoor, indoor, on ground or rooftops and wall mounted.

There are three types of Base stations used in GSM Technology:

- **(a) Macro base stations:**

The Macro cells are large cells used for urban and rural areas. It makes use of higher output power, which for better network coverage. These include RBS 2101, 2102,**2202**,**2206**,2207.

- **(b) Micro base stations:**

The Micro cells are used for urban areas. It makes use of minimum output power, which makes frequency re-use possible. These include RBS 2301, **2302**.

- **(c) Pico base stations:**

The Pico cells are used where coverage of 360 degrees is not needed. It uses a selective cell with coverage of 120 degrees. It operates on a low output power, and this makes frequency re-use possible .Used in Hot spot areas. i.e. high demanding areas like airport, shopping mail, entrance of tunnels. These include RBS **2401**.

The Micro and Pico Base Station (RBS 2301, 2302, and 2401), are working in the same way, but the hardware differs.

For densely populated areas, the combinations of the 3 types of base stations are used, so as to cater for any kind of traffic levels encountered by subscribers in these areas.

3.2 RBS 2202

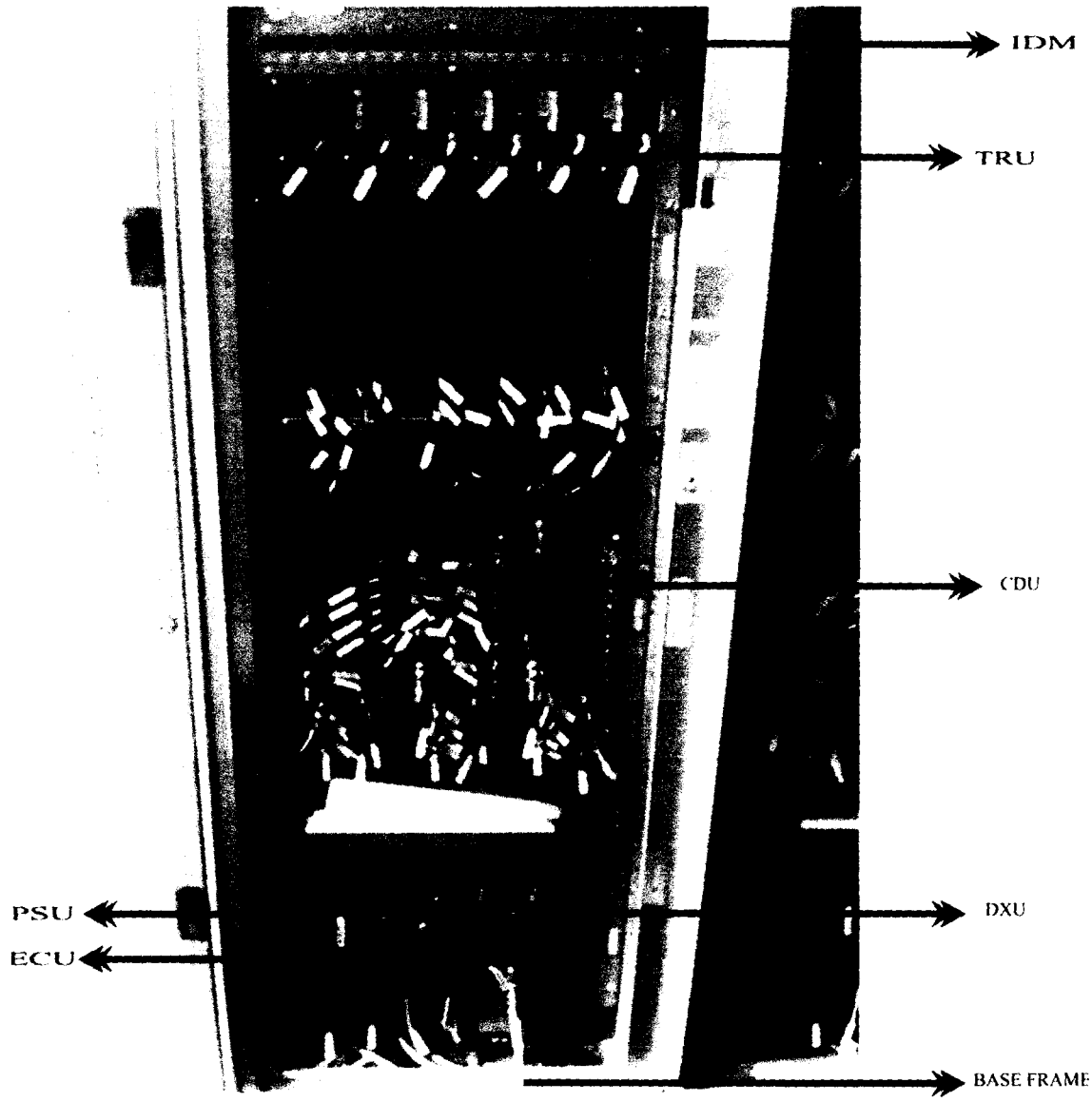


Figure 3.2.1: RBS 2202

The RBS 2202 is an indoor RBS supporting up to six transceivers per cabinet as shown in figure 3.2.1 above.

It can be used in one, two, and three sector-configurations. It can be used as multicabinet configurations with two cabinets, master and extension cabinet and up to twelve transceivers are supported.

It used the same Replaceable Units (RU) as all RBSs in the RBS 2000 TRU – based macro products.

3.2.2 RBS 2202 Cabinet Configuration

The cabinet is to be housed in a climate protected shelter or room which gives suitable climate for the units.

- The RBS cabinet houses up to 6 TRUs plus common equipment needed for serving the cell configuration.
- Cable entries for antenna jumpers, transmission cables, and mains power are concentrated on the roof of the cabinet.
- Power supply can be either 230V AC,-48V DC or +24V DC. If 230V AC is used, battery back-up,i.e BBS 2202 which can provide up to 8 hours of battery back-up
- A top cowl can be attached to the cabinet roof, providing acoustic damping and contributing to a clean cabinet look.

3.3 RBS 2302

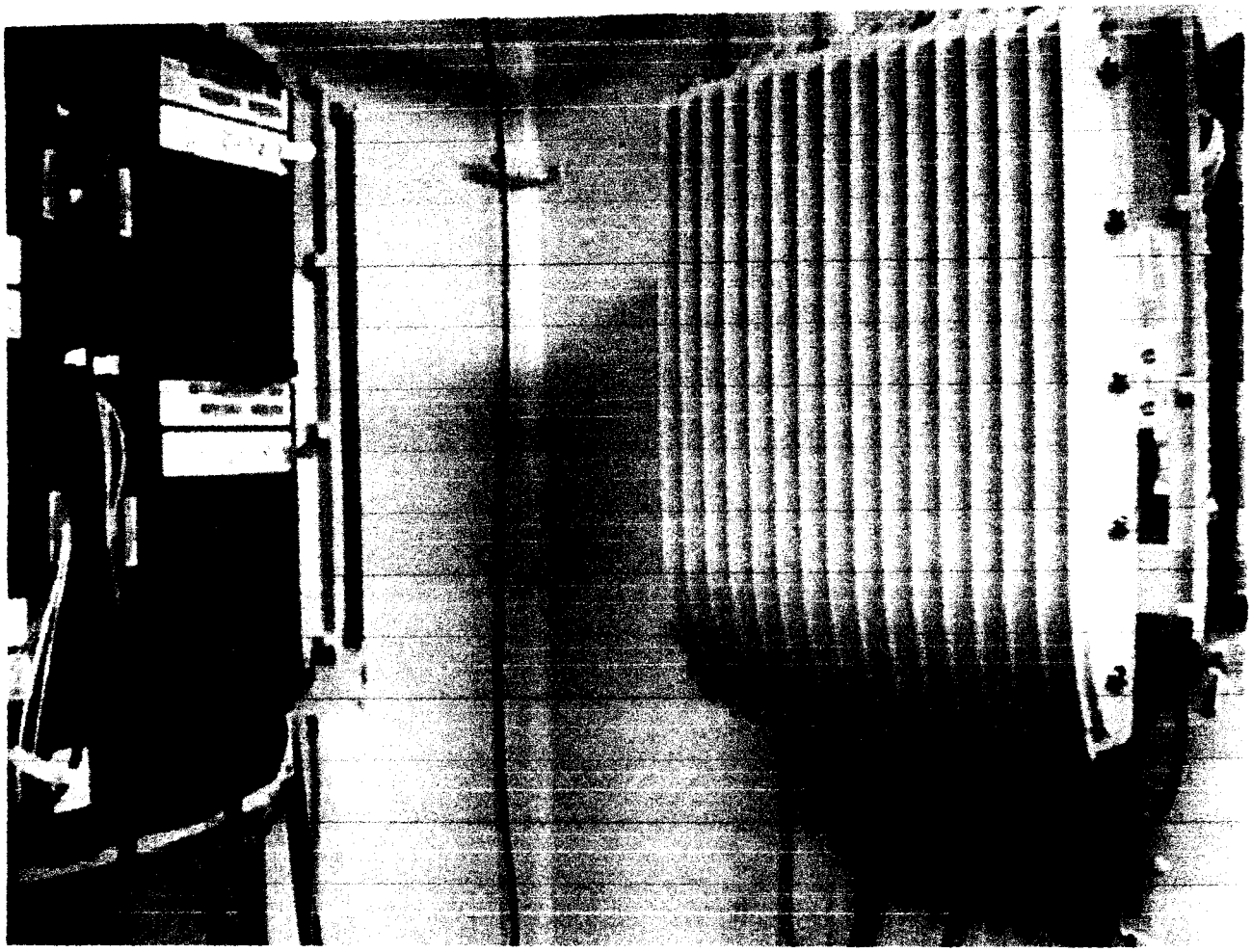


Figure 3.3.1: RBS 2302

THE RBS 2302 IS BY THE RIGHT WITH A BATTERY BACK-UP BY THE LEFT ON A VMOBILE BTS.

The RBS 2302 is designed for both indoor and outdoor applications.

This cabinet is possible to be mounted on the wall or on the mast pole. It's delivered with 2 TRXs. It can be extended to 6 TRX solutions connecting up to three cabinets together in one cell.

It supports Maxite (active antennas).Its low output power makes it useful for small cells, such as: arenas, streets, shopping malls, etc. The cabinet can be fitted with external antennas, internal sector or omni antenna.

It can be used for building pico-cell coverage using only one antenna feeder.

The diagram for RBS 2302 is shown in figure 3.3.1 above.

3.3.2 RBS 2302 Cabinet Configuration

The size is smaller than the other base stations in the RBS 2000 family, and this is mainly thanks to the low output power.

Due to this, the base station does not need so much cooling and that is why its size is smaller. The base station contains only few replaceable parts, the main parts are:

- Cabinet ---- This houses up to two transceivers plus common equipment needed for serving one cell; that is power supply, distribution switch, antenna interfaces and a battery for power back up minimum 3 minutes.
- Mounting base ---- Here all incoming cables are connected, that is AC-power, transmission lines and external alarms.
- Sunshields ---- Are mounted around the base station to give the cabinet a cleaner look.

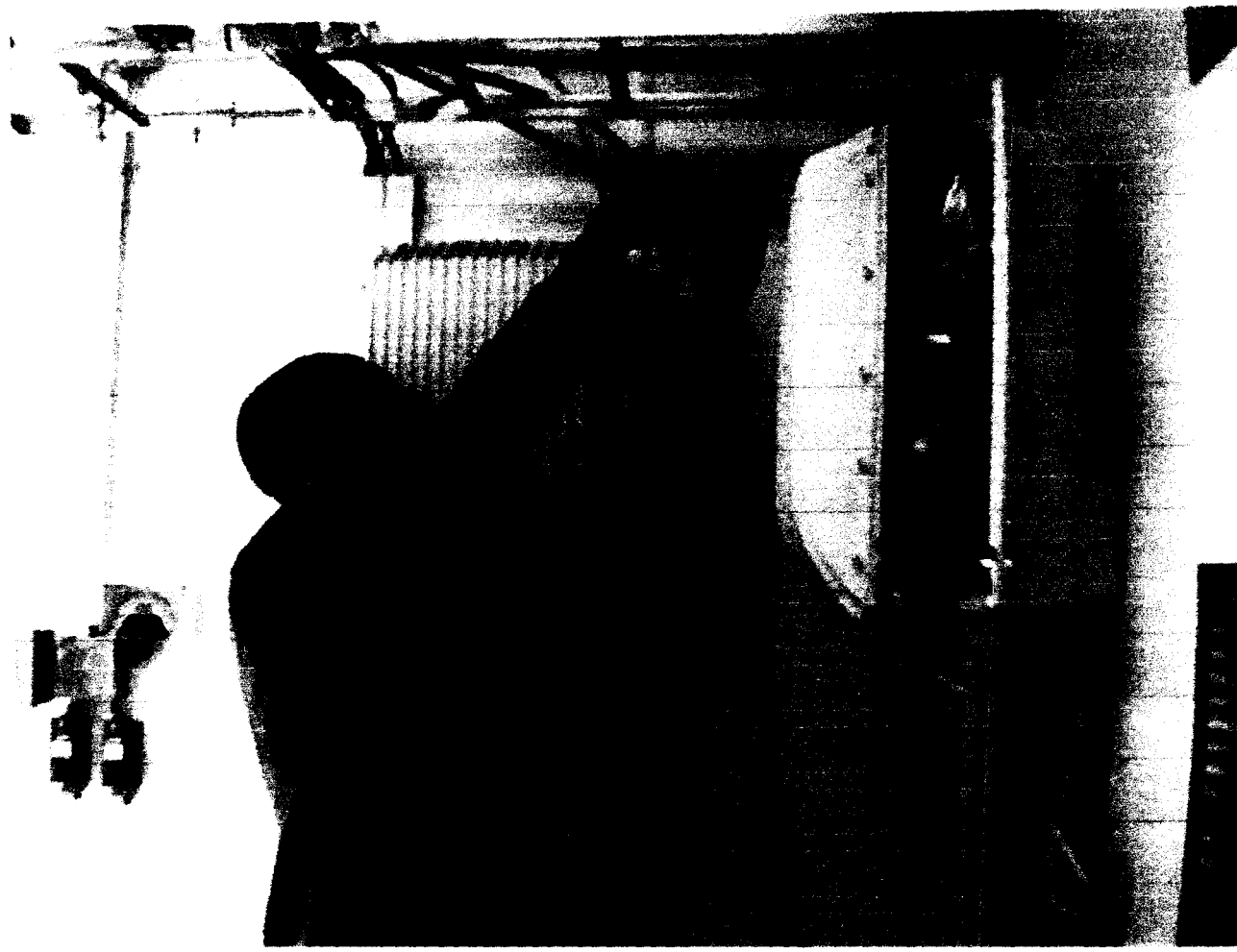


Figure 3.3.3: INSTALLATING OF RBS 2302 AT A VMOBILE BTS SITE

3.4 RBS 2401

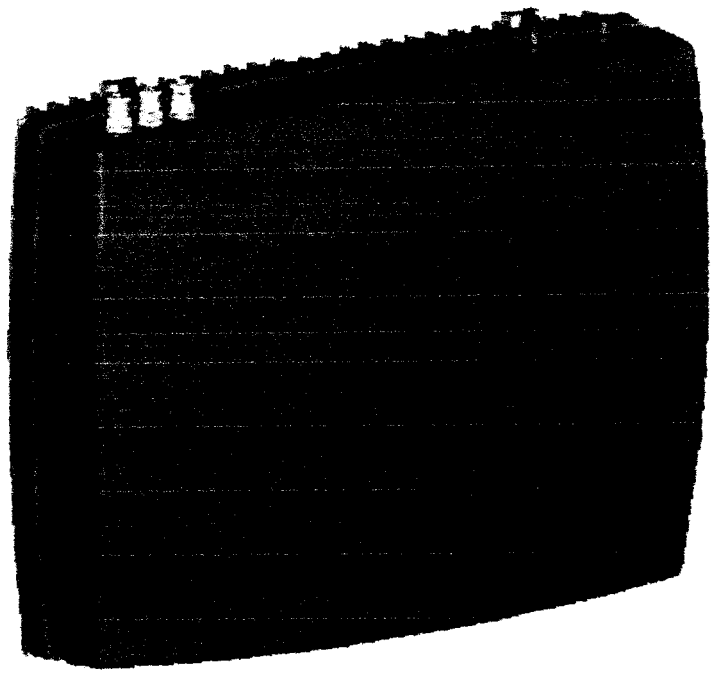


Figure 3.4.1: RBS 2401

The RBS 2401 is the first dedicated indoor radio base station, designed for indoor applications.

RBS 2401 is in itself a complete RBS, including transmission and integrated power supply. It is designed for maximum efficiency in indoor situations like office solutions and public hot spot indoor applications. This, together with flexible transmission solutions and antenna configurations, gives the most efficient and flexible indoor RBS solution available today.

The diagram of RBS 2401 is shown in figure 3.4.1 above.

3.4.2 RBS 2401 Cabinet Configuration

The cabinet houses two transceivers plus common equipment needed for serving one cell.

To be able to make the RBS 2401 less visible and become a part of the background, the RBS is delivered with a front shield in a discrete colour. It is also possible to paint the front shield, as to make it easier to blend in.

3.5 HARDWARE ARCHITECTURE OF RBS 2000 FAMILY

The hardware consists of a number of Replaceable Units (RUs) and buses, which are briefly described in this section.

The RU is the smallest hardware part that can be swapped when carrying out repair at the site. This can be e.g. a Transceiver Unit (TRU), cable, fan, etc.

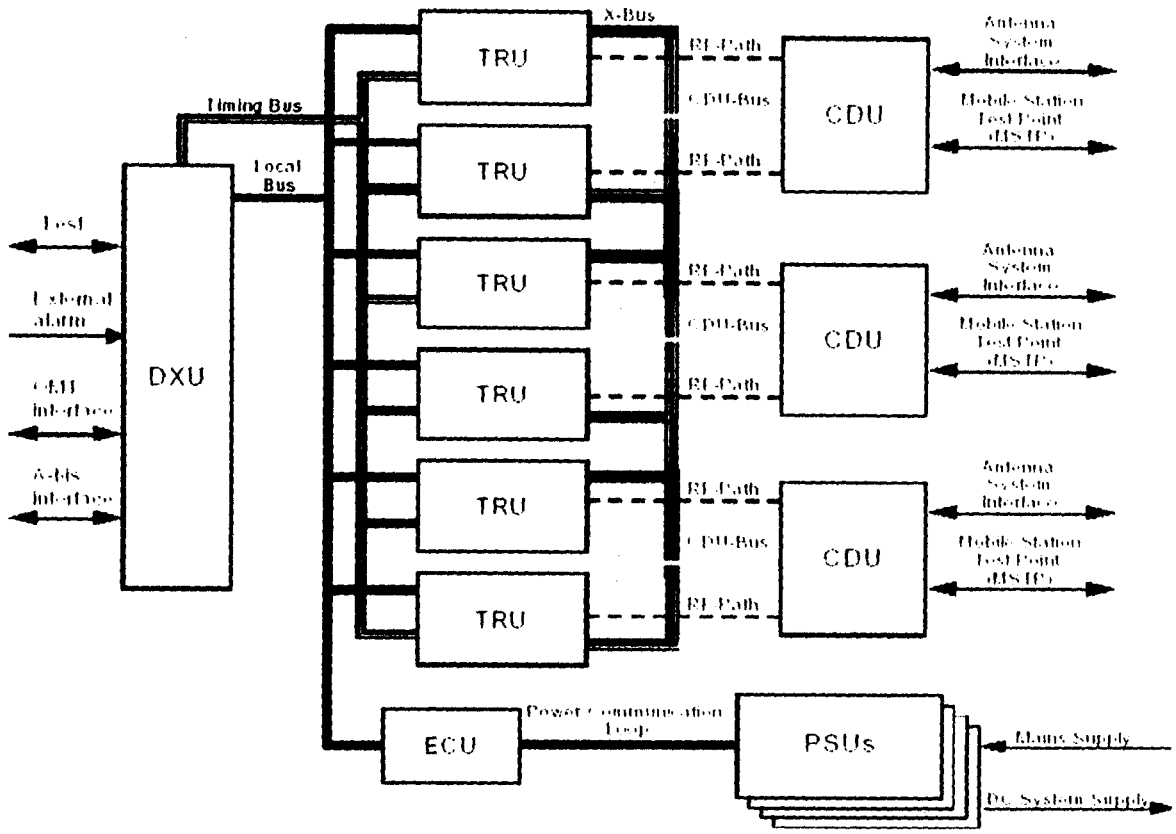


Figure 3.5.1 BLOCK DIAGRAM OF RBS 2202

3.5.1.1: Description of Each Functional Parts of RBS 2202 Block Diagram

DISTRIBUTION SWITCH UNIT (DXU)

It is the RBS central control unit. There is one DXU per RBS. It provides a system interface by cross connecting either 2Mbit/s or 1.5Mbit/s transport network and individual time slots to their associated transceivers. It is also the interface to the OMT. It is responsible for RUs software loading and storage. It also extracts time slots from the A-bis and passes them to the TRUs over the local bus.

TRANSCEIVER UNIT (TRU)

It is used basically for radio transmitting and radio receiving. Also used for air interface signal processing. Each TRU handles 8 air time slots, meaning it can handle 8-callers simultaneously.

COMBINING AND DISTRIBUTION UNIT (CDU)

It's a device which serves as an interface between the TRUs and the antennas. The main purpose of the CDU is to reduce the number of antennas used in each cell sector. The CDU combines or distributes the transmitted signals from various transceivers and distributes received signals to all transceivers. It is also used in RF signal filtering before the signal is passed unto the TRUs.

ENERGY CONTROL UNIT (ECU)

This unit controls, supervises and regulates the power, climate and environmental condition inside the cabinet to maintain system operation. It communicates with the DXU over the Local Bus. The main units in the power and climate system are:

- Power Supply Units (PSU)
- Battery and Fuse Unit (BFU) with batteries
- AC Connection Unit (ACCU)
- Fans controlled by Fan Control Units (FCU)

LOCAL BUS

It offers internal communication between the DXU, TRUs and ECU.

Examples of information sent on this bus are TRX signaling, speech and data.

TIMING BUS

It carries air timing information from the DXU to the TRUs.

X-BUS

It carries speech data on a time slot basis between the TRUs.

CDU BUS

It connects the CDU to the TRUs and facilities interface and Operation and Maintenance functions e.g. transfers alarm and RU specific information.

POWER COMMUNICATION LOOP

It consists of optical-fiber cables and carries control and supervision information between the ECU, PSUs and the BFU.e.g. The output current is regulated due to the traffic load of the RBS.

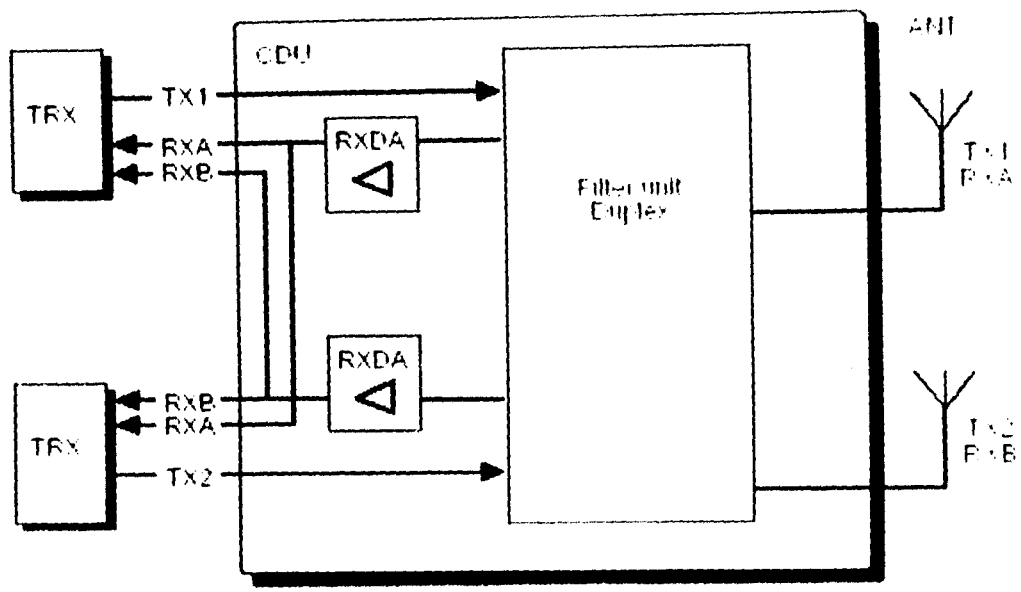


Figure 3.5.2 BLOCK DIAGRAM OF RBS 2302

3.5.2.1: Description of Each Functional Parts of RBS 2302 Block Diagram

TRX- Transceiver (Combined Transmitter and Receiver)-

Each TRU can only handle 8-time slots, meaning it can only handle 8 callers simultaneously and 16 callers in all at the same time.

TX1/ TX2- Transmitter Antenna Branch 1 & 2

RXA/ RXB - Receiver Antenna Branch A & B

RXDA- Receiver Divider Amplifier-

The RXDA (1 per RBS) contains equipment of low noise amplification of the received radio carriers and dividing each incoming RX into two output carriers.

FU Duplex- Filter Unit Duplex-

The FU (1 per RBS) is the interface between the transmitters, receivers and the antenna system.

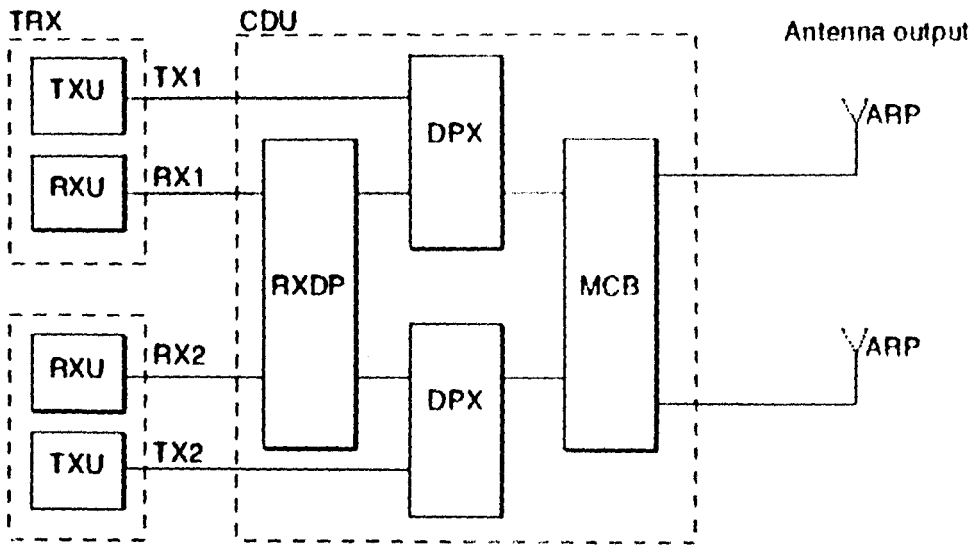


Figure 3.5.3 BLOCK DIAGRAM OF RBS 2401

3.5.3.1: Description of Each Functional Parts of RBS 2401 Block Diagram

TRX- Transceiver (Combined Transmitter and Receiver)-

Each TRU can handle 8-time slots, meaning it can handle 8 callers simultaneously, and 16 callers in all at the same time.

TX1/TX2- Transmitter Antenna Branch 1 & 2

RX1/RX2- Receiver Antenna Branch 1 & 2

TXU- Transmitter Unit-

The TXU (2 per RBS) contains equipment for transmission on one radio carrier.

RXU- Receiver Unit-

The RXU (2 per RBS) contains equipment for reception on one radio carrier.

RXDP- Receiver Distribution Plane-

It distributes received signal to the RXUs in the TRX.

MCP- Multicasting Box-

It is an interface between the ARP (Antenna) and the DPXs.

ARP- Antenna Reference Point-

It is defined as the point where the RX/TX antenna signal crosses the RBS border.

DPX- Duplexer

It is the interface between the MCB, RXDP and TXUs.

CHAPTER FOUR

RBS 2206 EQUIPMENT

4.1 OVERVIEW

The RBS 2206 is a member of the RBS 2000 family which is a high-capacity indoor base station. It is used for indoor applications with up to six double Transceiver Units (dTRU).Designed to be transported as a fully assembled cabinet to the site. All units in the cabinet are easily accessible from the front of the cabinet, which means that the cabinets can be mounted side by side with their backs against a wall. It covers the same floor area as the RBS 2202, its predecessor, and boasts double capacity.

4.2 MAIN FEATURES

The RBS 2206 supports all the standard features of the RBS 2000 family.
It also has the following features:

- 1, 2 or 3 sectors in one cabinet using CDU-G or CDU-F
- 12 TRXs
- Can be co-sited with TDMA equipment
- Can supervise external alarms with a maximum number of 15 alarms
- Interface for GPS positioning services
- Prepared for EDGE
- Radio configurations supported for GSM 800, 900, 1800 and 1900 MHz and EDGE

- Supports 3 types of Transmission Interface
  - . T1 1.5 Mbit/s, 100 ohms with internal synchronization
  - . E1 2 Mbit/s, 75 ohms with PCM synchronization
  - . E1 2 Mbit/s, 120 ohms with PCM synchronization
- There are three RBS 2206 cabinet versions:
  - . -48 to -60V DC
  - . 120 to 250V AC, 50/60Hz
  - . +24V DC (without PSUs)

The maximum power fed to the antenna as a function of the number of TRUs per antenna and the maximum power per TRU, for RBS 2206 at 900MHz and 1800MHz is given as:

Table 4.2: The Power Levels per TRU & the Numbers of TRUs per Antenna below;

Frequency (MHz)	Configuration (CDU)	No. of TRUs per Antenna	Maximum CDU output power per TRU (dBm)	Maximum power into Antenna (dBm)
GSM 900	1x2	1	48.3	45.3
GSM 900	1x4	2	45.0	45.0
GSM 1800	1x2	1	46.8	43.8
GSM 1800	1x4	2	43.5	43.5

4.3 HARDWARE UNITS

The RBS 2206 cabinet contains the radio equipment, power supply and the climate equipment (fans).

This section briefly describes the standard hardware (HW) units required for functionality, irrespective of configuration or frequency.

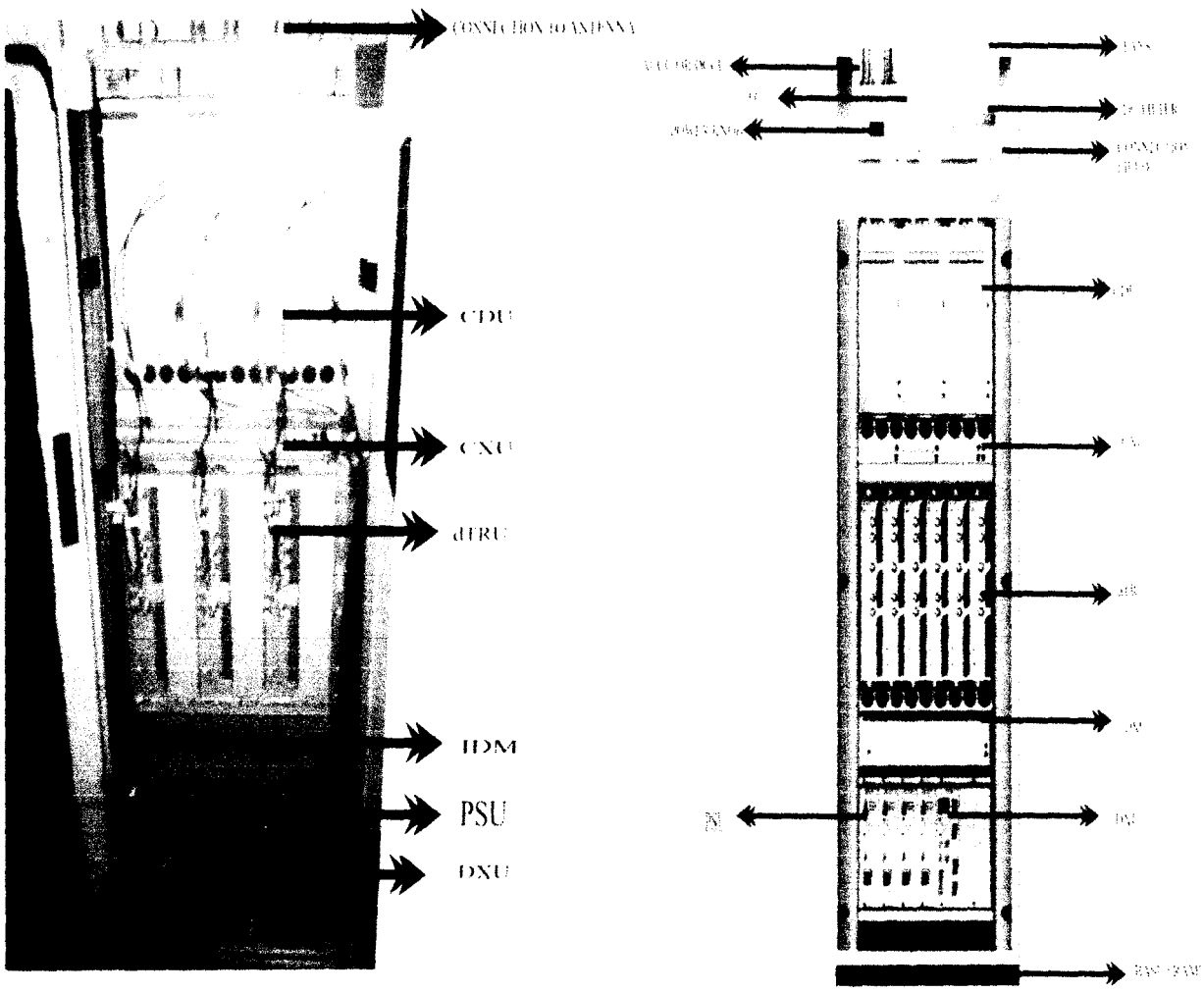
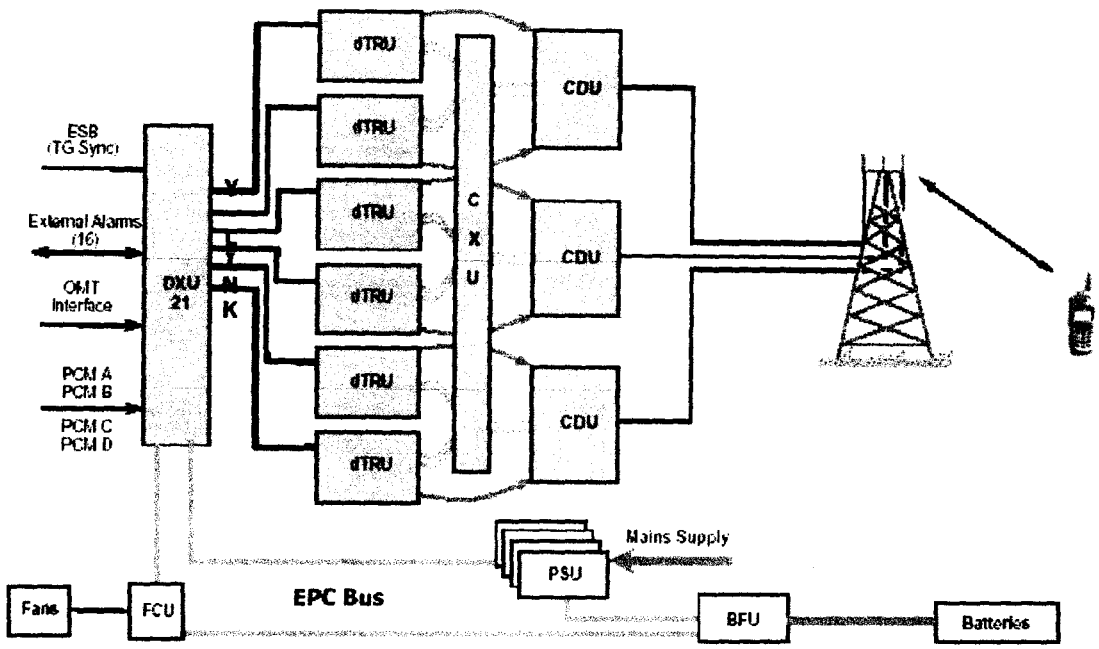


Figure 4.3.1: SIDE & FRONT VIEW OF RBS 2206

4.4 BLOCK DIAGRAM OF RBS 2206



4.4.1 RBS 2206 HARDWARE FUNCTIONS

ACCU – AC Connection Unit

The ACCU/DCCU handles distribution and connection/disconnection of the incoming power supply voltages to the PSUs. Connection/disconnections is performed by the main switch. The unit also contains filter equipment.

ACCU is shown in figure 4.3.1 above.

CDU – Combining and Distribution Unit

The CDU is the interface between the transceivers and the antenna system.

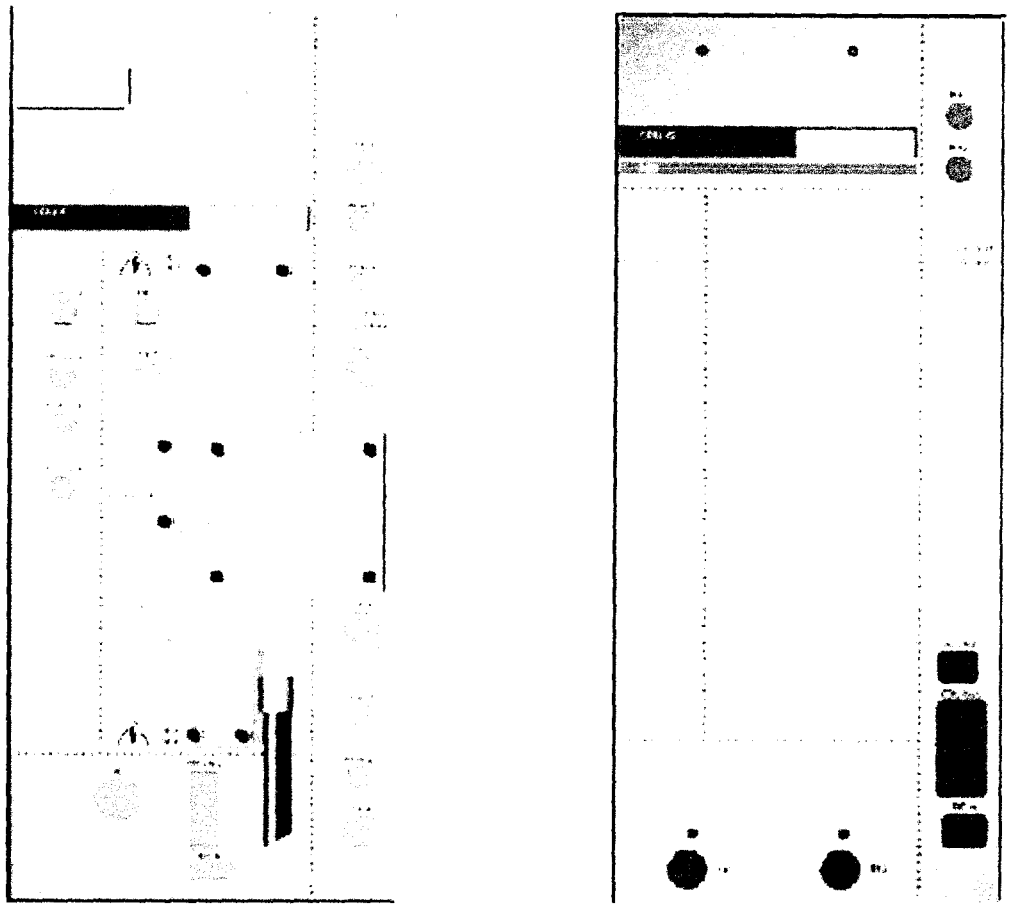
All signals are filtered before transmission and after reception by means of band pass filters. The CDU allows several dTRUs to share antennas. There are a maximum of three CDUs in one RBS 2206.

The CDU combines transmitted signals from several transceivers, and distributes the received signal to several transceivers. The CDU is hardware prepared to support EDGE. Two different CDU types are used in the RBS 2206 to support all configurations

. **CDU-F** is a filter combiner intended for high capacity solutions

. **CDU-G** can be configured either for high capacity or for high coverage.

The CDUs are shown in figure 4.4.1a below.



CDU-F **CDU-G**

Figure 4.4.1a: CDU-F & CDU-G

CXU – Configuration Switch Unit

The CXU cross-connects the CDU and the dTRU in the receiver path. The CXU makes it possible to expand or reconfigure a cabinet without moving or replacing any RX cables. The RX inputs/outputs on the dTRU and the CDU are placed in such positions that they minimize the amount of cable types for connecting the CXU with the dTRUs and the CDUs. The CXU is configured by means of software.

CXU is shown in figure 4.4.1b below.

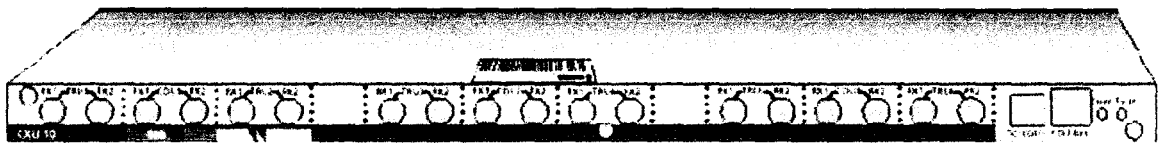


Figure 4.4.1b: CXU

DCCU – DC Connection Unit

The DCCU handles distribution and connection/disconnection of the incoming power supply voltages to the PSUs. Connection/disconnection is performed by the main switch. The unit also contains filter equipment.

DCCU is shown in figure 4.3.1 above.

dTRU – double Transceiver Unit

The dTRU contains two TRXs for transmission and reception of two radio carriers. It has a built-in combiner with the optional possibility of combining two TX signals into one TX output. It is also prepared for four-branch RX diversity for further improvements in sensitivity. This version of the dTRU supports only GMSK and a later version will support both GMSK and EDGE. Each dTRU can handle 16 time slots, meaning one dTRU can handle 16-callers simultaneously.

dTRU is shown in figure 4.4.1c below.

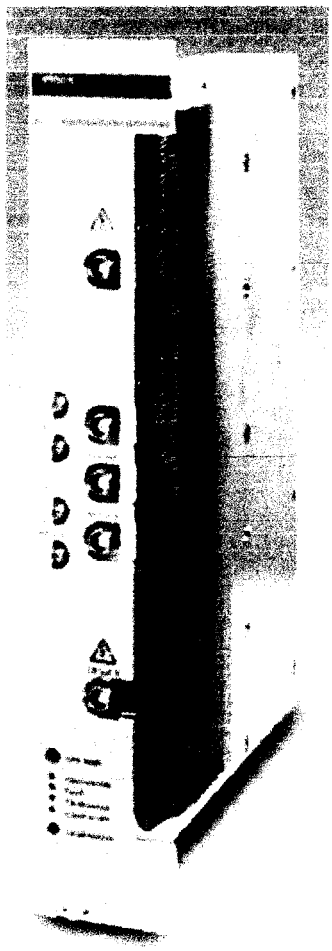


Figure 4.4.1c: dTRU

DXU – Distribution Switch Unit

The DXU is the central control unit for the RBS. It supports the interface to the BSC and it collects and transmits alarms. The DXU controls the power and climate equipment for the RBS. It has a removable compact flashcard which makes it possible to replace a faulty DXU without the need for loading RBS software from the BSC. The DXU is also provided with four connections for transmission lines. It can handle both 2 Mbit (E1) and 1.5 Mbit (T1) PCM links.

The DXU has hardware support for EDGE on 12 TRXs.

DXU is shown in figure 4.4.1d below.

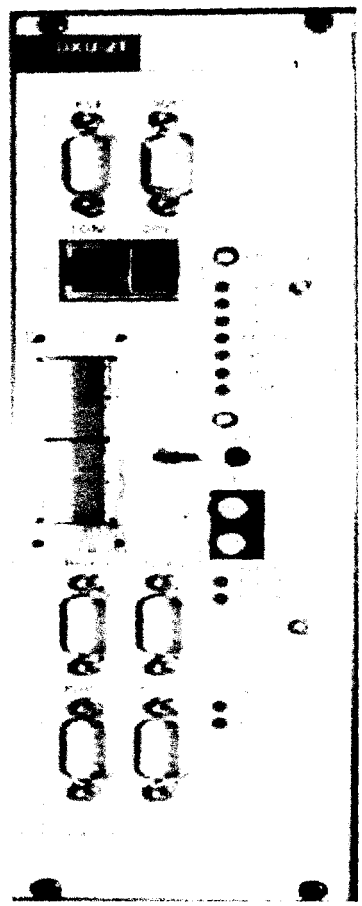


Figure 4.4.1d: DXU

FCU – Fan Control Unit

The FCU controls the four fans in the cooling system by regulating fan speed.

The FCU is controlled by the DXU.

FCU is shown in figure 4.3.1 above.

IDM – Internal Distribution Module

The IDM is a panel for distributing the internal +24 V DC power to the various units. Each distribution circuit in the cabinet is connected to a circuit breaker in the IDM.

IDM is shown in figure 4.3.1 above.

PSU – Power Supply Units

The PSUs are available in two versions, PSU AC for connection to AC mains, or PSU DC for connection to -48 or -60 V DC power supply. The PSU AC converts 120 - 250 V to regulated +24 V DC. The PSU DC converts (-48 to -60)V DC to regulated +24 V DC.

PSU is shown in figure 4.4.1e below.

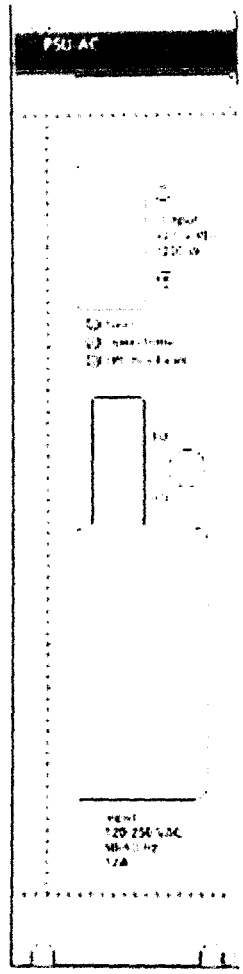


Figure 4.4.1e: PSU

DC Filter

The DC filter unit is the interface for +24 V DC power supply or battery backup.

DC Filter is shown in figure 4.3.1 above.

Connection Field

The Connection field is just a provision made on the two sides of the cabinet for interchanging of the door of the cabinet.

Connection field is shown in figure 4.3.1 above.

Base Frame

The Base frame is layer on which the RBS cabinet is placed upon.

Base frame is shown in figure 4.3.1 above.

4.5 COMPARISON BETWEEN RBS 2206 AND RBS 2202

The reasons for carrying out comparison between these two RBSs is simply because they are the main Radio Base Station equipments used in GSM operation by most of the GSM operators (especially **Vmobile Networks**) in Nigeria.

4.5.1 DIFFERENCES BETWEEN RBS 2206 AND RBS 2202

(1) Commissioning and integrating of RBS 2206 takes between 2-20minutes, while for RBS 2202 it takes between 45-120minutes.

(2) Only the flashcard is removed from the DXU if there is any fault within the DXU of RBS 2206, while the whole of the DXU is replaced if there is any fault within the DXU of RBS2202.

(3) RBS 2206 contains 12 TRXs meaning it can handle 96 callers at the same time, while for RBS 2202 it only contains 6-TRXs meaning it can handle 48 callers at the same time.

(4) The useful life span of RBS 2206 is 25 years, 24 hours, 7days continuously, while that of RBS 2202 is 20 years, 24 hours, 7 days continuously.

(5) RBS 2206 contains CXU, used for easy expansion/upgrading from one configuration to the other, while the RBS 2202 does not have CXU, reconfigurations is done by means of re-cabling.

(6) RBS 2206 has a better output power and better sensitivity that is better than that of RBS 2202.

(7) RF losses is greatly reduced and minimized with the positioning of the CDUs in RBS2206 cabinet (antennas are connected directly to the CDUs), while RF losses is highly in RBS 2202 because of the positioning of the CDUs in the cabinet.

4.5.2 SIMILARITIES BETWEEN RBS 2206 AND RBS 2202

(1) Both RBSs are of the same RBS 2000 family.

(2) Both RBSs make use of the 40A circuit breakers fuse ratings to protect the cabinets.

(3) The voltage and power consumed by both RBSs PSUs is the same (+27.2 V DC and 1200W).

(4) Both RBSs can co-exist with other RBS 2000 family.

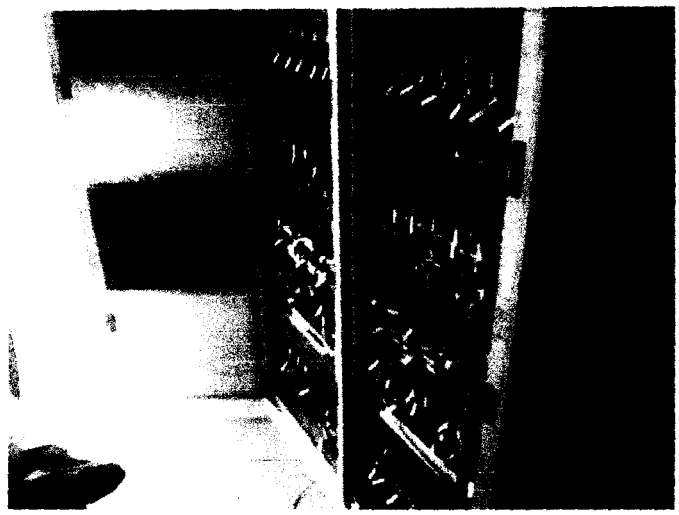


Figure 4.5.2a: RBS 2202 CO-EXISTING WITH ANOTHER RBS 2202

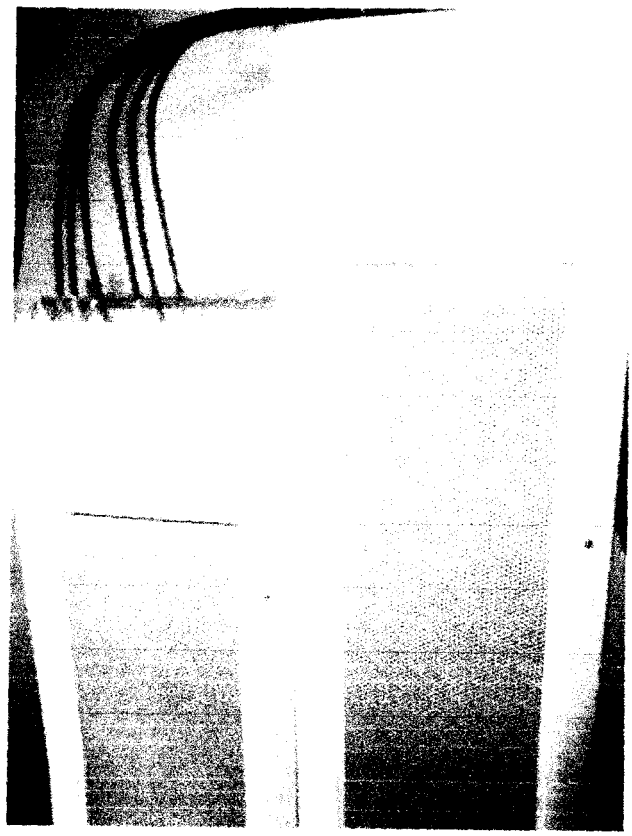


Figure 4.5.2b: RBS 2206 CO-EXISTING WITH RBS 2207

CHAPTER FIVE

FUTURE OF GSM

5.1 INTRODUCTION

The market for mobile communications has grown explosively since the introduction of 2nd generation digital systems. The mobile phone has become common place in most developed and developing countries. There are clear indications that the number of subscribers will not cease to increase in the coming years.

The market is predicted to boom tremendously for the next 5 years in all the continents, but focus is now on the continent of Africa especially Nigeria.

With an incredible increase in the number of GSM users and in the minutes of use, as well as the introduction of new types of services for Mobile Internet – the operators (**Vmobile Networks** especially) need to prepare them to be winners in the new market.

The mobile services are evolving beyond voice to Internet access and multimedia services, as the market demands are increasing. End users are becoming gradually used to multimedia communications with ever growing demands on bandwidth and Quality of Service (QoS).

Throughout the world the evolution of mobile communications is at different stages. For the end user to satisfactorily use advanced applications, mobile telephony networks are required to offer higher bandwidth.

With 2G systems, such as GSM, the highest available bandwidth affords a 56kbit/s download rate, which at best gives the end user internet text. To succeed in video services, of either medium or high quality, operators are obliged to invest in 3G networks such as

EDGE (Enhanced Data for Global Evolution) or UMTS (Universal Mobile Telecommunication Systems).

One of the main aspects of 3G is to support data services at high bit rates, up to 2Mbit/s. To be able to support these bit rates, a new radio technology, Enhanced Data for Global Evolution (EDGE) is used.

5.2 THE EVOLUTION OF GSM TO 3G

In the last two decades the wireless industry has gone through dramatic change sparked by the ever growing demands of the wireless consumer.

Until recently, the most advanced version of GSM circuit switched (CS) data services standard allowed for a data rate of 9.6kbit/s. In this version of GSM the user is allowed only one time slot per carrier and because each timeslot has a maximum capacity of 9.6kbit/s, the capacity of this version is limited to 9.6kbit/s.

GSM has evolved to become a 3G network through several steps to make a "soft evolution". GSM as mentioned is optimized for speech and not for data and originally it only provides 9.6kbit/s over the air interface.

The most important steps involved in the evolution of GSM to increase the data transfer rate are:

- High Speed Circuit Switched Data (HSCSD);
- General Packet Radio Service (GPRS);
- Enhanced Data for Global Evolution (EDGE);

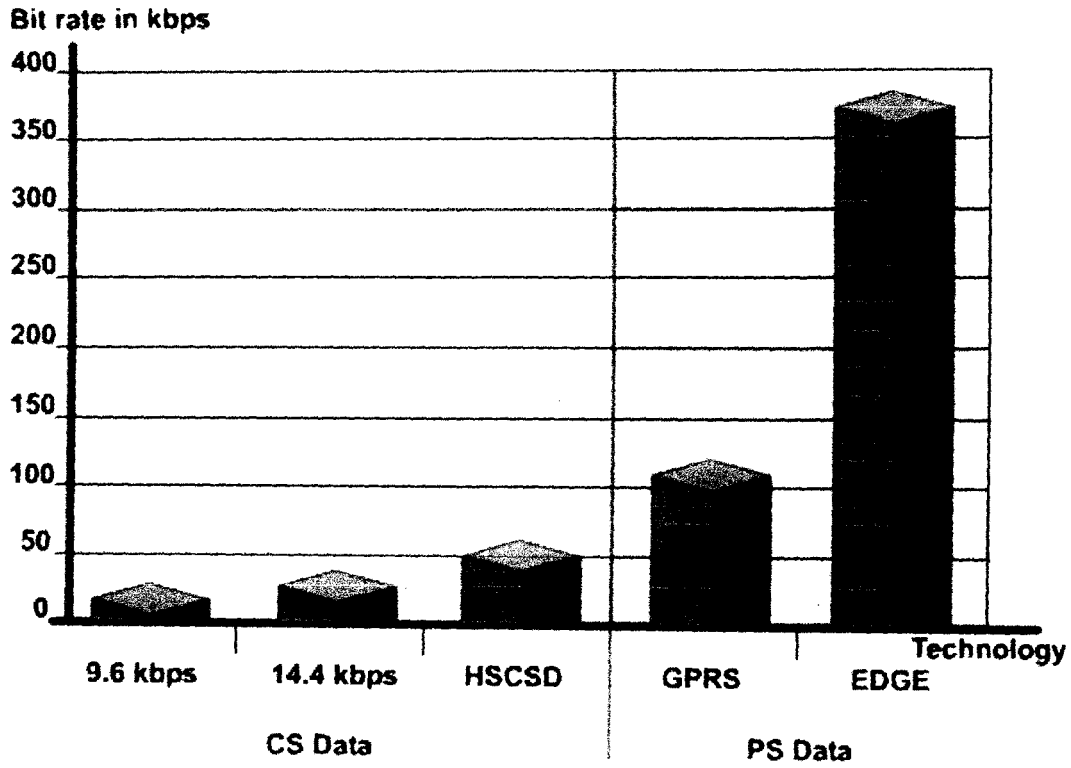


Figure 5.2: The Evolution of GSM

5.2.1 HSCSD

With the introduction of HSCSD (High Speed Circuit Switched Data) a more advanced version of GSM was introduced.

High Speed Circuit Switched Data (HSCSD) makes it possible to use several timeslots simultaneously in "circuit switched mode". Today up to 4 timeslots can be used at the same time. Furthermore, the maximum data rate in one timeslots is increased from 9.6kbit/s to 14.4kbit/s with new coding scheme.

A combination of four timeslots gives a bit rate of 38.4 – 57.6kbit/s, which is comparable to ISDN (Integrated Standard Digital Network). HSCSD is preferable for real time

voice/video services. The major disadvantage of HSCSD is that it wastes insufficient radio resources due to its circuit switched nature.

5.2.2 GPRS

The next step to more data service capability came in the form of GPRS (General Packet Radio Service).

Although HSCSD does well on bandwidth by combining multiple channels, but its disadvantage makes it necessary to introduce packet switching in the existing GSM networks in order to provide an attractive bearer service for users wanting fast, efficient and cheap access to the internet and corporate intranet. Extending GSM networks to support packet switching services is therefore critical for operators wanting to position itself in the 3G telecom market. GPRS is a prerequisite to support packet data in UMTS/EDGE systems.

5.2.3 EDGE

Operators deploying GSM/GPRS systems have two paths from which to choose. With the addition of EDGE to a GPRS network, operators (like **Vmobile Networks**) can introduce EGPRS (Enhanced GPRS) that offers speeds of up to 384 – 473.5kbit/s. An operator who acquires a license to operate in the new spectrum can implement UMTS, deploying WCDMA (Wideband Code Division Multiple Access) technology and offers access speeds of up to 2Mbit/s.

EDGE, which stands for Enhanced Data rates for Global Evolution, is an improved version of GPRS and a logical cost-effective step toward third-generation (3G) technology. The implementation of EDGE in Ericsson GSM networks creates minor changes in the network. EDGE is an "add on" to the radio parts of GPRS, which means EDGE requires GPRS and cannot work alone. With better signaling, EDGE increases data transmission speeds to up to 384kbit/s or higher. This translates into a bit rate of approximately 48kbit/s per timeslot.

The EDGE standard has been defined for both circuit-switched and packet-switched traffic. The term EGPRS, which stands for Enhanced GPRS, refers to the packet-switching side of EDGE.

EGPRS reflects the significant increase in data rates that GPRS provides when EDGE is deployed.

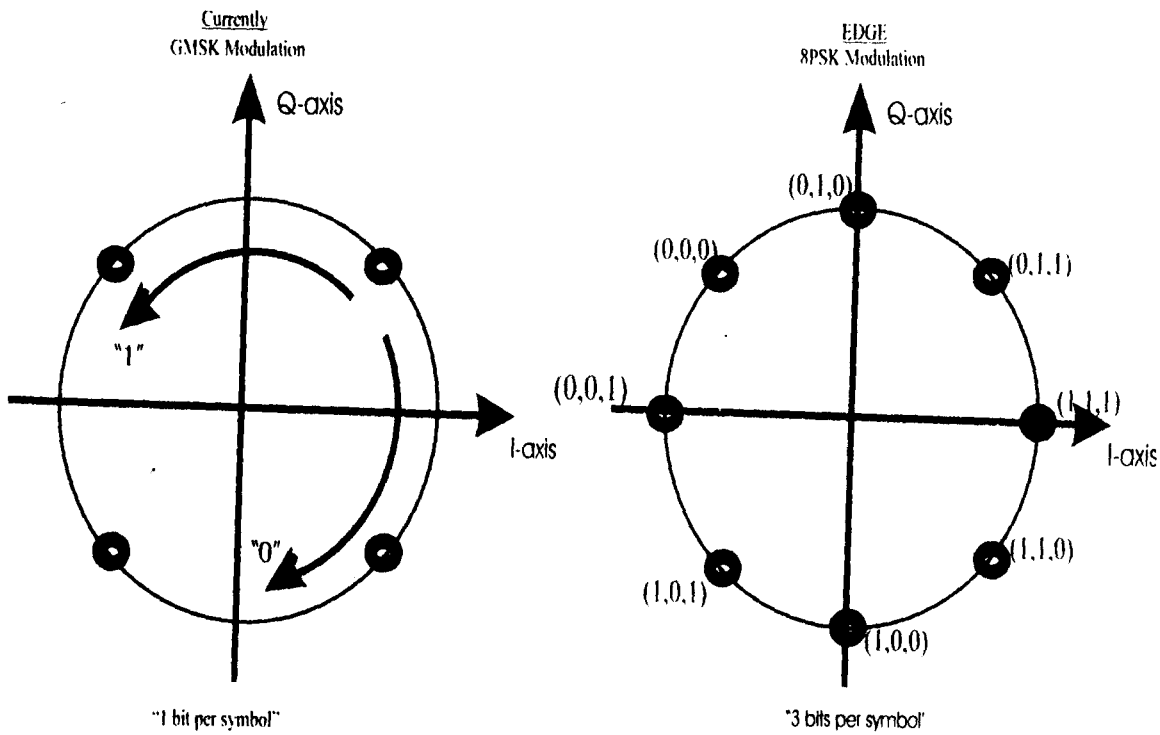
On average, EDGE can handle three times the data throughput of GPRS using existing 800, 900, 1800 and 1900 MHz radio spectrum bands.

Apart from enhancing the throughput for each data user, EDGE also leads to an increased capacity. More users can be supported on the same timeslot, which means a decrease in the number of radio resources needed to support the same traffic. Capacity can therefore be freed up for voice services. With EDGE it is far easier to make circuit-switched and packet-switched traffic coexist when battling over the same radio resources.

EDGE should be seen as a capacity booster for the data traffic.

5.3 EGDE MODULATION TECHNIQUE

The modulation type that is used in GSM is called Guassian Minimum Shift Keying (GMSK), which is a type of phase modulation. This can be visualized in a so-called I/Q-diagram that shows the real (I) and the imaginary (Q) components of the transmitted signal. Transmitting a 0-bit or a 1-bit is then represented by incrementing the phase with $+1/2\pi$. Every symbol that is transmitted represents one bit; i.e. each shift in the phase represents one bit.



5.3.1 EDGE Modulation

In order to have higher data rates per timeslot, a new modulation method, called 8 Phase Shift Keying is required. This is the modulation technique for EDGE.

8PSK modulation has the same qualities in terms of generating interference on adjacent channels as GMSK. This makes it possible to totally integrate EDGE channels into an existing frequency plan and to assign new EDGE channels in the same way as standard GSM channels. The chosen modulation method, for EDGE 8PSK, is a linear modulation, where three consecutive bits are mapped onto one symbol in the I/Q-plain. Since the symbol rate, i.e. the number of symbols sent within a certain time, is kept the same as for GMSK, but each symbol now represents three bits instead of one, the total data rate is increased with a factor three. Of course this does not come without a penalty. The distance between the different "symbols" is shorter in the 8PSK case. Hence, it is more difficult for the radio receiver to detect which symbol it has received.

In good radio conditions, this does not matter. In poor radio conditions it does, but then the "extra" bits could be used to add more error correcting coding and the correct information could be recovered. Only in very bad radio environments is GMSK more efficient.

5.4 THE THIRD GENERATION (3G) OF MOBILE SYSTEMS

5.4.1 INTRODUCTION

One characteristic of a true third generation services and applications will be the infrastructure capabilities to deliver several services in parallel to each end user/terminal. This means subscribers to services can carry on a voice conversation in parallel to accessing an intranet or extranet to obtain important information or participate in a video conferencing and at the same time exchange e-mails and/or multimedia mails.

The general concepts for third generation (3G) systems are grouped under the concept of the International Mobile Telecommunications 2000 (IMT-2000) system. This is complemented by the development of Universal Mobile Telecommunications System (UMTS). UMTS aims to deliver wide-area/high-mobility data rates of 384kbits/s and up to 2Mbits/s for local-area/low-mobility coverage.

5.4.2 SERVICES OF 3G TECHNOLOGIES

Some basic planned 3G services include:

- Voice/high-quality audio;
- High-speed data transmission including still photographs;
- E-postcard in combination with digital cameras;
- Video conferencing and multimedia;
- Downloading large files from intranets.

5.4.3 IMPLEMENTATION OF 3G TECHNOLOGIES

Ericsson is currently working on supplying a solution for UMTS using EDGE. EDGE will work on existing spectrum and the GSM operators' network resulting in high data rate offering to the end user.

Since November 2004, Ericsson has started deploying the BTS equipments (RBS 2206) on some **Vmobile Networks** base stations within the country and it's one of the two RBSs that support EDGE.

A number of opportunities for infrastructure sharing exist which are outlined below. To the extent that the current 2G network needs to be adapted in order to co-exist and inter-work with the new 3G equipment. For operators like **Vmobile Networks** that already have GSM, 3G networks are built on top of an enhanced GSM core network.

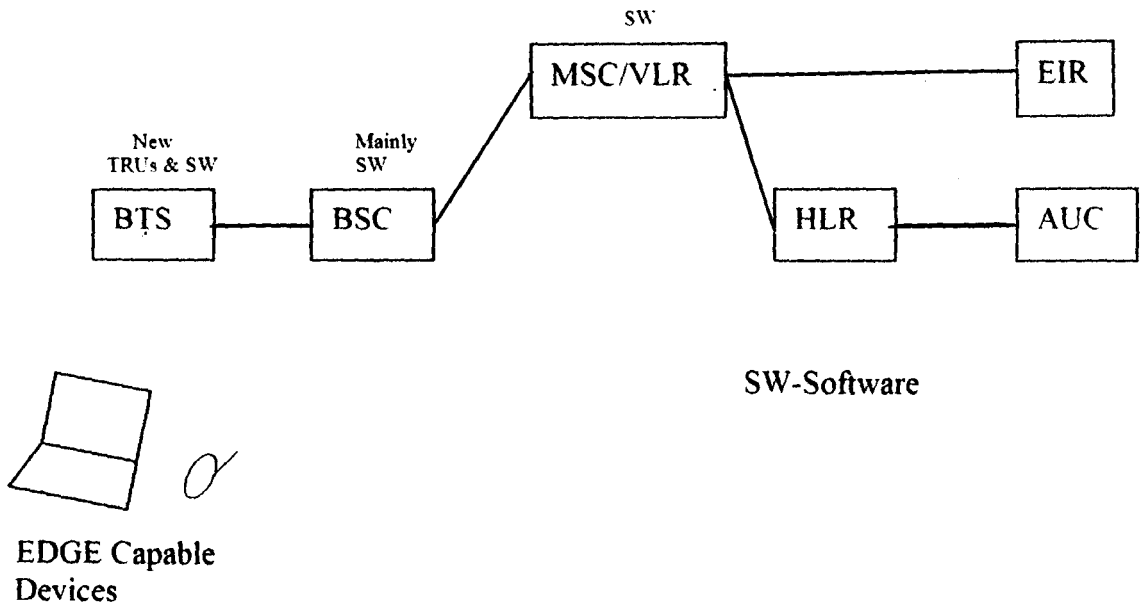


Figure 5.4.4: Diagrammatic Representation of the Network Modification Due to EDGE (3G)

CHAPTER SIX

COMMENTS/RECOMMENDATIONS/CONCLUSION

6.1 COMMENTS

A review of the GSM license after 5 years of operation by NCC (Nigeria Communications Commission), the telecommunication/communication regulatory body by the end of March, 2006, is a date all of the GSM operators (including **Vmobile Networks**) are looking up to.

Apart from Globacom Networks that is presently on 2.5G technology, all other operators are currently on 2G technology. One of the major issues that will be discussed at the March, 2006 meeting with the NCC is the 3G technology, being the next phase of GSM technology, which is operational in most parts of Europe, America, and the Asian countries. Most of these GSM operators are ready to meet up with the challenges of 3G technology. Take for example; **Vmobile Networks** have started deploying the 3G technology equipments (RBS 2206/2207) since November, 2004 in all their BTS sites, also the BSCs, MSCs/VLRs only needs software upgrading and configurations mainly to meet up with the 3G technology evolution, which they have equally started working with.

As for the old equipments that are being used, i.e. for the RBS 2202 to be upgraded to 3G, the TRUs and CDUs are swapped out and replaced with the EDGE dTRUs and CDU-F/CDU-G. And for the RBS 2302/2401 to be upgraded to 3G, they are been swapped out and replaced with enhanced RBS 2308, which is 3G ready.

All telecommunication roads lead to 3G. Because **Ericsson** offers a full range of 2nd and 3rd generation solutions it can ensure that whatever 2G system operators are using, their core networks and competencies can be updated and retained during migration to 3G.

6.2 RECOMMENDATIONS

It is highly recommended that GSM operators in Nigeria fully go into the next phase of GSM technology (3G), in order to meet up with the yearning and thirst of the subscribers, and to meet up with the world at large, where the technology is fully in operation. I.e. countries like China, Japan, America, etc.

The need for 3G technology has already been created but with the introduction of RBS 2206 equipment by Ericsson the challenges of 3G technology is easily met.

GSM subscribers should be ready to with some reasonable amount of money in order to be able to get the new 3G phones (like Ericsson K700i, P800, P900, P910, Z1010, Nokia 6600, 6260, 9500 Communicator, etc), these phones has internet facilities, GPRS and MMS facilities.

6.3 CONCLUSION

A new generation of fast, data-rich, multimedia services accessed instantly over mobile handsets is emerging worldwide. The technology which makes this possible is named 3G, or third-generation telecommunications. Every telecom operator (like **Vmobile Networks**), developer and vendor (like **Ericsson**) in the world is going to be affected by this technology as telecommunication evolves towards a 3G of networks, services and applications in which Nigeria cannot afford to be left out of this global evolution.

The goodnews is that the transition towards this exciting new technology is safe, manageable and gradual partnering with **Ericsson**. 3G is an "evolution" within the telecommunications industry and not a "revolution". On one hand, the evolutionary path to

3G will be carefully managed and profitable for operators while on the other hand, smooth and seamless for users.

Working with **Ericsson**, operators (especially **Vmobile Networks**) can keep their core technologies and investments in place, while enhancing their systems for the 3G mobile multi-media services. Operators will have maximum reuse of their original investments while moving towards full 3G services at their own speed, according to their own needs, and with the introduction of the new RBS 2206 equipment and other softwares for necessary upgrades.

REFERENCES

(1) Ibitomihi Sunday Michael, "The Study of Telecommunications in Nigeria & the Interconnectivity Problems", a final year project report for the award of B. Eng of Electrical/Computer Engineering. F.U.T.Minna, 2004, pp. 1-10.

(2) Ericsson Radio Systems AB, "Ericsson GSM System Survey", Ericsson, 1998, pp. 1, 2, 7- 17, 335-348.

(3) Ericsson Radio Systems AB, "Ericsson RBS 2206 Hardware Reference Manual", Ericsson, 2002, pp. 171-198.

(4) Ericsson Radio Systems AB, "Ericsson RBS 2206 Installation & Integration Book", Ericsson, 2002, pp.11, 14.

(5) Ericsson Radio Systems AB, "Ericsson RBS 2206 Product Description", Ericsson, 1999, pp. 109-111.

(6) Ericsson Radio Systems AB, "Ericsson RBS 2206 Cabinet Reconfiguration Manual", Ericsson, 2002, pp. 33-40.

(7) Ericsson Radio Systems AB, "Ericsson RBS 2206 Maintenance Manual", Ericsson, 2002, pp. 50-107, 171-174.

(8) Ericsson Radio Systems AB, "Ericsson RBS 2202 Installation & Integration Manual", Ericsson, 2003, pp.113-123.

(9) Ericsson Radio Systems AB, "Ericsson Student Text GSM BSS Integration Manual", Ericsson, 1999, pp. 39-56.

(10) Ericsson Radio Systems AB, "Ericsson RBS 2302 User's Guide", Ericsson, 1999, pp. 57-59, 184.

(11) Ericsson Radio Systems AB, "Ericsson RBS 2401 User's Guide", Ericsson, 1999, pp. 21-23.

(12) Ericsson Radio Systems AB, "Ericsson Technical Description", Ericsson, 1999, pp. 109-111.

(13) Ericsson Education Europe, "Ericsson ABC on Mobile Network", Ericsson, pp 13-29.

(14) Dr. Bhaskar Ramamurthi, "Short Course on; EDGE: 3G-Evolution of GSM & GPRS. Lecture Notes on GSM Basics", Ushamartin Academy of Communication Technology, I.C & S.R Bldg, I.I .T Madras, Chennai, March 9-10, 2001, pp 1-35.

(15) Ericsson, "White Paper on EDGE: Introduction of High-Speed Data in GSM/GPRS Networks", Ericsson, 2001, pp 4-10, 12-13.

(16) http:// www.implementation.GSM support@era.ericsson.se

(17) http:// www.vmobile-nigeria.com

(18) http:// www.nigeriabusinessinfo.com

(19) http:// www.internalericsson.com

(20) http:// www.cpi.al.sw.ericsson.se/alex

(21) http:// www.alex_tmp.ericsson.com

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