ISSN (Online) 2394-6849

International Journal of Engineering Research in Electronics and Communication Engineering (IJERECE)
Vol 4, Issue 12, December 2017

Design and Development of RBS Based Network Monitoring Tool for Wireless Systems

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Abstract: **This paper aims at development of monitoring critical data in different network entities i.e., in both Base transceiver station (BTS) in GSM and Node-B in UMTS of wireless communication system so that preventive measures can be taken before the actual failure. It enables users to obtain readings remotely and gives protection of safety of monitoring personally under certain dangerous circumstances. This improves system reliability and reduces cost. The data and its associated history is stored in servers and the logs generated due to interruption, identify the cause of failures in system using characteristics as configuration management, performance, backup and restoration procedures which are provided by applications available to every end users all the time. The system consists of maintenance terminal for monitoring the various network entities of wireless communication systems. This tool utilises GUI interface and representing physical model. This tool is implemented in logical model via Visual studios, C# language.**

Index Terms— Radio base station, OMC, Hardware units, GSM & UMTS technologies.

I. INTRODUCTION

In wireless communication systems there will be a huge number of nodes which are intercommunicated. To maintain the network we have to physically visit the sites; identify the faults and rectify the faults accordingly. But it is very difficult to visit number of sites physically as it demands more manpower. Hence more investments which results reduction of profit margin. To resolve this, remote access of equipment and to have privilege to modify, equipped/unequipped the card in the concerned equipment and to configure the equipment accordingly to the existing demand etc. To get this access, server is to be designed which keeps track of data base of various network equipment's. The data base of concerned NE can be accessed via client.

It is a radio communication system where components that have been traditionally implemented in hardware are instead implemented by means of software on a personal computer One of innovation in the field of technology is a system of monitoring and controls Radio base stations (RBS) i.e., both BTS (Base Transceiver Station) in GSM and Node-B in UMTS. An operator that charge for monitoring and controlling the RBS can do it wherever he is. With the presence of this system monitor becomes easy and efficient, including the efficiency of time. An operator can monitor the condition of the RBS simply by opening the application via a PC (Personal Computer). The system is also useful at the time efficiency. [5]

The term network monitoring describes the use of a system that constantly monitors a computer network for slow or failing components and that notifies the network administrator in case of outages via email, pager or other alarms. It is a subset of the functions involved in network management. There exists a wide variety of software and hardware products that help network system administrators manage a network. Network management covers a wide area, including:

- ***Security:*** Ensuring that the network is protected from unauthorized users.
- ***Performance:*** Eliminating bottlenecks in the network.
- ***Reliability:*** Making sure the network is available to users and responding to hardware and software malfunctions.

For designing such graphical system design we are using .C# language i.e. DOTNET. A programming infrastructure created by Microsoft for building, deploying, and running applications and services that use .NET technologies, such as desktop applications and Web services .NET Framework is intended to be used by most new applications created for the Windows platform. Microsoft also produces an integrated development environment largely for .NET software called Visual Studio. Here, we focus on the access system and its monitoring tool where the complete radio base station can be operated remotely for 2G and 3G technologies. Depending upon the specifications of 2G and 3G the complete tool is designed where we can switch between two users. This tool is limited only for these two generations.

II. RBS OPERATION AND MAINTENANCE:

The RBS is managed via "OMT" (Operations and Maintenance Terminal). OMT is what is usually called a LMT (Local Maintenance Terminal). A special cable is

ISSN (Online) 2394-6849

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needed to connect to the serial port of the RBS with the LMT. Operation Maintenance Centre (OMC) is used to monitor and maintain the performance of each wireless Systems. It has been designed and implemented in order to help the operator via valuable services and functions appropriately conceived to speed up and further control management tasks.

OMC-R Functions:

It is the dedicated centralized management system of GSM/UTMS Access Network. It manages configuration, supervision and performance of all GSM/UTMS Access Network elements through a single graphical interface. OMC-R offers high reliability and enhanced security management as well as the ability to deliver a disaster recovery mechanism for customers requiring such a solution. Functions of OMC-R are: [4]

Configuration Management:

•Manage GSM radio resources.
•Manage transmission at various levels.
•Support the network for O&M communications.
•Manage logical configuration data.
•Manage hardware configuration.

Fault Management:

•Manage different support activities such as alarm management, logs...
•Manage tests (diagnostic tests and audits)

Performance Management:

•Define and supervise counter thresholds.
•Generate instant or scheduled statistics and reports.

III. RADIO FUNCTIONS:

RBS functionality can be divided into the following areas:

•Radio resources: An RBS's main function is to provide connection with the MSs Over the air interface.

•Signal Processing: An RBS is responsible for the processing of signals before transmission and after reception.

•Signalling Link Management: An RBS manages the signalling link between the BSC/RNC and MS, applying the appropriate protocols to the information being sent.

•Synchronization: Timing information is extracted from the PCM-links from the BSC/RNC and is sent to a timing module within the RBS. That enables the RBS to synchronize with the correct frequency reference and TDMA frame number.

•Local Maintenance Handling: An RBS enables operation and maintenance functions to be carried out locally at the RBS site, without BSC/RNC connection. In this way, field technicians can maintain RBS equipment and software on site.

IV. RBS HARDWARE UNITS: [1]

RBS provides the radio interface to the mobile (radio) stations in a radio cell. RBS is consisting of one or more radio transceivers. Often by the name RBS is about cabinet topology which contains Radio Frequency (RF) unit, Digital Signal Processing Unit, Base Band Unit, Rectifier and Battery Backup, and transmission module.
The RBS series is based on standardized hardware units called Replaceable Units (RU). The major RU's which usually has a combination or subset of these hardware cards:
•Power Supply Unit (PSU)
•Distribution Switch Unit (DXU)
•Transceiver Unit (TRU)
•Combining and Distribution Unit (CDU)
•AC or DC Connection Unit (ACCU/DCCU)
•Internal Distribution Module (IDM)
•Configuration Switch Unit (CXU)
•Fan Control Unit (FCU)
•DC filter
•Tower Mounted Antenna - Control Module (TMA-CM)

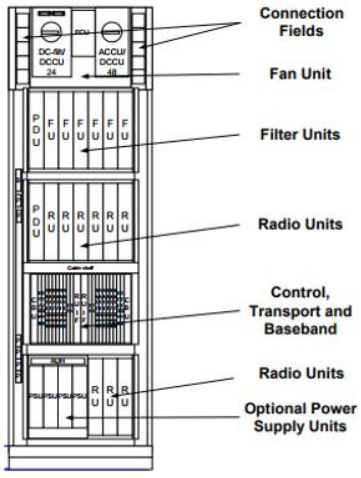

Figure 1: RBS Cabinet

Power supply unit (PSU): The PSU rectifies the power supply voltage to the +24V DC necessary for RBS operation.

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International Journal of Engineering Research in Electronics and Communication Engineering (IJERECE)
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Distribution switch Unit (DXU): It provides an interface to the BSC/RNC and manages the link resources and connects the traffic time slots from the BSC link to the TRU's. It extracts synchronization information from the link and generates a timing reference for the RBS.

Transceiver Unit (TRU): One TRU includes all functionality needed for handling one radio carrier. It is responsible for radio transmitting, radio receiving, power amplification and signal processing.

Combining and Distribution Unit (CDU): The CDU is the interface between the TRUs and the 2-way antenna system. The task of the CDU is to combine signals to be transmitted from various transceivers and to distribute received signals to the receivers. All signals are filtered before transmission and after reception using band pass filters.

AC or DC connection unit (ACCU/DCCU):
The AC connection unit connects the incoming AC power and distributes it to the AC PSU's.
The DC Connection Unit (DCCU) distributes primary power to the Power Supply Units.
Internal distribution module (IDM): The Distribution Module (IDM) distributes +24 V DC to all DC powered units in the RBS. Distribution circuits are protected by circuit breakers.

Configuration switch unit (CXU): The Configuration Switch Unit (CXU) distributes the RX signals from the CDU to the TRU within the same RBS.

Fan control unit (FCU): The Fan Control Unit (FCU) controls and supervises the fans in an RBS cabinet.

DC filters (DCF): The DC Filter Unit is the RBS's interface for external +24 V DC power supply. The DC filter is required to connect the incoming DC signal to the RBS. The filter unit contains a low noise amplifier and handles the radio frequency carrier for splitting. For every frequency band there is a DC filter.

Tower Mounted amplifier-Control module (TMA-CM): A TMA (Tower Mounted Amplifier) amplifies signals from the antenna reducing the noise figure of a base transceiver station (BTS) & Node-B which leads to an improved overall sensitivity of the RBS. The TMA consists of a low noise amplifier (LNA) and a filter which protects the LNA from high power signals. It is placed near antenna/towers. This is controlled with the help of its control module.

V. GSM & UMTS TECHNOLOGIES:

GSM network based on time division multiple access (TDMA) technique and have been deployed worldwide as 2G mobile communication systems. This is the digital signal with speed around 64Kbps with high quality and capacity. GSM is operated with 200 KHz bandwidth with 1bit per symbol and uses GMSK modulation. This is extended further with GSM packet radio service where it used CDMA access with increasing speed up to 64 – 144Kbps. GSM digitizes and compresses data, then sends it down a channel with two other streams of user data, each in its own time slot. It operates at either the 900 MHz or 1800 MHz frequency band. Universal mobile telecommunication system (UMTS) [3] networks based on wideband code division multiple access (WCDMA) have been deployed worldwide as 3rd generation mobile communications systems. In order to exploit the full potential of WCDMA 5 MHz operation, the performance of HSPA-based radio networks has been further enhanced in terms of spectrum efficiency, peak data rate and latency. UMTS includes downlink MIMO operation, higher-order modulation (downlink 64QAM, uplink 16QAM). It is used in web based applications with speed up to 144Kbps to 2Mbps.
Considerations in selection of the best Modulation technique
• High Bandwidth efficiency
• High Power efficiency
• Compact Power density Spectrum

VI. OMT TOOL DESIGN & RESULT:

The OMT is a powerful PC application providing efficient aid for the operation and maintenance of RBS Radio base stations. The OMT supports all RBSs of BTS and Node-B family and is used locally at the RBS site. It connects via a serial cable from the OMT PC to a port on the RBS. The main areas of OMT usage are RBS configuration and fault localization. Main important feature is an easy-to-use graphical user interface.

Initially for performing login operation we must define the server port number so that the client can access only to that server. For client access we must follow the port number and name combined known as socket. After getting accessed into the system the OMC must be connected to RBS (radio base station) and the data base is installed into the system using IDB (installation data base).

A programming infrastructure created by Microsoft for building, deploying, and running applications and services. Microsoft also produces an integrated development environment largely for .NET software called Visual Studio.

ISSN (Online) 2394-6849

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This designing procedure is done using .NET Framework, Version=v4.5 with .C# language. [2]

VIEWS:

A view displays the RBS system graphically. There are three types of views: System view, Cabinet view and Radio view A view contains several objects where each object represents a hardware unit or a logical unit, such as the Transmission, Alarm Inlets. The number of objects in System view is fixed. The number of objects in the other views can change depending on the current IDB configuration.

•System View:

The System view window shows an overview of the RBS Radio Base Station and its environment. The System view is displayed when the OMT enters Initial state.

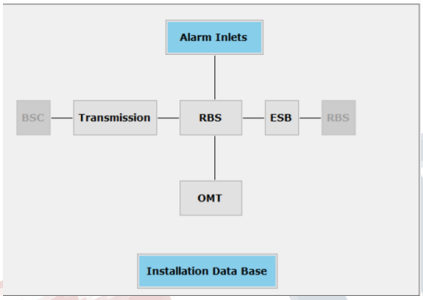

Figure 2: System view

•Cabinet View:

The Cabinet view displays the physical overview of the cabinet. The replaceable units or the hardware units present in the cabinet can be used depending on user traffic so it is known as replaceable unit. User switching between two technologies can be possible in this OMT tool.

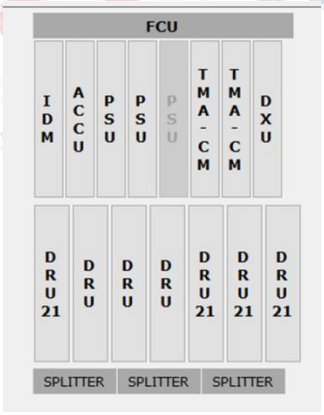

Figure 3: Cabinet view

•Radio View:

The Radio View shows a schematic structure of the RBS where radio connections can be seen. Fault status monitoring can also be started in the connected state.

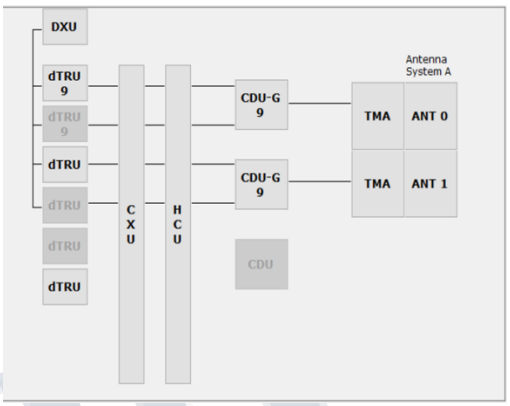

Figure 4: Radio view

ALARM INLETS

There are completely 10 alarm inlet usages we are using in RBS can be defined. Whenever the alarm inlet usage is selected simultaneously it is connected to its hardware sensor in RBS via PCM cables. The Alarm inlets used in RBS are Fire/smoke alarm, main fails, high room temperature, low fuel level, door opens, AC off, battery fuse fails, rectifier fails and low battery level.

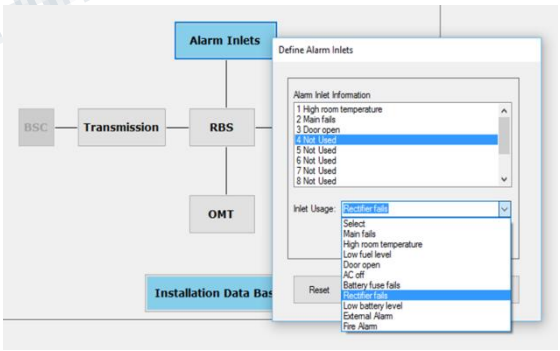

Figure 5: Alarm Inlet setup

Now this complete process runs on front end using .NET framework tool and the data base of the complete OMC system or the back end of the program shown using Microsoft access which is shown in fig: It contains tables with all the operations and reports generated during system performance. It shows cabinet details for knowing status of replaceable units, generated logs as shown each log is assigned with log ID, error reports, cabinet elements etc. The

logs which are to be generated are controlled depending on the user privileges, and the operations like external alarms are installed during creating of the IDB itself.

VII. CONCLUSION:

The hardware and software of the RBS can be prepared for functionality and capacity. New configurations may be applied without affecting cells in operation or calls in progress. Future enhancements can in many cases be implemented without affecting installed hardware. RBS capacity is expanded by adding activation keys for baseband resources, carriers and output power. The development in online monitoring tool with this 2G and 3G access gives the user to access voice data with high speed by using remote sensing from all the stations which are accessed. In this project the online monitoring terminal for remote access of wireless communication systems for GSM and UMTS is designed, where the cabinet design for both the GSM and UMTS is designed depending on the hardware used and differentiated with the frequency used.

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