

# **Upgradation of 2<sup>nd</sup> Generation Radio Link to 3<sup>rd</sup> Generation**

**BY**

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An Internship Report Presented in Partial Fulfillment of the Requirements  
for the Degree of Bachelor of Science in Electronics and  
Telecommunication Engineering

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**DAFFODIL INTERNATIONAL UNIVERSITY**

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## **APPROVAL**

This Internship titled “Upgradation of 2<sup>nd</sup> Generation Radio Link To 3<sup>rd</sup> Generation”, submitted by A.W.M. Badiul Hassan to the Department of Electronics and Telecommunication Engineering, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Electronics and Telecommunication Engineering and approved as to its style and contents. The presentation has been held on 26-28 February, 2011.

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## **DECLARATION**

We hereby declare that, this Internship has been done by us under the supervision of Md. Mirza Golam Rashed. Assistant professor, Department of ETE Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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## **ABSTRACT**

Wireless cellular communication is witnessing a rapid growth in markets, technology and range of services. An attractive approach for high quality digital cellular service is use of GSM and other wireless communication. The GSM system is based on three major subsystems: the radio subsystem (RSS), the Network Subsystem (NSS) and the operation Subsystem (OSS). The Base Transceiver station (BTS) is the main component of Radio Subsystem. The Base Transceiver Station) BTS) can only communicate with the mobile station equipment, so it is very important component of mobile communication system.

This report contains the total process of NSN Flexi BTS installation and commissioning. This describes GSM system overview, some important points, including the importance of installation of the BTS and BTS room, Hardware description, cabinet, configuration and starting of commissioning process where the BTS is a product of the vendor NSN communication network of using wireless router, which helps a Network Administrator to build up a control over the total network using a security key. The aim of Nokia Flexi EDGE BTS is enabling efficient LTE (Long Time Evolution) including GSM/EDGE and other radio technologies such as WIMAX in the future.

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# Chapter-01

## The GSM System

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### 1.1 Communication:

The term 'Communication' refers to sending, receiving and processing of information by electronic means. Electronic Communications started with wire telegraphy in the 1940s, developing into telephony some decades later. It is used radio technology at the beginning of the past century after the invention of the triode tube. It subsequently became even more widely used and refined through invention and use of transistors, integrated circuits (ICs) and other semiconductor devices. More recently, the use of satellites and fiber optics have made communications even more widespread, with an increasing emphasis on computers and other data communication devices.

Communication is a learned skill. Most people are born with the physical ability to talk, but we must learn to speak well and communicate effectively. Speaking, listening, and our ability to understand verbal and nonverbal meanings are skills we develop in various ways. We learn basic communication skills by observing other people and modeling our behaviors based on what we see. We also are taught some communication skills directly through education, and by practicing those skills and having them evaluated.

**1.2 Telecommunications:** Telecommunications is a general term for a vast array of technologies that send information over distances. Mobile phones, land lines, satellites phones and voice over Internet protocol (VoIP) are all telephony technologies -- just one field of telecommunications. Radio, television and networks are a few more examples of telecommunication.

While most people associate telecommunications with modern technologies, the strict definition of the term encompasses primitive and even ancient forms of telecommunication. Among these is the use of smoke signals as a kind of visual telegraph. Puffs of smoke were time-released by smothering a fire with a blanket, then quickly removing and replacing the blanket. Widely used by the American Indians, smoke signals could communicate short messages over long distances, assuming a clear line of sight.

**1.3 Description of GSM :** Ericsson's GSM System is a mobile system containing the frequencies 800, 900, 1800 and 1900. A GSM network can be divided into three systems called Switching System (SS), Base Station Systems (BSS) and Operation and Support System (OSS). The switching System is the top system based on AXE technology and performs switching functions, registration functions, authentication, identity register etc. The Base Station System consists of Transcoder Controller/ Base Station Controller (TRC/BSC) and Radio Base Stations (RBS). The Base Station

Controller manages all radio related functions, including calls, over a GSM network. The BSC functions as the master and controls its underlings; the RBS: s. The Radio Base Station handles the radio interface to the mobile phone. The cabinet (The RBS) contains all radio and transmission interface equipment needed to sustain a telephone call using a mobile phone. GSM communication structure: MSC/TRC \_\_ BSC \_\_ RBS \_\_ Mobile phone. Low total life cycle costs and long MTBF has been achieved in the newest generation of RBS: s, namely the Ericsson's RBS 2000 product family. Even though they are new and made with the greatest of care, they still suffer from sporadic flaws in quality. A RBS unit that has high quality is one that functions without being noticed. If everything works as predicted then nobody except Ericsson and the operator will ever know it even exist. Poor quality can take the shape of dropped calls, missed handovers (between different RBS: s) and a complete loss of traffic. The search for flaws regarding quality, in cabinets installed by Ericsson, is currently being done manually by people working at Operations & Maintenance (O&M). They are forced to look at numerous paper-reports and retrieve the vital parts by comparing one revision with a couple of others. The number of reports that needs examination can be several thousands. Monthly statistical reports using MTBA have been handed over to senior management at Ericsson. [1]

#### 1.4 Block diagram of GSM architecture:

A GSM network consist of several function entities whose functions and interface are defined. The network can be divided into following broad parts.

- 1.The Mobile Station (MS)
- 2.The Base Station Subsystem (BSS)
- 3.The Network Switching Subsystem (NSS)
- 4.The Operation Support Subsystem (OSS)

Following is the simple architecture diagram of GSM Network.

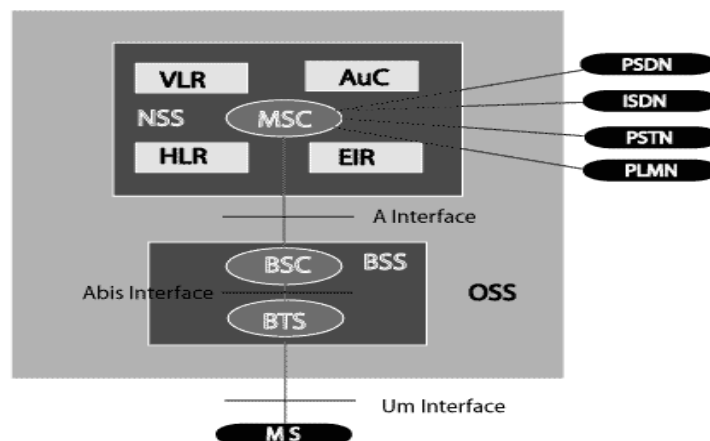


Fig: 1(a)

The added components of the GSM architecture include the function of the databases and messaging system:

- a. Home location Register (HLR)
- b. Visitor Location Register (VLR)
- c. Equipment Identity Register (EIR)
- d. Authentication center (AUC)
- e. SMS Serving Center (SMS SC)
- f. Gateway MSC (GMSC)
- g. Chargeback center (CBC)
- h. Transcoder and Adaptation Unit (TRAU)

#### Architecture of the GSM network

- 1. Mobile Station
- 2. Base Station Subsystem
- 3. Network Subsystem

A GSM network is composed of several functional entities, whose functions and interfaces are defined.

Figure 1 shows the layout of a generic GSM network. The GSM network can be divided into three broad parts. The Mobile Station is carried by the subscriber, the Base Station Subsystem controls the radio link with the Mobile Station. The Network Subsystem, the main part of which is the Mobile services Switching Center, performs the switching of calls between the mobile and other fixed or mobile network users, as well as management of mobile services, such as authentication. Not shown is the Operations and Maintenance center, which oversees the proper operation and setup of the network. The Mobile Station and the Base Station Subsystem communicate across the Um interface, also known as the air interface or radio link. The Base Station Subsystem communicates with the Mobile service Switching Center across the A interface. [7]

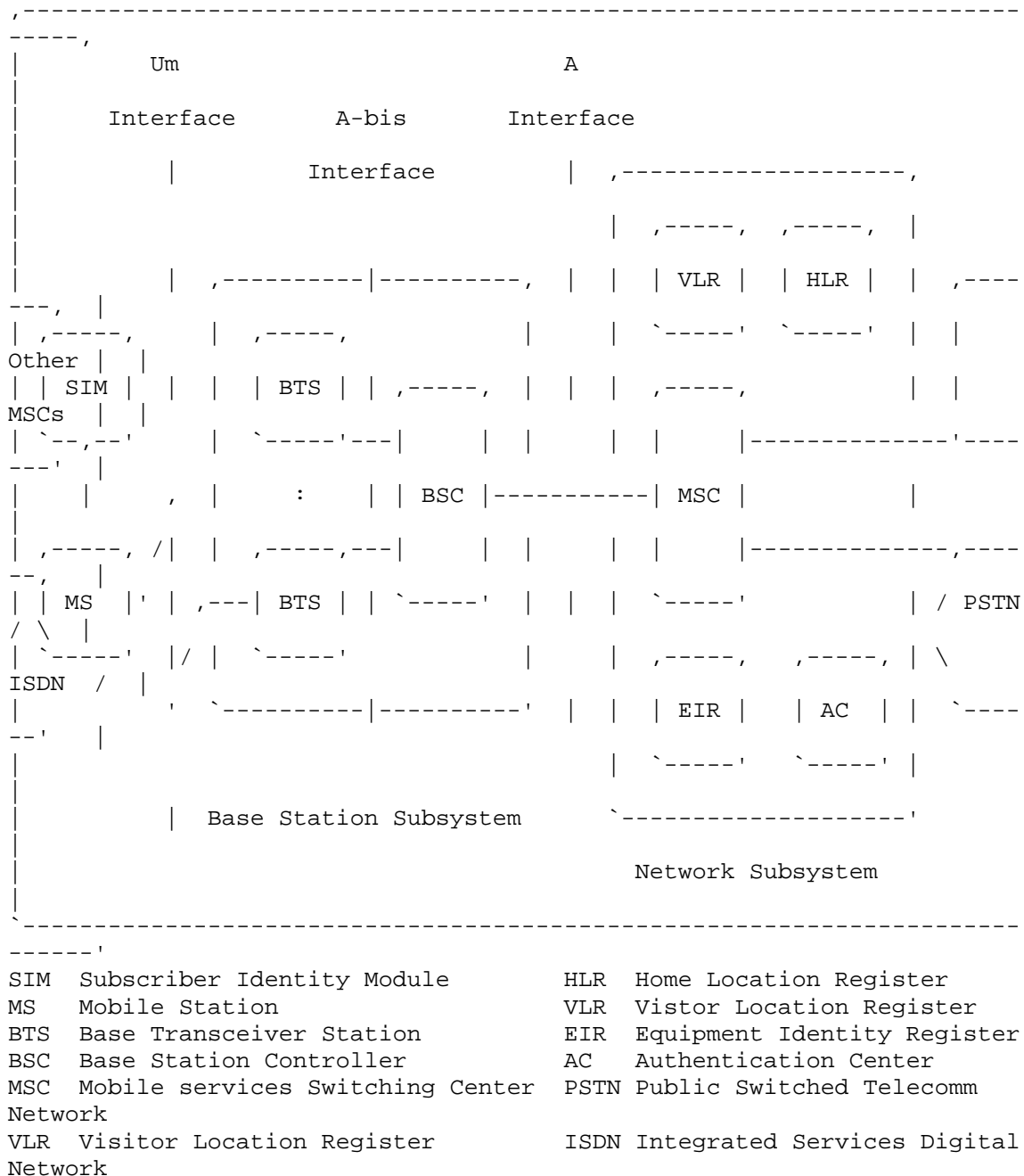


FIGURE 1(b)

## 1.5. Mobile Station

The mobile station (MS) consists of the physical equipment, such as the radio transceiver, display and digital signal processors, and a smart card called the Subscriber Identity Module (SIM). The SIM provides personal mobility, so that the user can have access to all subscribed services irrespective of both the location of the terminal and the use of a

specific terminal. By inserting the SIM card into another GSM cellular phone, the user is able to receive calls at that phone, make calls from that phone, or receive other subscribed services.

The mobile equipment is uniquely identified by the International Mobile Equipment Identity (IMEI). The SIM card contains the International Mobile Subscriber Identity (IMSI), identifying the subscriber, a secret key for authentication, and other user information. The IMEI and the IMSI are independent, thereby providing personal mobility. The SIM card may be protected against unauthorized use by a password or personal identity number. [8]

In GSM, the Mobile Station consists of four main components:

- **Mobile Terminal (MT)**- offers common functions that are used by all the service the Mobile Station offers. It is equivalent to the network termination of an ISDN access and is also the end-point of the radio interface.
- **Terminal Equipment (TE)** - is a peripheral device of the Mobile Station and offers services to the user. It does not contain any functions specific to GSM.
- **Terminal Adapter (TA)** - hides radio-specific characteristics.
- **Subscriber Identity Module (SIM)** - is a personalization of the Mobile Station and stores user specific parameters (such as mobile number, contacts etc).

## 1.6 Base Station Subsystem

The Base Station Subsystem is composed of two parts, the Base Transceiver Station (BTS) and the Base Station Controller (BSC). These communicate across the specified Abis interface, allowing (as in the rest of the system) operation between components made by different suppliers.

The Base Transceiver Station houses the radio transceivers that define a cell and handles the radio link protocols with the Mobile Station. In a large urban area, there will potentially be a large number of BTSs deployed. The requirements for a BTS are ruggedness, reliability, portability, and minimum cost. The **Base station subsystem (BSS)** is the section of a traditional cellular telephone network which is responsible for handling traffic and signaling between a mobile phone and the network switching subsystem. The BSS carries out transcending of speech channels, allocation of radio channels to mobile phones, paging, quality management of transmission and reception over the air interface and many other tasks related to the radio network. Base transceiver station. [9]

**1.6.1 Base transceiver station:** The base transceiver station, or BTS, contains the equipment for transmitting and receiving of radio signals (transceivers), antennas, and equipment for encrypting and decrypting communications with the base station controller

(BSC). Typically a BTS for anything other than a picocell will have several transceivers (TRXs) which allow it to serve several different frequencies and different sectors of the cell (in the case of sectaries base stations). A BTS is controlled by a parent BSC via the base station control function (BCF). The BCF is implemented as a discrete unit or even incorporated in a TRX in compact base stations. The BCF provides an operations and maintenance (O&M) connection to the network management system (NMS), and manages operational states of each TRX, as well as software handling and alarm collection.

The functions of a BTS vary depending on the cellular technology used and the cellular telephone provider. There are vendors in which the BTS is a plain transceiver which receives information from the MS (mobile station) through the Um (air interface) and then converts it to a TDM ("PCM") based interface, the Abis interface, and sends it towards the BSC. There are vendors which build their BTSs so the information is preprocessed, target cell lists are generated and even intracell handover (HO) can be fully handled. The advantage in this case is less load on the expensive Abis interface.

The BTSs are equipped with radios that are able to modulate layer 1 of interface Um; for GSM 2G+ the modulation type is GMSK, while for EDGE-enabled networks it is GMSK and 8-PSK.

Antenna combiners are implemented to use the same antenna for several TRXs (carriers), the more TRXs are combined the greater the combiner loss will be. Up to 8:1 combiners are found in micro and pico cells only.

Frequency hopping is often used to increase overall BTS performance; this involves the rapid switching of voice traffic between TRXs in a sector. A hopping sequence is followed by the TRXs and handsets using the sector. Several hopping sequences are available, and the sequence in use for a particular cell is continually broadcast by that cell so that it is known to the handsets.

A TRX transmits and receives according to the GSM standards, which specify eight TDMA timeslots per radio frequency. A TRX may lose some of this capacity as some information is required to be broadcast to handsets in the area that the BTS serves. This information allows the handsets to identify the network and gain access to it. This signaling makes use of a channel known as the broadcast control channel (BCCH). [9]

**1.6.2 Base station controller:** The base station controller (BSC) provides, classically, the intelligence behind the BTS. Typically a BSC has tens or even hundreds of BTSs under its control. The BSC handles allocation of radio channels, receives measurements from the mobile phones, controls handovers from BTS to BTS (except in the case of an inter-BSC handover in which case control is in part the responsibility of the anchor MSC). A key function of the BSC is to act as a concentrator where many different low capacity connections to BTSs (with relatively low utilization) become reduced to a smaller number of connections towards the mobile switching center (MSC) (with a high



level of utilization). Overall, this means that networks are often structured to have many BSCs distributed into regions near their BTSs which are then connected to large centralized MSC sites.

The BSC is undoubtedly the most robust element in the BSS as it is not only a BTS controller but, for some vendors, a full switching center, as well as an SS7 node with connections to the MSC and serving GPRS support node (SGSN) (when using GPRS). It also provides all the required data to the operation support subsystem (OSS) as well as to the performance measuring centers.

A BSC is often based on a distributed computing architecture, with redundancy applied to critical functional units to ensure availability in the event of fault conditions. Redundancy often extends beyond the BSC equipment itself and is commonly used in the power supplies and in the transmission equipment providing the A-ter interface to PCU.

The databases for all the sites, including information such as carrier frequencies, frequency hopping lists, power reduction levels, receiving levels for cell border calculation, are stored in the BSC. This data is obtained directly from radio planning engineering which involves modelling of the signal propagation as well as traffic projections.

**1.7 Transcoder:** The transcoder is responsible for transcoding the voice channel coding between the coding used in the mobile network, and the coding used by the world's terrestrial circuit-switched network, the Public Switched Telephone Network. Specifically, GSM uses a regular pulse excited-long term prediction (RPE-LPC) coder for voice data between the mobile device and the BSS, but pulse code modulation (A-law or  $\mu$ -law standardized in ITU G.711) upstream of the BSS. RPE-LPC coding results in a data rate for voice of 13 kbit/s where standard PCM coding results in 64 kbit/s. Because of this change in data rate *for the same voice call*, the transcoder also has a buffering function so that PCM 8-bit words can be recoded to construct GSM 20 ms traffic blocks.

Although transcoding (compressing/decompressing) functionality is defined as a base station function by the relevant standards, there are several vendors which have implemented the solution outside of the BSC. Some vendors have implemented it in a stand-alone rack using a proprietary interface. In Siemens' and Nokia's architecture, the transcoder is an identifiable separate sub-system which will normally be co-located with the MSC. In some of Ericsson's systems it is integrated to the MSC rather than the BSC. The reason for these designs is that if the compression of voice channels is done at the site of the MSC, the number of fixed transmission links between the BSS and MSC can be reduced, decreasing network infrastructure costs. [10]

This subsystem is also referred to as the *transcoder and rate adaptation unit* (TRAU). Some networks use 32 kbit/s [ADPCM] on the terrestrial side of the network instead of 64 kbit/s PCM and the TRAU converts accordingly. When the traffic is not voice but data

such as fax or email, the TRAU enables its rate adaptation unit function to give compatibility between the BSS and MSC data rates.

**1.8 Packet control unit:** The packet control unit (PCU) is a late addition to the GSM standard. It performs some of the processing tasks of the BSC, but for packet data. The allocation of channels between voice and data is controlled by the base station, but once a channel is allocated to the PCU, the PCU takes full control over that channel.

The PCU can be built into the base station, built into the BSC or even, in some proposed architectures, it can be at the SGSN site. In most of the cases, the PCU is a separate node communicating extensively with the BSC on the radio side and the SGSN on the Gb side.

## 1.9 BSS interfaces

Image of the GSM network, showing the BSS interfaces to the MS, NSS and GPRS Core Network

Um

The air interface between the mobile station (MS) and the BTS. This interface uses LAPDm protocol for signaling, to conduct call control, measurement reporting, handover, power control, authentication, authorization, location update and so on. Traffic and signaling are sent in bursts of 0.577 ms at intervals of 4.615 ms, to form data blocks each 20 ms.

Abis

The interface between the BTS and BSC. Generally carried by a DS-1, ES-1, or E1 TDM circuit. Uses TDM subchannels for traffic (TCH), LAPD protocol for BTS supervision and telecom signaling, and carries synchronization from the BSC to the BTS and MS.

A

The interface between the BSC and MSC. It is used for carrying traffic channels and the BSSAP user part of the SS7 stack. Although there are usually transcoding units between BSC and MSC, the signaling communication takes place between these two ending points and the transcoder unit doesn't touch the SS7 information, only the voice or CS data are transcoded or rate adapted.

Ater

The interface between the BSC and transcoder. It is a proprietary interface whose name depends on the vendor (for example Ater by Nokia), it carries the A interface information from the BSC leaving it untouched.

Gb

Connects the BSS to the SGSN in the GPRS core network

to the standard 64 kbps channel used by the Public Switched Telephone Network or ISDN.

## 1.10 Network switching subsystem

**Network switching subsystem (NSS)** is the component of a GSM system that carries out switching functions and manages the communications between mobile phones and the Public Switched Telephone Network (PSTN). It is owned and deployed by mobile phone operators and allows mobile phones to communicate with each other and telephones in the wider telecommunications network. The architecture closely resembles a telephone exchange, but there are additional functions which are needed because the phones are not fixed in one location. Each of these functions handle different aspects of mobility management and are described in more detail below.

The Network Switching Subsystem, also referred to as the GSM core network, usually refers to the circuit-switched core network, used for traditional GSM services such as voice calls, SMS, and circuit switched data calls.

There is also an overlay architecture on the GSM core network to provide packet-switched data services and is known as the GPRS core network. This allows mobile phones to have access to services such as WAP, MMS, and Internet access.

All mobile phones manufactured today have both circuit and packet based services, so most operators have a GPRS network in addition to the standard GSM core network.

There are several types of Network switching subsystem (NSS).

## 1.11 Mobile switching center (MSC)

The **mobile switching center (MSC)** is the primary service delivery node for GSM, responsible for handling voice calls and SMS as well as other services (such as conference calls, FAX and circuit switched data). The MSC sets up and releases the end-to-end connection, handles mobility and hand-over requirements during the call and takes care of charging and real time pre-paid account monitoring.

In the GSM mobile phone system, in contrast with earlier analogue services, fax and data information is sent directly digitally encoded to the MSC. Only at the MSC is this re-coded into an "analogue" signal (although actually this will almost certainly mean sound encoded digitally as PCM signal in a 64-kbit/s timeslot, known as a DS0 in America).

There are various different names for MSCs in different contexts which reflects their complex role in the network, all of these terms though could refer to the same MSC, but doing different things at different times. [5]

The **gateway MSC** (G-MSC) is the MSC that determines which visited MSC the subscriber who is being called is currently located. It also interfaces with the PSTN. All mobile to mobile calls and PSTN to mobile calls are routed through a G-MSC. The term is only valid in the context of one call since any MSC may provide both the gateway function and the Visited MSC function, however, some manufacturers design dedicated high capacity MSCs which do not have any BSSs connected to them. These MSCs will then be the Gateway MSC for many of the calls they handle.

The **visited MSC** (V-MSC) is the MSC where a customer is currently located. The VLR associated with this MSC will have the subscriber's data in it.

The **anchor MSC** is the MSC from which a handover has been initiated. The **target MSC** is the MSC toward which a Handover should take place. A mobile switching centre server is a part of the redesigned MSC concept starting from 3GPP Release 5.

## 1.12 Mobile switching centre server (MSS)

The **mobile switching centre server** is a soft-switch variant of the mobile switching centre, which provides circuit-switched calling, mobility management, and GSM services to the mobile phones roaming within the area that it serves. MSS functionality enables split between control (signalling) and user plane (bearer in network element called as media gateway/MG), which guarantees more optimal placement of network elements within the network.

MSS and MGW media gateway makes it possible to cross-connect circuit switched calls switched by using IP, ATM AAL2 as well as TDM. More information is available in 3GPP TS 23.205. [5]

## 1.13 Other GSM core network elements connected to the MSC

The MSC connects to the following elements:

- The home location register (HLR) for obtaining data about the SIM and mobile services ISDN number (MSISDN; i.e., the telephone number).
- The base station subsystem which handles the radio communication with 2G and 2.5G mobile phones.
- The UMTS terrestrial radio access network (UTRAN) which handles the radio communication with 3G mobile phones.
- The visitor location register (VLR) for determining where other mobile subscribers are located.
- Other MSCs for procedures such as handover.

### 1.13.1 Home location register (HLR)

The **home location register** (HLR) is a central database that contains details of each mobile phone subscriber that is authorized to use the GSM core network. There can be several logical, and physical, HLRs per public land mobile network (PLMN), though one international mobile subscriber identity (IMSI)/MSISDN pair can be associated with only one logical HLR (which can span several physical nodes) at a time.

The HLR stores details of every SIM card issued by the mobile phone operator. Each SIM has a unique identifier called an IMSI which is the primary key to each HLR record.

The next important items of data associated with the SIM are the MSISDNs, which are the telephone numbers used by mobile phones to make and receive calls. The primary MSISDN is the number used for making and receiving voice calls and SMS, but it is possible for a SIM to have other secondary MSISDNs associated with it for fax and data calls. Each MSISDN is also a primary key to the HLR record. The HLR data is stored for as long as a subscriber remains with the mobile phone operator.

### 1.13.2 Authentication centre (AUC)

The **authentication centre** (AUC) is a function to authenticate each SIM card that attempts to connect to the GSM core network (typically when the phone is powered on). Once the authentication is successful, the HLR is allowed to manage the SIM and services described above. An encryption key is also generated that is subsequently used to encrypt all wireless communications (voice, SMS, etc.) between the mobile phone and the GSM core network.

If the authentication fails, then no services are possible from that particular combination of SIM card and mobile phone operator attempted. There is an additional form of identification check performed on the serial number of the mobile phone described in the EIR section below, but this is not relevant to the AUC processing.

Proper implementation of security in and around the AUC is a key part of an operator's strategy to avoid SIM cloning.

The AUC does not engage directly in the authentication process, but instead generates data known as *triplets* for the MSC to use during the procedure. The security of the process depends upon a shared secret between the AUC and the SIM called the  $K_i$ . The  $K_i$  is securely burned into the SIM during manufacture and is also securely replicated onto the AUC. This  $K_i$  is never transmitted between the AUC and SIM, but is combined with the IMSI to produce a challenge/response for identification purposes and an encryption key called  $K_c$  for use in over the air communications.

### **1.13.3 Visitor location register (VLR)**

The **visitor location register** is a temporary database of the subscribers who have roamed into the particular area which it serves. Each base station in the network is served by exactly one VLR, hence a subscriber cannot be present in more than one VLR at a time.

The data stored in the VLR has either been received from the HLR, or collected from the MS. In practice, for performance reasons, most vendors integrate the VLR directly to the V-MSC and, where this is not done, the VLR is very tightly linked with the MSC via a proprietary interface.

Data stored include:

- IMSI (the subscriber's identity number).
- Authentication data.
- MSISDN (the subscriber's phone number).
- GSM services that the subscriber is allowed to access.
- Access point (GPRS) subscribed.
- The HLR address of the subscriber.

### **1.14 Other GSM core network elements connected to the VLR**

The VLR connects to the following elements:

- The V-MSC to pass needed data for its procedures; e.g., authentication or call setup.
- The HLR to request data for mobile phones attached to its serving area.
- Other VLRs to transfer temporary data concerning the mobile when they roam into new VLR areas. For example, the temporal mobile subscriber identity (TMSI).

### **1.15 Procedures implemented**

The primary functions of the VLR are:

- To inform the HLR that a subscriber has arrived in the particular area covered by the VLR.
- To track where the subscriber is within the VLR area (location area) when no call is ongoing.
- To allow or disallow which services the subscriber may use.
- To allocate roaming numbers during the processing of incoming calls.
- To purge the subscriber record if a subscriber becomes inactive whilst in the area of a VLR. The VLR deletes the subscriber's data after a fixed time period of

- inactivity and informs the HLR (e.g., when the phone has been switched off and left off or when the subscriber has moved to an area with no coverage for a long time).
- To delete the subscriber record when a subscriber explicitly moves to another, as instructed by the HLR.

## **1.16 Equipment identity register (EIR)**

The **equipment identity register** is often integrated to the HLR. The EIR keeps a list of mobile phones (identified by their IMEI) which are to be banned from the network or monitored. This is designed to allow tracking of stolen mobile phones. In theory all data about all stolen mobile phones should be distributed to all EIRs in the world through a Central EIR. It is clear, however, that there are some countries where this is not in operation. The EIR data does not have to change in real time, which means that this function can be less distributed than the function of the HLR. The EIR is a database that contains information about the identity of the mobile equipment that prevents calls from stolen, unauthorized or defective mobile stations. Some EIR also have the capability to log Handset attempts and store it in a log file.

## **1.17 Other support functions**

Connected more or less directly to the GSM core network are many other functions.

### **1.17.1 Billing centre (BC)**

The **billing centre** is responsible for processing the toll tickets generated by the VLRs and HLRs and generating a bill for each subscriber. It is also responsible for to generate billing data of roaming subscriber.

### **1.17.2 Short message service centre (SMSC)**

The **short message service centre** supports the sending and reception of **text messages**.

### **1.17.3 Multimedia messaging service centre (MMSC)**

The **multimedia messaging service centre** supports the sending of multimedia messages (e.g., images, audio, video and their combinations) to (or from) MMS-enabled Handsets.

### **1.17.4 Voicemail system (VMS)**

The **voicemail system** records and stores voicemails

## 1.18 Network Subsystem

The central component of the Network Subsystem is the Mobile services Switching Center (MSC). It acts like a normal switching node of the PSTN or ISDN, and in addition provides all the functionality needed to handle a mobile subscriber, such as registration, authentication, location updating, handovers, and call routing to a roaming subscriber. These services are provided in conjunction with several functional entities, which together form the Network Subsystem. The MSC provides the connection to the public fixed network (PSTN or ISDN), and signalling between functional entities uses the ITUT Signalling System Number 7 (SS7), used in ISDN and widely used in current public networks.

The Home Location Register (HLR) and Visitor Location Register (VLR), together with the MSC, provide the callrouting and (possibly international) roaming capabilities of GSM. The HLR contains all the administrative information of each subscriber registered in the corresponding GSM network, along with the current location of the mobile. The current location of the mobile is in the form of a Mobile Station Roaming Number (MSRN) which is a regular ISDN number used to route a call to the MSC where the mobile is currently located. There is logically one HLR per GSM network, although it may be implemented as a distributed database.

The Visitor Location Register contains selected administrative information from the HLR, necessary for call control and provision of the subscribed services, for each mobile currently located in the geographical area controlled by the VLR. Although each functional entity can be implemented as an independent unit, most manufacturers of switching equipment implement one VLR together with one MSC, so that the geographical area controlled by the MSC corresponds to that controlled by the VLR, simplifying the signalling required. Note that the MSC contains no information about particular mobile stations - this information is stored in the location registers. The other two registers are used for authentication and security purposes. The Equipment Identity Register (EIR) is a database that contains a list of all valid mobile equipment on the network, where each mobile station is identified by its International Mobile Equipment Identity (IMEI). An IMEI is marked as invalid if it has been reported stolen or is not type approved. The Authentication Center is a protected database that stores a copy of the secret key stored in each subscriber's SIM card, which is used for authentication and ciphering of the radio channel. Following is the diagram of GSM Network along with added elements.

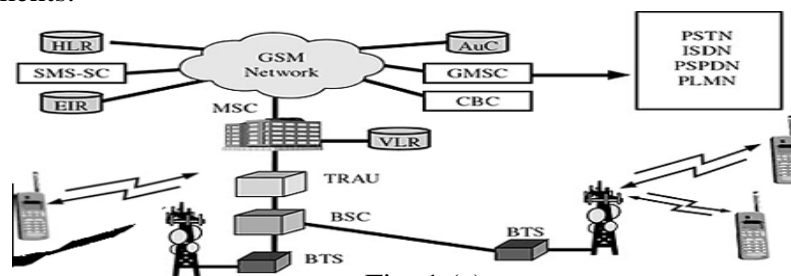


Fig: 1 (c)



The MS and the BSS communicate across the Um interface, also known as the air interface or radio link. The BSS communicates with the Network Service Switching center across the A interface.

### **1.19 Call from Mobile Phone to PSTN:**

When a mobile subscriber makes a call to a PSTN telephone subscriber, the following sequence of events takes place:

1. The MSC/VLR receives the message of a call request.
2. The MSC/VLR checks if the mobile station is authorized to access the network. If so, the mobile station is activated. If the mobile station is not authorized, service will be denied.
3. MSC/VLR analyzes the number and initiates a call setup with the PSTN.
4. MSC/VLR asks the corresponding BSC to allocate a traffic channel (a radio channel and a time slot).
5. The BSC allocates the traffic channel and passes the information to the mobile station.
6. The called party answers the call and the conversation takes place.
7. The mobile station keeps on taking measurements of the radio channels in the present cell and neighboring cells and passes the information to the BSC. The BSC decides if handover is required, if so, a new traffic channel is allocated to the mobile station and the handover is performed. If handover is not required, the mobile station continues to transmit in the same frequency. [1]

### **1.20 Call from PSTN to Mobile Phone:**

When a PSTN subscriber calls a mobile station, the sequence of events is as follows:

The Gateway MSC receives the call and queries the HLR for the information needed to route the call to the serving MSC/VLR.

1. The GMSC routes the call to the MSC/VLR.
2. The MSC checks the VLR for the location area of the MS.
3. The MSC contacts the MS via the BSC through a broadcast message, that is, through a paging request.
4. The MS responds to the page request.
5. The BSC allocates a traffic channel and sends a message to the MS to tune to the channel. The MS generates a ringing signal and, after the subscriber answers, the speech connection is established.
6. Handover, if required, takes place, as discussed in the earlier case.

The MS codes the speech at 13 Kbps for transmission over the radio channel in the given time slot. The BSC converts (or transcodes) the speech to 64 Kbps and sends it over a land link or radio link to the MSC. The MSC then forwards the speech data to the PSTN. In the reverse direction, the speech is received at 64 Kbps rate at the BSC and the BSC does the transcoding to 13 Kbps for radio transmission.

In its original form, GSM supports 9.6 Kbps data, which can be transmitted in one TDMA time slot. Over the last few years, many enhancements were done to the GSM standards (GSM Phase 2 and GSM Phase 2+) to provide higher data rates for data applications

# Chapter-02

## BTS overview

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### 2.1 Base transceiver station (BTS):

A base transceiver station (BTS) is a piece of equipment that facilitates wireless communication between user equipment (UE) and a network. UEs are devices like mobile phones (handsets), WLL phones, computers with wireless internet connectivity, WiFi and WiMAX gadgets etc. The network can be that of any of the wireless communication technologies like GSM, CDMA, WLL, WAN, WiFi, WiMAX etc. BTS is also referred to as the *radio base station* (RBS), *node B* (in 3G Networks) or, simply, the *base station* (BS). For discussion of the LTE standard the abbreviation *eNB* for enhanced node B is widely used. [ 9]

**2.2 BTS in Mobile Communication** A GSM BTS network is made up of three subsystems: • The Mobile Station (MS) • The Base Station subsystem (BSS) – comprising a BSC and several BTSs • The Network and Switching Subsystem (NSS) – comprising an MSC and associated registers.

Though the term BTS can be applicable to any of the wireless communication standards, it is generally and commonly associated with mobile communication technologies like GSM and CDMA. In this regard, a BTS forms part of the base station subsystem (BSS) developments for system management. It may also have equipment for encrypting and decrypting communications, spectrum filtering tools (band pass filters) etc. antennas may also be considered as components of BTS in general sense as they facilitate the functioning of BTS. Typically a BTS will have several transceivers (TRXs) which allow it to serve several different frequencies and different sectors of the cell (in the case of sectorized base stations). A BTS is controlled by a parent base station controller via the base station control function (BCF). The BCF is implemented as a discrete unit or even incorporated in a TRX in compact base stations. The BCF provides an operations and maintenance (O&M) connection to the network management system (NMS), and manages operational states of each TRX, as well as software handling and alarm collection. The basic structure and functions of the BTS remains the same regardless of the wireless technologies. [9]

### 2.3 A BTS in general has the following units:

**2.3.1 Transceiver (TRX):** Quite widely referred to as the driver receiver (DRX). Basically does transmission and reception of signals. Also does sending and reception of signals to/from higher network entities (like the base station controller in mobile telephony)

### **2.3.2 Power amplifier (PA):**

Amplifies the signal from DRX for transmission through antenna; may be integrated with DRX.

### **2.3.3 Combiner:**

Combines feeds from several DRXs so that they could be sent out through a single antenna. Allows for a reduction in the number of antenna used.

### **2.3.4 Duplexer:**

For separating sending and receiving signals to/from antenna. Does sending and receiving signals through the same antenna ports (cables to antenna).

### **2.3.5 Antenna:**

This is also considered a part of the BTS.

### **2.3.6 Alarm extension system:**

Collects working status alarms of various units in the BTS and extends them to operations and maintenance (O&M) monitoring stations.

### **2.3.7 Control function:**

Control and manages the various units of BTS including any software. On-the-spot configurations, status changes, software upgrades, etc. are done through the control function.

Baseband receiver unit (BBxx)

Frequency hopping, signal DSP, etc...

## **2.4 Equipment of base station:**

The service providers for BTS outdoor and indoor work including:

- Fixing of cable ladder
- Outdoor work consisting of fixing RF and Microwave antennae
- Routing of cables
- Clamping
- Ground / Earthing Cable
- Alignment of Antenna as per specifications
- Installation of Radio Base Station (RBS)
- Installation of Transmission Rack
- Grounding of equipments
- Installation of rectifier and battery bank
- The antennae, the wave-guide locks, flexible wave guides to ensure reliable and proper RF connections.
- The outdoor radio unit & antenna support arms
- Alignment of Antenna of the link to achieve the required signal level
- Integration and commissioning of the BTS with the BSC

## Chapter -03

### **Nokia Siemens Flexi BTS Installation and Commissioning**

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#### **Technical overview of Flexi EDGE BTS**

Nokia Flexi EDGE BTS is a modular base station for GSM/EDGE capacity and coverage. Its modular design makes site acquisition and installation easier, reducing the time needed for rolling out network coverage in a new area. Nokia Flexi EDGE BTS allows using existing site space sparingly and efficiently

#### **3.1 Easy installation**

With Nokia Flexi EDGE BTS, weatherproof modules and casings are used to build base stations and a dedicated BTS cabinet is not necessary. The modules used without a cabinet are environmentally protected and, due to a broad operational temperature range, suitable for varied climatic conditions. A fully functional macrocellular BTS consists of only two logical modules which can be carried by one person. Capacity can be expanded simply by adding modules. With Flexi EDGE BTS, it is possible to upgrade remotely with the license mechanism, provided the HW required for the configuration is already installed. For example, if an upgrade configuration is installed and one DTRX is split in two sectors as described in Nokia Flexi EDGE Dual TRX Module (EXxA) section in this document.

The same modules are used in indoor and outdoor sites for macrocellular and microcellular solutions. The modules can be installed on floor, wall, or pole.

Nokia Flexi EDGE BTS modules can also be installed into existing site support cabinets having 19 inch space available and where cooling requirements are fulfilled. Optional Nokia Flexi cabinets are available for indoor and outdoor sites. Nokia Flexi EDGE BTS allows effective use of BTS footprint supporting expansion to up to 24 TRX per cabinet when HW is considered. The modules may also be installed in older BTS or site support cabinets or in standard 19" racks, when space and cooling allows. [4]

## 3.2 Capacity and performance

Nokia Flexi EDGE BTS is highly integrated. For example, it supports up to 24 TRXs (12 Dual TRXs) in the volume of a traditional single BTS cabinet. There is virtually no limit to site capacity, due to synchronised Nokia Flexi EDGE BTS chaining.

## 3.3 Construction and modules

### 3.3.1 Nokia Flexi EDGE System Module (ESMA) :

The System Module is a unit providing BTS common functionalities and external and internal connections for the whole BTS. The BTS software is stored in the System Module. The System Module also receives and stores the unit identification information of all other units of the BTS. The System Module supports configurations to up to 12 TRXs.

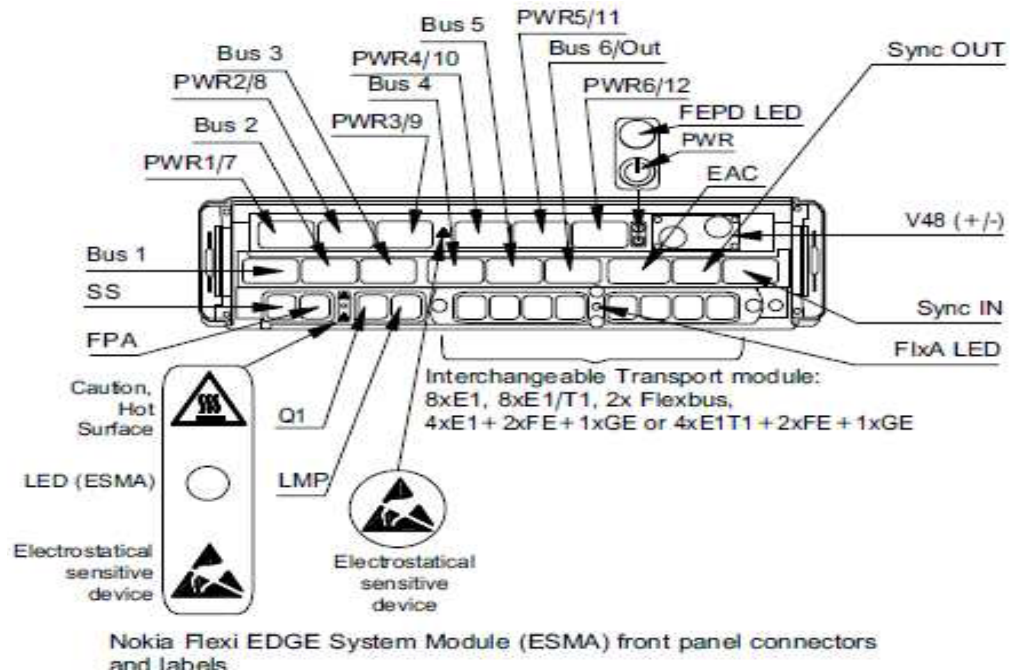


Fig: 3 (a)

The main functions of the System Module are:

1. BTS integrated transport
2. System bus control and module synchronization
3. Power distribution (48 VDC) to other modules

### **3.3.2 Nokia Flexi EDGE System Extension Module (ESEA) :**

The System Extension Module (ESEA) is a unit also providing BTS common functionalities and external and internal connections for the whole BTS. System Extension Module also receives and stores the unit identification information of all other units of the BTS. The System Module supports configurations to up to 12 TRXs. For larger configurations (Dual Band- 900 + 1800), the System Extension Module is used.

Nokia System Extension Module Passes Data to DTRX From Its data port and also passes the power (only 900 GHz) to DTRX . ESEA Collect this power from Rectifier. [6]

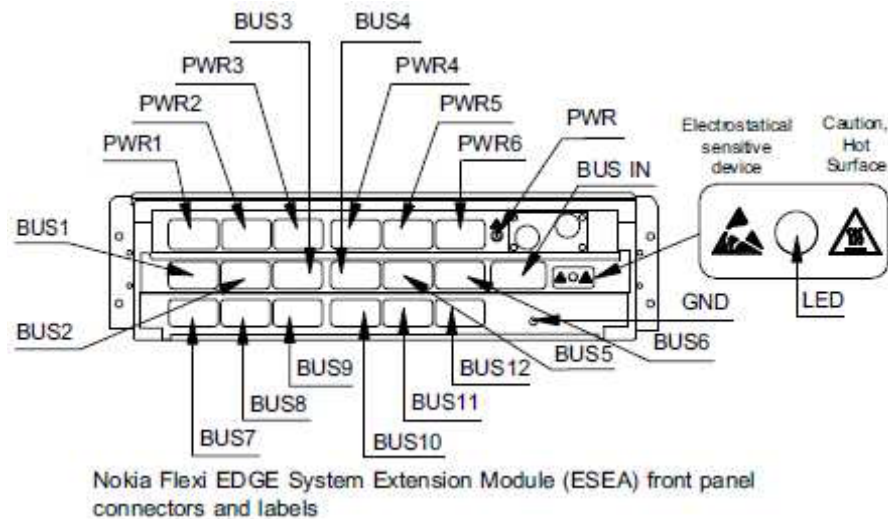


Fig: 3(b)

The main functions of the System Extension Module are:

1. BTS integrated transport
2. System bus control and module synchronization
3. Power distribution (48 VDC) to other modules

### 3.3.3 Nokia Flexi EDGE Dual TRX Module (EXxA) :

The Dual TRX Module (DTRX) is a two-carrier TRX unit. The module contains the common (2 carrier) baseband part and two separate RF parts: for two transceivers (transmitter and receiver chains) and space for two optional Wideband Combiners (WBC).

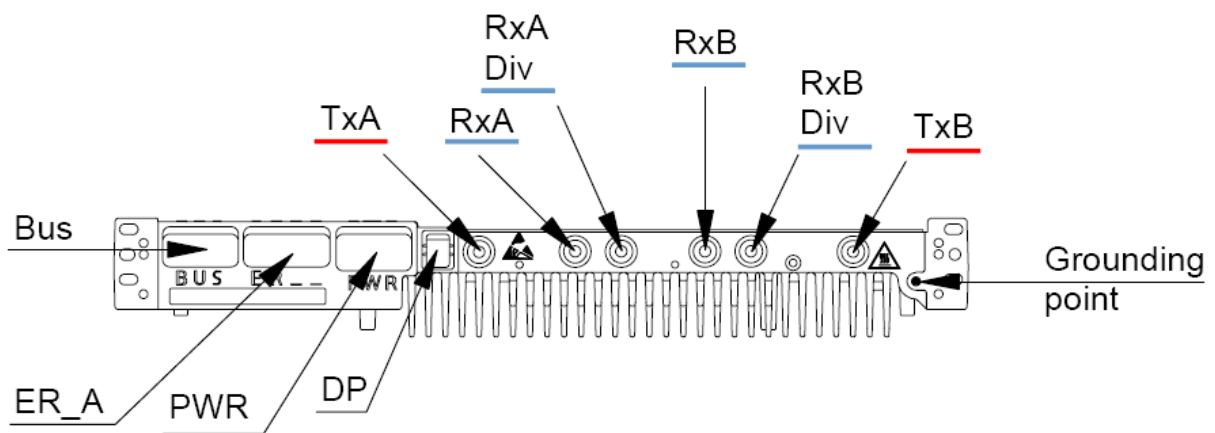


Fig: 3(c)

The Dual TRX Module is used as:

- . a combined module with the Dual Duplexer Module, making a logical Sector Module
- . or a stand-alone TRX module with the Remote Tune Combiner (RTC) module
- . or a stand-alone extension TRX module.

The Dual TRX Module and System Module communication is managed through a single Ethernet interface. Each transceiver within the Dual TRX Module can be separately activated with a license key at the BSC.

### 3.3.4 Nokia Flexi EDGE Dual Duplexer Module (ERxA):

The Dual Duplexer Module and the Dual TRX Module create one Sector Module. A minimum of one Dual Duplexer Module is needed per sector to enable diversity. The Dual Duplexer Module is always attached to the Dual TRX Module, which provides the



Dual Duplexer Module with power feeding and O&M link. Extension Dual TRX Modules are installed without the Dual Duplexer Module.

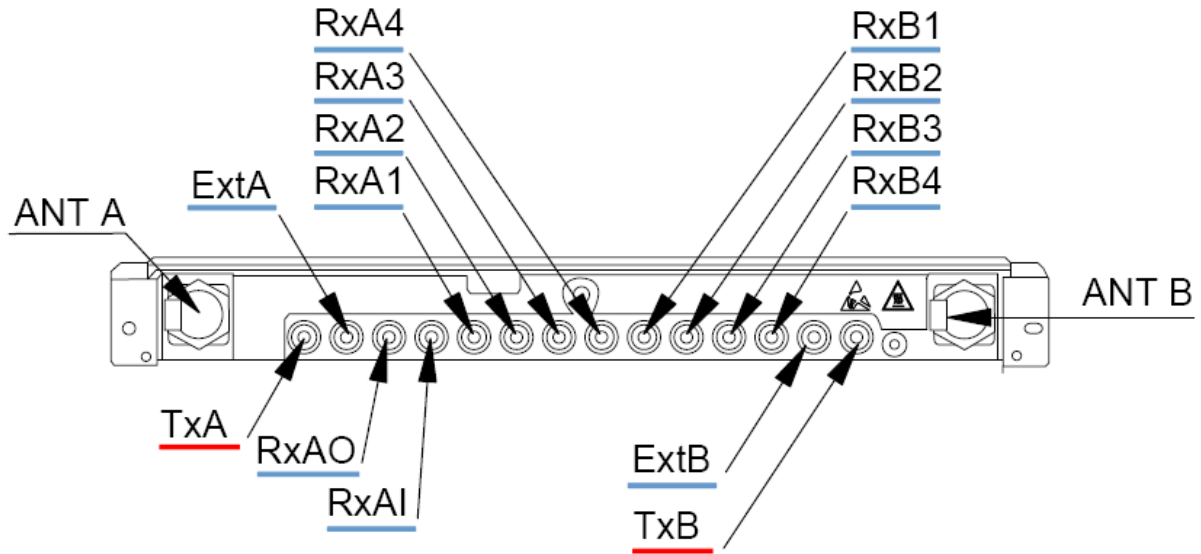


Fig: 3 (d)

The role of the Dual Duplexer Module is to provide the duplex functionality to combine TX and RX signals in a common antenna feeder. The Dual Duplexer Module provides two antenna connections of Nokia Flexi EDGE BTS for bypass and wideband combined configurations. The Dual Duplexer Module supports antenna sharing with another BTS. [6]

The Dual Duplexer Module contains two duplex filters: two Low Noise Amplifiers (LNAs), two Bias-Ts, voltage standing wave ratio (VSWR) measurement functionality, and a common TRX loop for TRXs in one sector. The TRX loop is controlled through the Sector Module.

### 3.3.5 Flexi EDGE Wideband Combiner Sub-module (EWxA):

Two optional Wideband Combiner (WBC) Sub-modules can be attached to the Dual TRX Module. One Wideband Combiner combines two TX signals together. The module can be used for combining carriers that have the same or different frequencies. Double power TRX uses same frequencies.

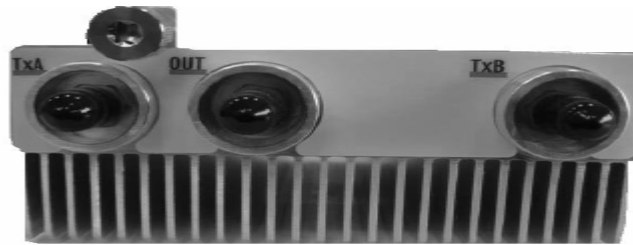


Fig: 3 (e)

### 3.3.6 Flexi Cabinet for Indoor (FCIA):

Nokia Flexi BTS indoor cabinet is an optional sales item for new indoor sites where a cabinet is needed. The optional indoor cabinet can include the following optional items:

- Smoke detector (FCDA)
- EAC and Over-voltage Protector (OVP) connection box (FSEB)



Fig: 3 (f)

### **3.4 General Site Requirements:**

1. Site is accessible and safe for working.
2. All required documentation are available.
3. External connections for the cabinet are available, for example, Site grounding point main power, transmission connections point Power connection point etc.
4. Floor and wall surface is even.
5. Product delivery is complete.
6. Wall or pole at the BTS site is strong enough to withstand the Weight of BTS.
7. Wall or pole site is strong enough to meet earthquake requirement.
8. Pole at BTS site is strong enough to withstand the wind load.
9. BTS is not take out of its delivery package until the site construction work is finished and site is clean and dry.
10. Site security should be established at site.

### **3.5 Alarms of NSN flexi BTS:**

1. Main fail
2. DV Meter
3. Rectifier Module Fail
4. Temperature
5. Smoke
6. Door Open
7. Temp High low (Aircon)
8. Generator Set faulty
9. Generator set on load
10. Generator set servicing
11. Low fuel Generator set
12. Water

### **3.6 Equipment of NSN Flexi Bts:**

- Fixing of cable ladder
- Routing of cables
- Clamping
- Ground / Earthling Cable
- Alignment of Antenna as per specifications

- Installation of Radio Base Station (RBS)
- Installation of Transmission Rack
- Grounding of equipments
- Installation of rectifier and battery bank
- The antennae, the wave-guide locks, flexible wave-guides to ensure reliable and proper RF connections.
- The outdoor radio unit & antenna support arms
- Alignment of Antenna of the link to achieve the required signal level

Integration and commissioning of the BTS with the BSC

### 3.7 Optional modules

This section describes the optional modules in Nokia Flexi EDGE BTS

#### 3.7.1 Flexi EDGE Wideband Combiner Sub-module (EWxA)

Two optional Wideband Combiner (WBC) Sub-modules can be attached to the Dual TRX Module. One Wideband Combiner combines two TX signals together. The module can be used for combining carriers that have the same or different frequencies. Double power TRX uses same frequencies.

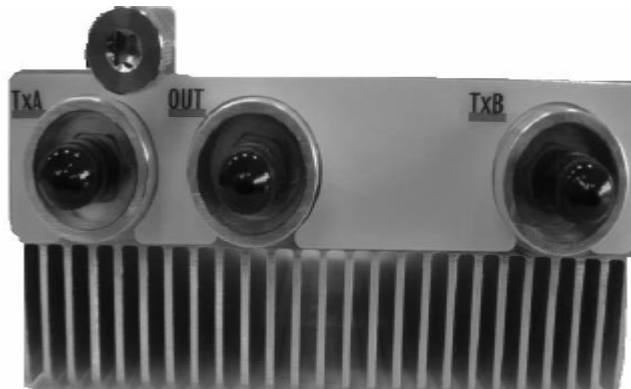


Fig: 3(g)

### 3.8 Double Power TRX and 4-way uplink diversity

For even a bigger improvement in uplink and coverage, the Double Power TRX (DPTRX) can be implemented with 4-way uplink diversity. It requires two Sector modules per sector. This solution requires four antennas: one for transmit/receive and

three for receive. The Double Power TRX with 4-way uplink diversity increases the coverage area by up to 40%, significantly reducing the number of sites needed

### **3.9 Extended Cell Range**

The maximum supported cell range is normally 35 km. With the Extended Cell feature, the maximum cell range is extended up to 70 km. The Extended Cell feature in Nokia Flexi EDGE BTS is based on the same method as in Nokia UltraSite EDGE BTS, that is, the delayed reception of the signal. This means that it provides the same capacity as the normal range TRX, and minimum traffic capacity is wasted. The Extended Cell feature can be used to efficiently provide coverage in coastal and rural Areas where high capacity or high data rates are not needed.

### **3.10 Configurations and site expansion**

Nokia Flexi EDGE BTS is optimised for high capacity as well as high coverage for macrocellular applications. It also enables evolution paths by providing a flexible expansion capability. It is possible to expand sector by sector so that traffic in only one sector is impacted at the time, and the traffic in the whole BTS is not affected. Modules can be used as such without a cabinet, or with an indoor or outdoor cabinet according to prevailing conditions. The carrier capacity of Nokia Flexi EDGE BTS can be flexibly dimensioned according to the expected traffic by increasing in a number of TRX modules. Each Dual TRX module supports two GSM/EDGE carriers. Nokia Flexi EDGE BTS offers flexible combining options to increase the BTS capacity without a need to increase the number of BTS antennas. There are also combining options to maximise the cell coverage or capacity. [4]

Nokia Flexi EDGE BTS supports:

- . 1 ... 6 sectors
- . Up to 24 carriers/BCF
- . Up to nine cabinets can be synchronised with the Multi BCF feature
- . Multiple TX antennas for any sector and band

### **3.11 Procedure for Swap**

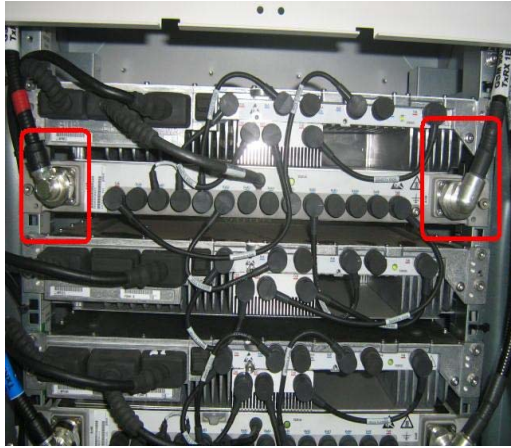
- Jumper, Feeder, power cable Shifting
- Grounding /Earthling cable attach
- Transmission Shifting
- Flexi BTS Installation

- Flexi BTS Commissioning
- Cross-Connections at BTS and BSC end

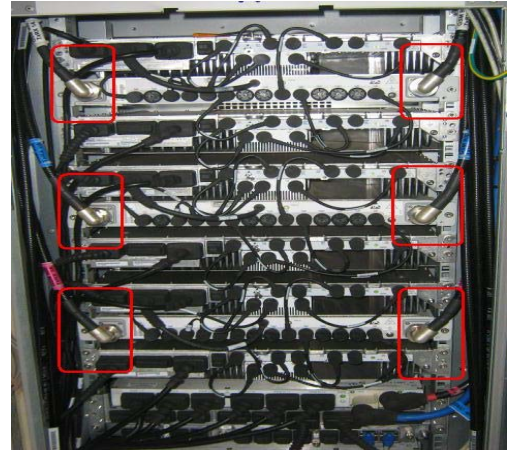
### **3.11.1 Jumper, Feeder cable and power cable Shift:**

#### **Jumper and feeder Cable**

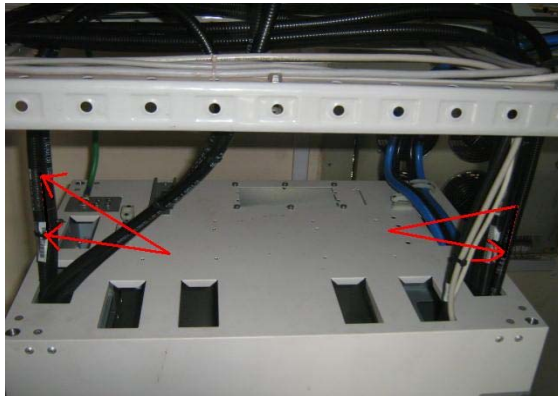
- Feeder connections should be connected to the front face of duplexer, jumper cable are 'L' shape as shown in fig:3.1 (a)
- Jumper cables laid according to the layers and sectors as shown fig: 3.1 (b)
- The indoor jumper ½ inch are kept straight for 5m or 3 m at their joints with the cabinet as shown in fig:3.1(c)
- The connections of jumper are fixed in position lest that possible false connection should be cause abnormal VSWR.
- The usage of jumper cables, at the same time, be sure to fasten jumper connectors. As shown in fig: 3.1 (e)
- No E1 cables or RF cables are scratched or broken. As shown in fig: 3.1 (d)
- The labels RF jumper cables and feeder cables should be stuck and tied according to speculations. The labels should be arranged in the orderly way with the same direction. As shown in fig: 3.1 (e)
- The lug handle are bare wire of a power cable must be wrapped with the tube
- No power/GND cables are scratched or broken
- The -48 VDC cable is blue and DC GND cable is black. Shown in fig:3.1(g)
- No cables can fixed on ventilation meshes hole.
- -48 VDC cable from BTS to Rectifier should be connect to the 63A circuit Breaker in the rectifier. As shown fig 3.1(h)
- Should be tied the AC connation.
- The power cable and signal cable should be 3cm distance between each other.



(a)



(b)



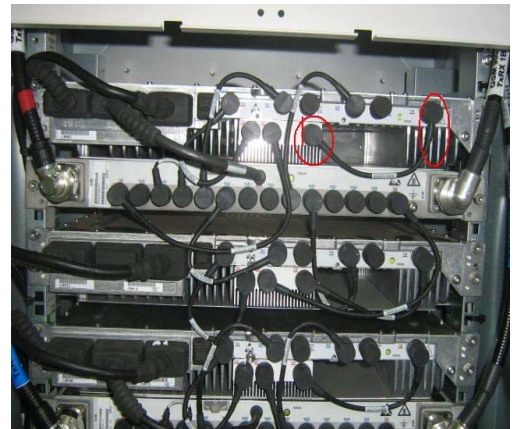
(c)



(d)

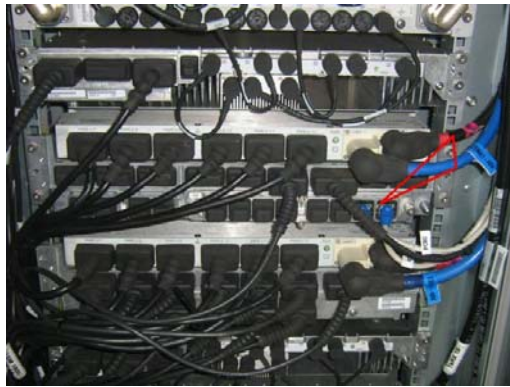


(e)



(f)





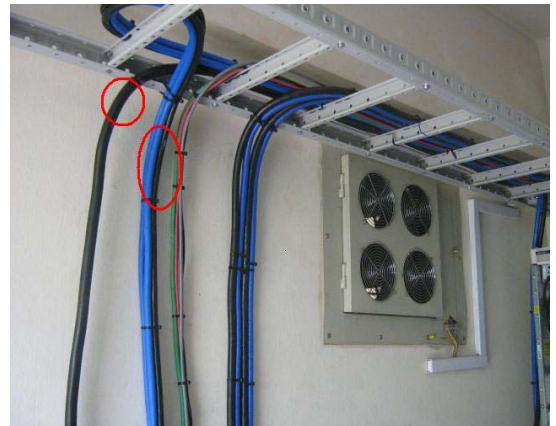
(g)



(h)



(i)



(j)

**Fig: 3.1**

### **3.11.2 Indoor Earth /Grounding Cable Attach**

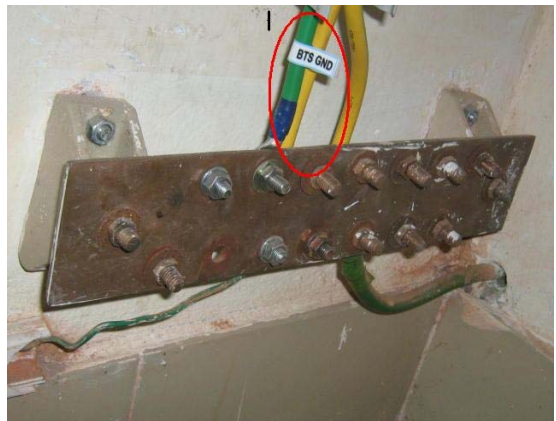
The working GND and the lightning protection ground of the indoor parts share one group of the grounding bodies and then connected to the main Ear thing net

- The upper label of BTS must be grounding. As shown in fig:3.2(a)
- Same as BTS Grounding cable attach in Grounding bar. Shown as fig:3.2(b)
- GND cable should be installed in the rectifier in a right way
- DDF box should be grounding by GND cable





(a)



(b)



(c)



(d)



(e)

Fig: 3.2

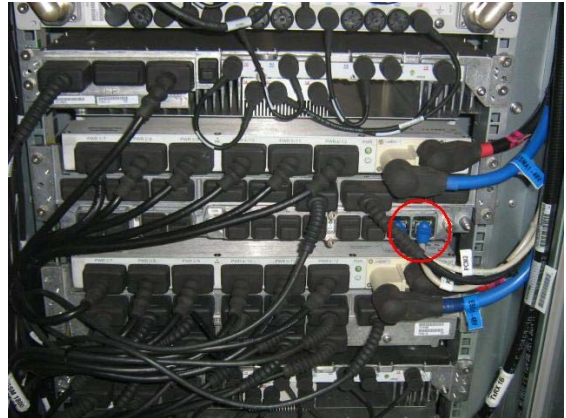
### 3.11.3 Transmission Shifting:

Transmission shifting involves:

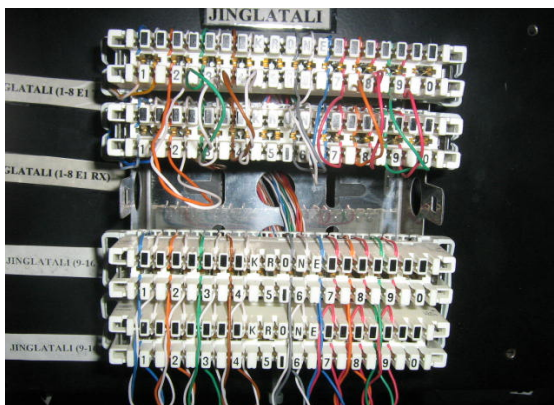
- Shifting of Siemens MW PDH Radios modems from indoor shelter to outdoor shelter
- Connecting all the MW PDH Radios equipment as were in indoor shelter
- Connecting IF cables b/w MW dishes and modems
- Loop testing to check Transmission Media
- Patching 2 E1,s b/w Flexi and MW radios (one E1 for 900 and one for 1800 band)



(a)



(b)



(c)



(d)

**Fig:3.3**

### **3.12 NSN Flexi BTS Configuration (Hardware):**

#### **3.12.1 Creating a 2+2+2 stacked configuration we need**

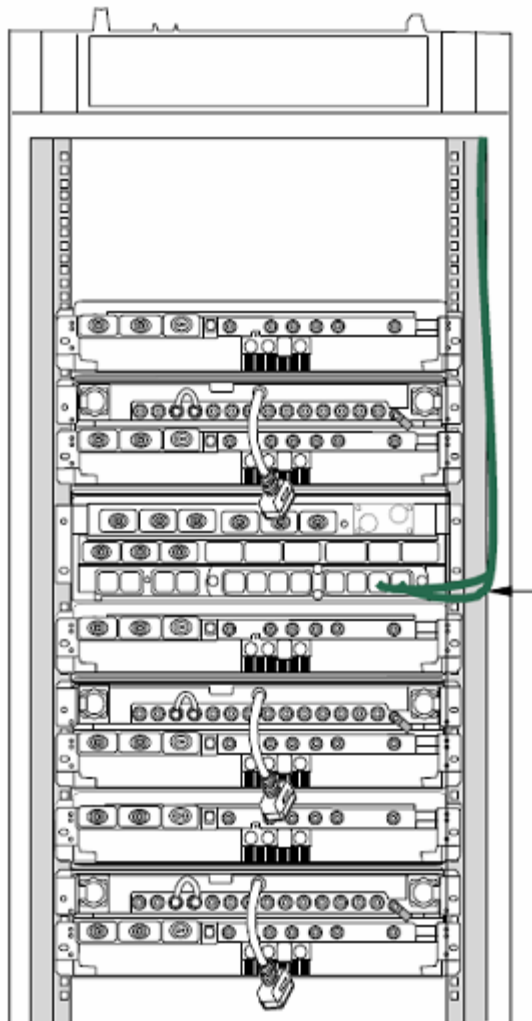
- Three Dual TRX Module (EXxA)
- Three Dual Duplexer Module (ERx A)
- One system module (ESMA)
- One transmission Sub-module (FIPA) [4]



**Fig:3.4**

#### **3.12.2 Creating a 4+4+4 stacked configuration we need**

- Six Dual TRX Module (EXxA)
- Three Dual Duplexer Module (ERx A)
- Six Wideband Combiner (EWxA)
- One system module (ESMA)
- One transmission Sub-module (FIPA)



**Fig:3.5**

### **3.13 Measure Voltage Standing Wave Ratio:**

- Measure the VSWR at the antenna connector For details, see measuring the VSWR at the antenna port
- If VSWR is high checking the antenna connection and jumper connection
- Measure the output power of the TRX
- NSN flexi bts standard VSWR is 1.3

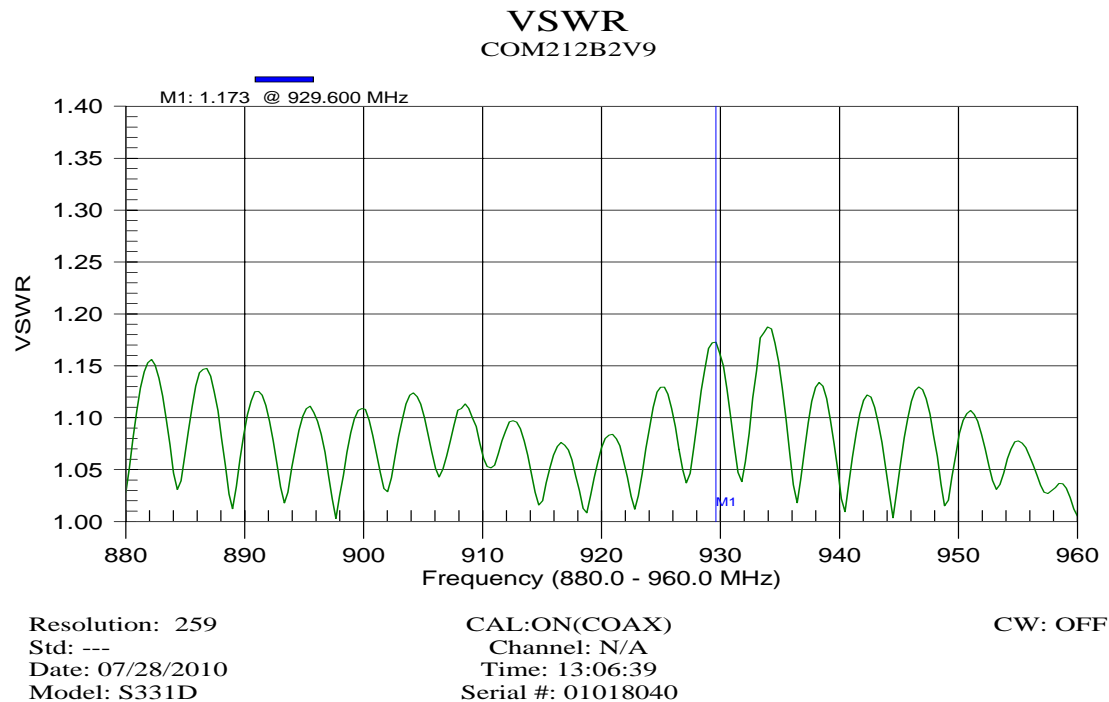


Fig: 3.6

### 3.14 Flexi BTS Commissioning

#### Flexi BTS Commissioning Involves:

- Connecting to Flexi BTS to Laptop
- The login cable RJ 45 straight land cable between Laptop and BTS
- Configure TRX,S and sectors via Flexi BTS user interface
- Configuring Abis plan via same user interface
- Cross-connecting b/w Flexi and Siemens MW PDH
- Cross-connecting changing from Siemens BSC to nokia BSC
- Loop-testing to check transmission media and new ET at Nokia BSC end

#### Step 1:

- Take the windows XP operating system as an example. on the windows Xp operating system, chose start>Control Panel
- Select networks connections then right click on the Local area connection icon.
- Choose properties on the shortcut menu. The local area connection properties dialog box is displayed.
- Select Internet protocol



Then put IP Address in laptop IP configuration. Nokia Flexi BTS login IP bellow:

IP Address: 192.168.255.130

Subnet Mask: 255.255.255.128

Default gateway: 192.168.255.129

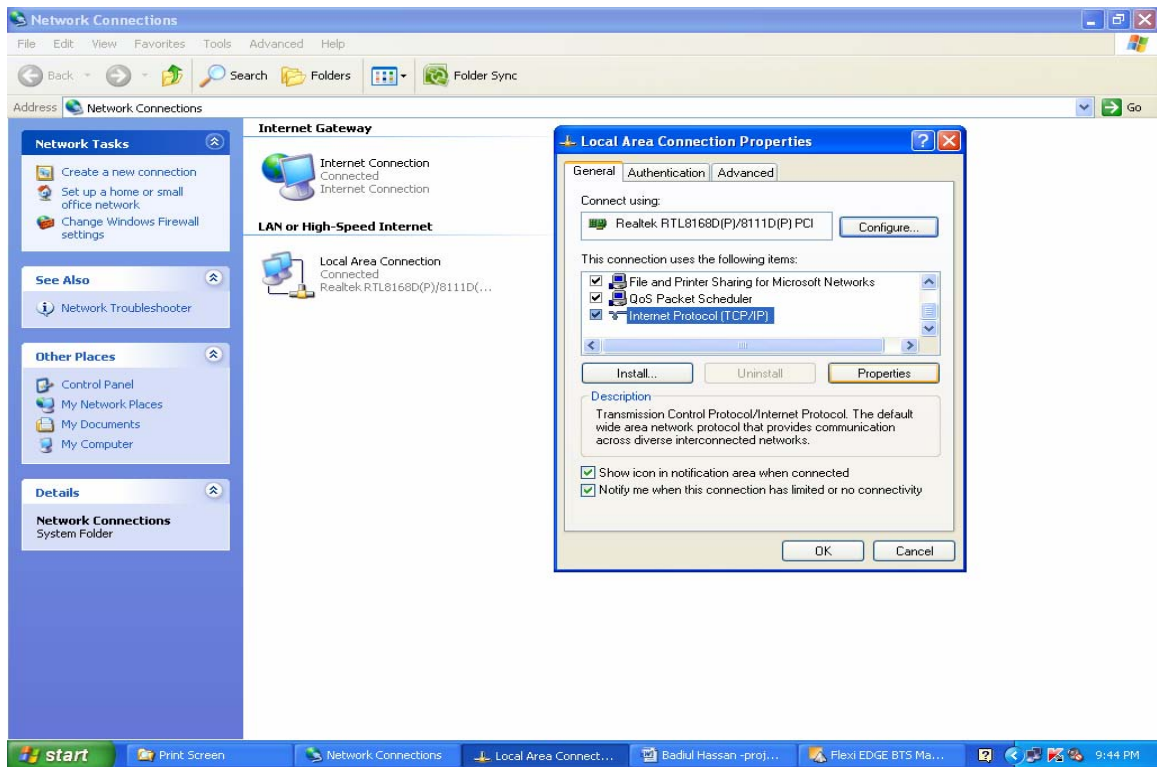


Fig: 3.7

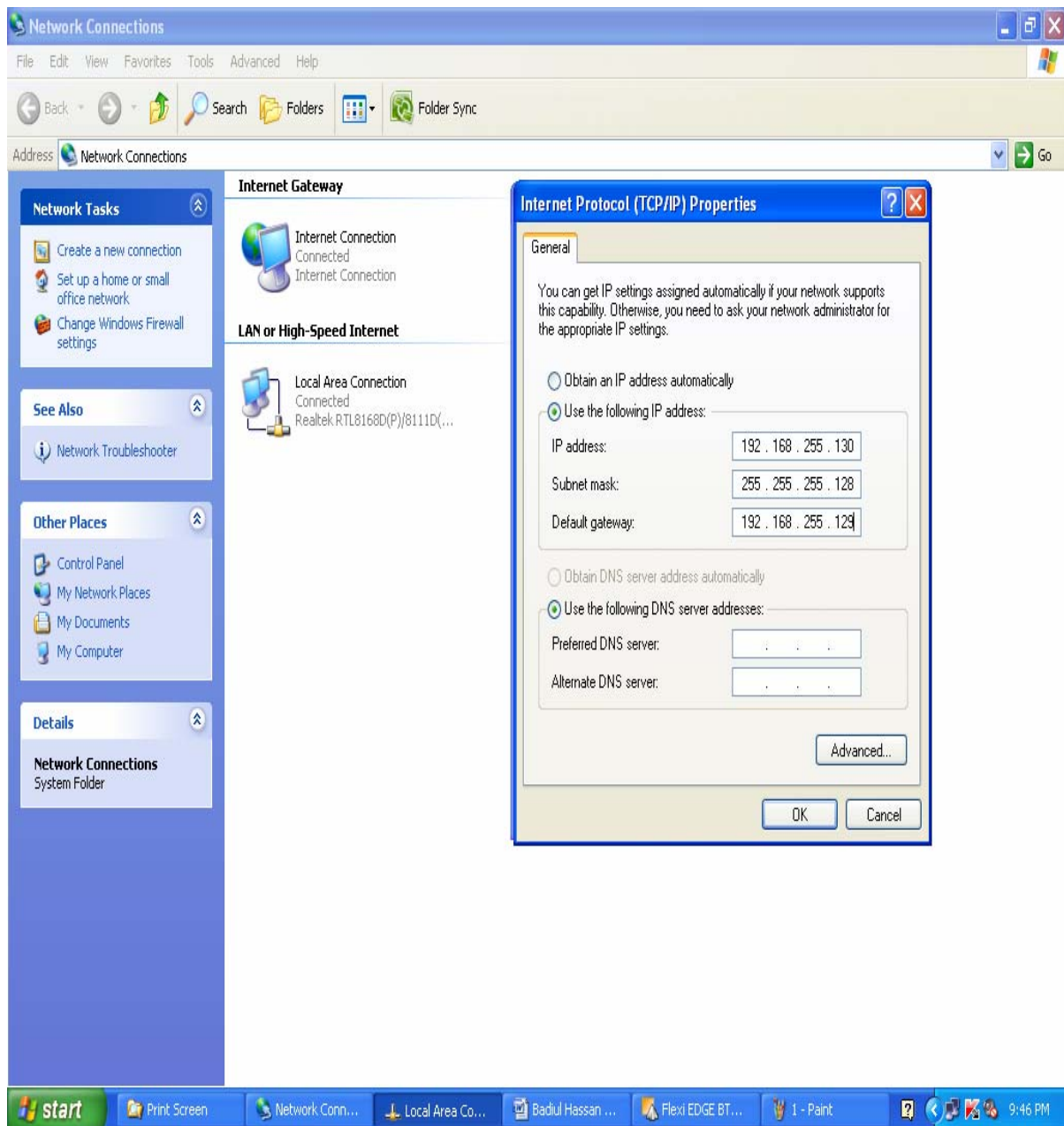


Fig : 3.8

## Step 2 :

Login RJ 45 Straight land cable and connect to the Nokia Siemens flexi EP3 MP2.0 version software.

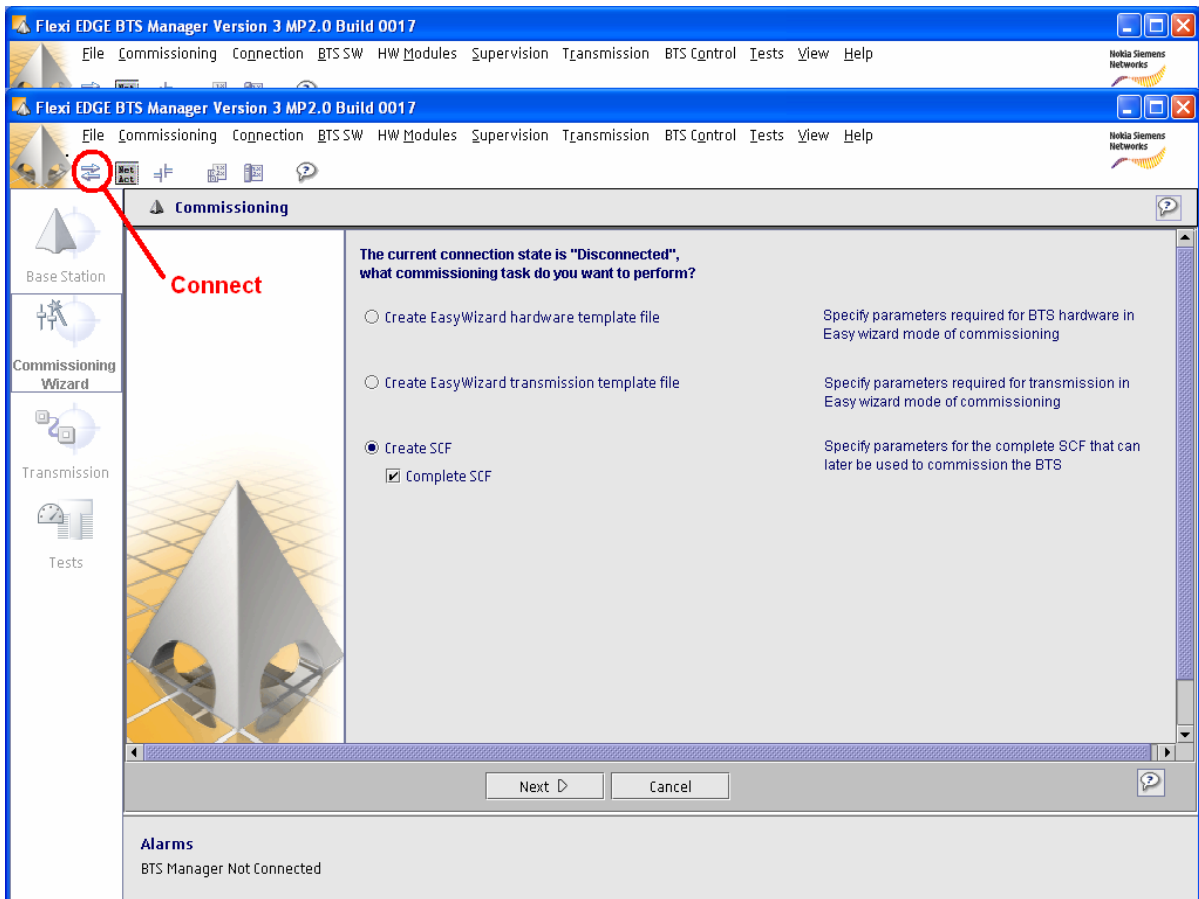


Fig: 3.9

### Step 3:

- After connection Software run on commissioning Wizard
- Click the create SCF Box
- click the complete SCF box as shown in fig:
- then click to next button



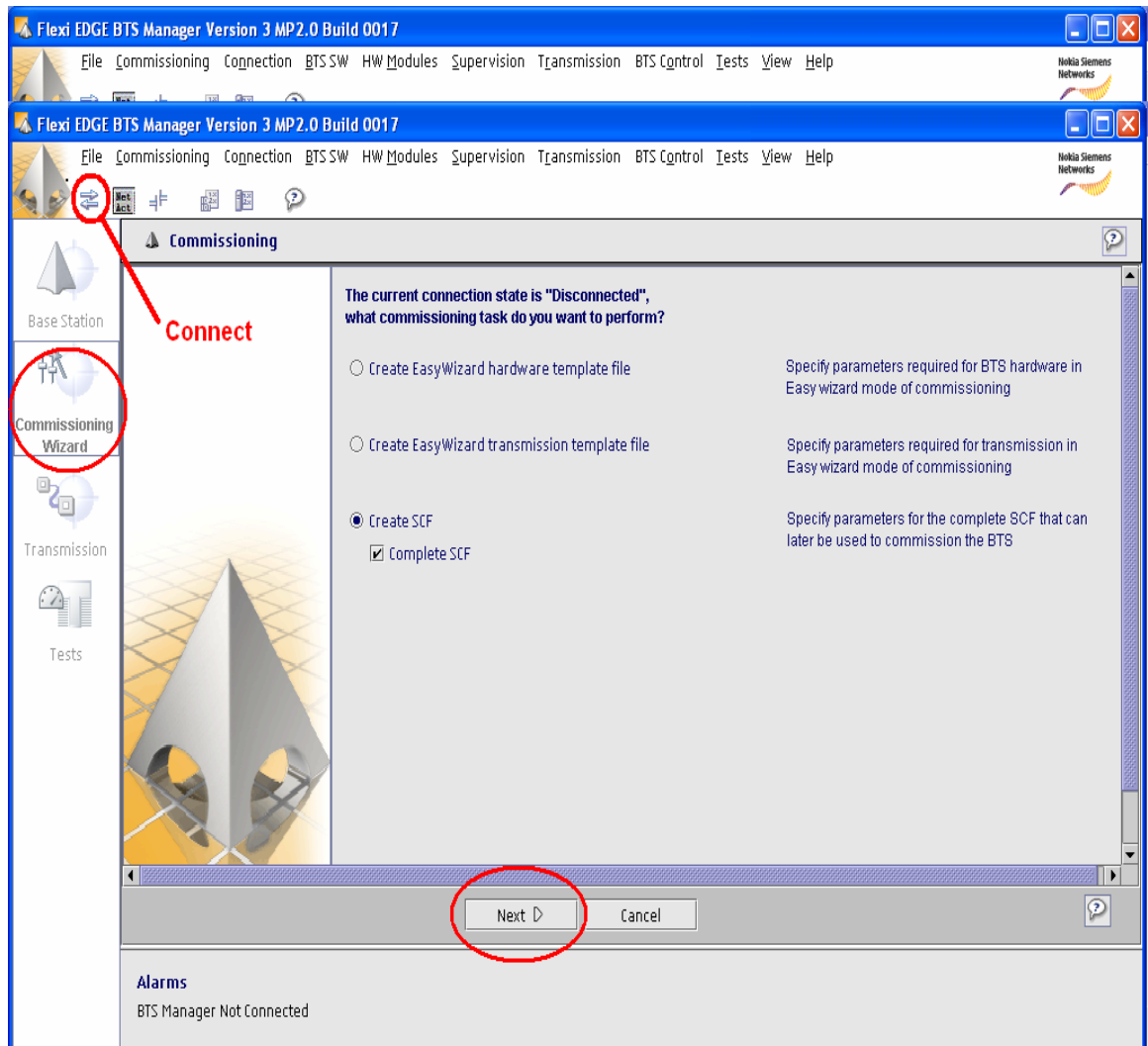


Fig: 3.10

#### Step 4:

- Select site name and site id
- Given BCF id
- select swap night date and installation name.
- For notes select site configuration

**Commissioning**

**Site Specific Information**

BCF Id: 1

BSC Id:

BSC Name:

Site Id: COM0212

Site Name: South Horipur

Location: COMilla

Climate Control Profile: Optimized Cooling

Ambient Air Temperature Offset: Normal

Installation Date: 07-Jul-2010

Installed By: Alliance

Notes: 4/4/4

Characters Left: 245

Navigation: < Back, **Next >**, Cancel, SCF Preview

Fig: 3.11

**Step 5:**

- Next step is cabling configuration and antenna setting
- Radio frequency cable configure for right antenna
- Also selected auto-detectable box and click there

**Commissioning**

**Cabling Configuration**

Antenna Cabling | Auto-detectable Cabling | Non Auto-detectable

RF Source Unit	RF Source Port	Antenna ID
ERxA1	AntA	1
ERxA1	AntB	2
ERxA2	AntA	3
ERxA2	AntB	4
ERxA3	AntA	5
ERxA3	AntB	6

Fig: 3.12

Step 6:

- Select FIPA transmission parameter
- Select Abis termination
- Select Abis allocation
- Select omusignal 32 kbps which is common for all configuration

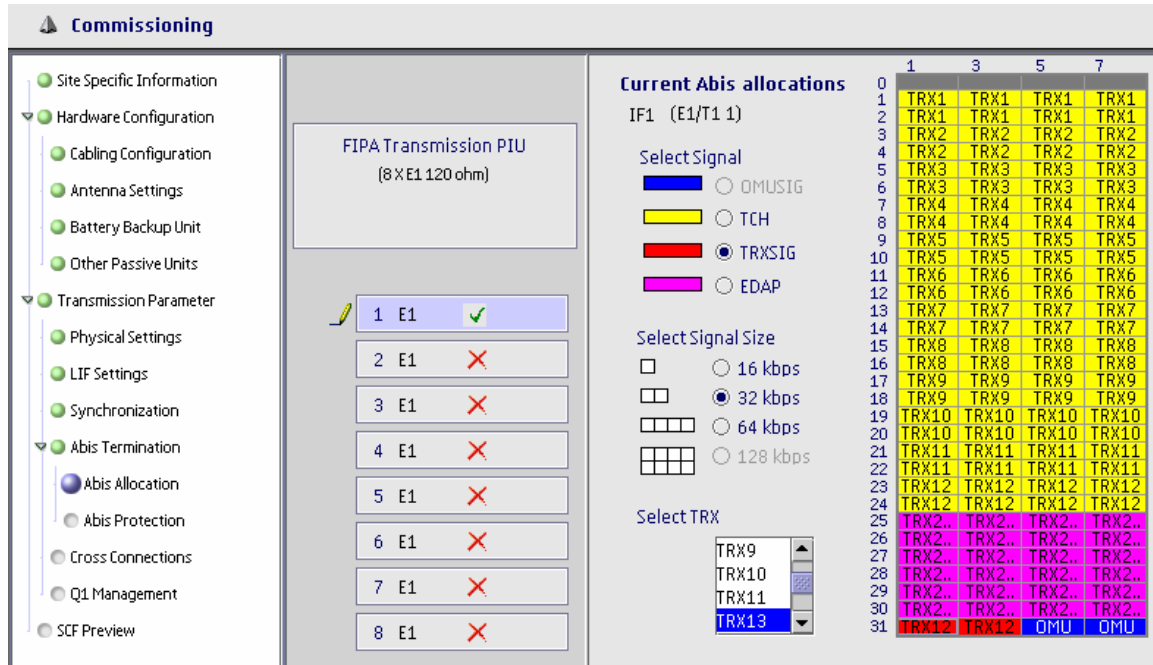
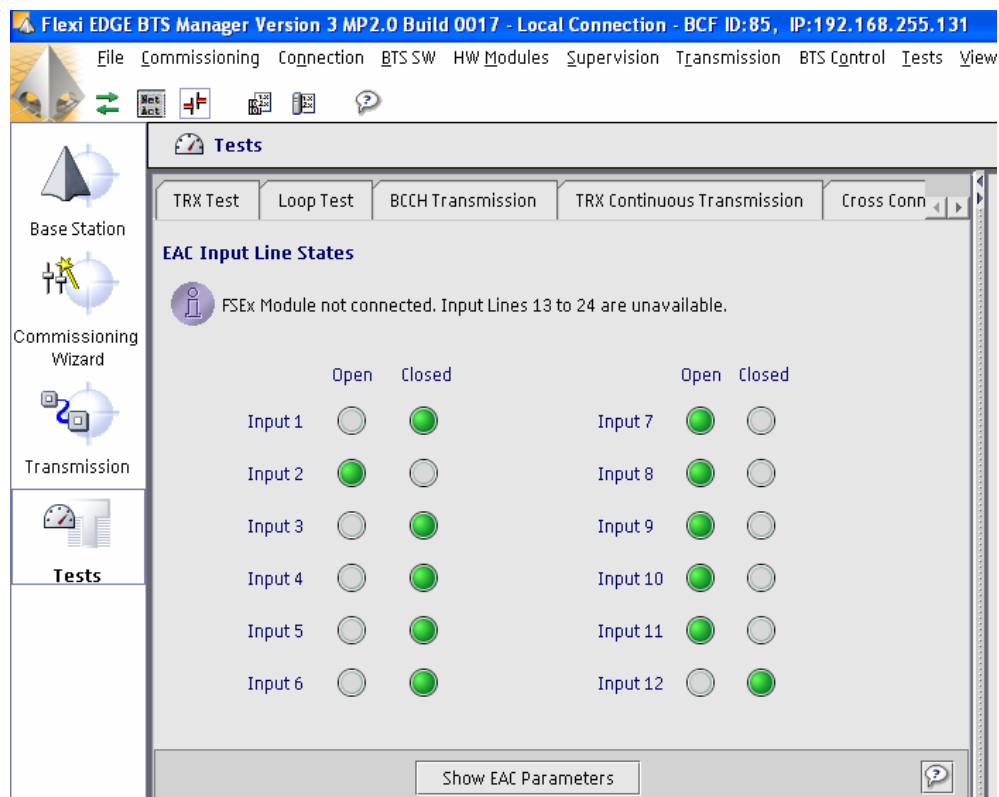


Fig: 3.13

### 3.15 Alarms:

1. Main fail
2. DV Meter
3. Rectifier Module Fail
4. Temperature
5. Smoke
6. Door Open
7. Temp High low (Aircon)
8. Generator Set faulty
9. Generator set on load
10. Generator set servicing
11. Low fuel Generator set
12. Water



**Fig:3.14**

- Normally alarm 1,3,4,5,6 and 12 are closed
- And 2,7,8,9,10,11 are normally open
- After Bts swap swap we create the alarm,and punch in DDF block

# Conclusion

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The report has presented the total picture of the process of “upgrading of 2<sup>nd</sup> Generation Radio Link to 3<sup>rd</sup> Generation”. First of all, a description about the base Transceiver Station and its general units: DTRX, Power amplifier, Combiner, Duplexer, Alarm extension system and control function has been provided. Nokia Siemens Flexi EDGE BTS is used for the total project. It’s a modular Base station for GSM/EDGE capacity and coverage. The details about Nokia Flexi BTS construction and Modules, capacity and its performance is also described along with its configuration Installation, Alarm system, Uplink diversity, Configuration and site expansion, Procedure of Swap and the Steps of Commissioning. Performing the test specified in the contract and integration in the site Troubleshooting is performed if the tests have indicated a fault.

## **GLOSSARY**

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### **Terms and Abbreviations**

AC	Authentication center
AC	Alternating Current
AGW	Abis gateway
ATM	Asynchronous transfer mode
AM	Amplitude modulation
ANSI	American National Standards Institute
ATPC	Automatic transmit power control
BCCH	Broadcast control channel
BSC	Base station Controller
BTS	Base transceiver station
BSIC	Base transceiver station identity code
BCC	Base station color code
BCF	Base station control function
CBC	Chargeback center
CI	Cell Identity
DTRU	Double Transceiver unit
EIR	Equipment Identity Register

GMSC	Gateway MSC
HLR	Home location Register
ISDN	Integrated Services Digital
MS	Mobile station
MSC	Mobile switching center
MSS	Mobile switching centre server
MT	Mobile Terminal
NSS	Network Switching Subsystem
NMS	Network management system
O&M	operations and maintenance
OSS	Operation Support Subsystem
PCU	Packet control unit
PSTN	Public Switched Telecomm
SMS SC	SMS Serving Center
SIM	Subscriber Identity Module
GMSC	Gateway MSC
TA	Terminal Adapter
TDM	Time division multiple
TE	Terminal Equipment
TRAU	Transcoder and Adaptation Unit
ISDN	Integrated Services Digital
V-MSC	Visited MSC

# REFERENCES

- [1] Ericsson GSM overview Guide.
- [2] Alliance BTS Installation Training guide.
- [3] <http://www.burnsidetelecom.com/documents/GSM>
- [4] Presentation slide on NSN.
- [5] GP training on GSM and power supply.
- [6] Alliance Installation Prerequisite training Guide
- [7] [www.roggeweck.net/uploads/media/Student\\_GSM\\_Architecture](http://www.roggeweck.net/uploads/media/Student_GSM_Architecture)
- [8] <http://www.m-indya.com/gsm/gsmarchitecture.php>
- [9] [http://en.wikipedia.org/wiki/Base\\_transceiver\\_station](http://en.wikipedia.org/wiki/Base_transceiver_station)
- [10] <http://www.gsmrating.com/theory/brief-description-of-gsm-standard/>