Empirical Study on Upgradation of 4G from 2G Cellular Network

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This Internship Report is presented in partial fulfillment of the requirements of the Degree of Bachelor of Science in Electronics & Telecommunication Engineering

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APPROVAL

This Internship Report Titled "**Empirical Study on Upgradation of 4G from 2G Cellular Network**" is submitted by S.M. Rajib Ahamed to the Department of Information & Communication Engineering, Daffodil International University, has been accepted as fit for the partial fulfillment of the condition for the Degree of BSc (Hon's) in Electronics &Telecommunication Engineering & approved as to its style and guts. The Presentation will be held on January, 2019

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DECLARATION

I hereby declare that this Internship Report has been done by me under the supervision of **Engr. Md. Zahirul Islam**, Assistant Professor, Department of ICE, Daffodil International University. I additionally proclaim that neither this report nor any piece of it has been submitted away for honor of any degree or certificate.

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The real sprit of achieving a goal is finished the way of quality and austere castigation. I would have never thrived in effecting my task without the teamwork, help and support provided to me by many personalities.

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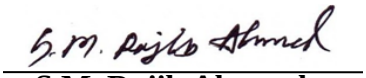
I must grant with due esteem the perpetual support and endurance of my family members for final this internship.



S.M. Rajib Ahamed

Abstract

In the present condition of thriving for mobile broadband, Long Term Evolution (LTE) is the most favored wireless innovation for the mobile operators. Considering the heritage multi-innovation networks, operators need to deliberately work after boosting their income while limiting their expense and fulfilling the endorser's necessities too. Operators have a decision between 2 organize techniques LTE overlay and single radio access network (SRAN). A study did turn out to be the ideal LTE deployment technique thinking about the aggregate expense of proprietorship. In this, report, it has been discussed about the impact on the system performance due to the up-gradation of system from second generation (2G) to third generation (3G) to long term evolution (4G) system utilizing Huawei base band unit.

Table of Contents

Chapter	Page
Chapter 1 Introduction	1-3
1.1 Introduction	1
1.2 About Starlink Engineering Limited	1
1.3 Company Profile	2
1.4 Objective of the Report	2
1.5 Summary of the Report	3
Chapter 2 Cellular Communication Network Technologies	4-6
2.1 Cellular Network Types	4
2.2 Global System for Mobile (GSM) Communications	5
2.3 Code Division Multiple Access (CDMA) technology	5
2.4 Universal Mobile Telecommunication Systems (UMTS) technology	5
2.5 Long Term Evolution (LTE) technology	6
Chapter 3 GSM Network	7-16
3.1 GSM system overview	7
3.2 GSM - Architecture	7-8
3.3 Mobile station	8-9
3.4 Base Station Subsystem (BSS)	9-10
3.4.1 The Base Transceiver Station (BTS)	10-11
3.4.2 The Base Station Controller (BSC)	11-12
3.4.3 Transcoding & Rate Adaptation Unit	12
3.5 The Network and Switching Subsystem (NSS)	13
3.5.1 Home Location Register (HLR)	13
3.5.2 Mobile Services Switching Center (MSC)	14
3.5.3 Visitor Location Register (VLR)	14
3.5.4 Authentication Center (AUC)	15
3.5.5 Equipment Identity Register (EIR)	15-16
Chapter 4 Long Term Evolution (LTE) Technology	17-21
4.1 Long Term Evolution (LTE)	17-18

4.2 LTE Architecture Overview 18-19
4.2.1 The User Equipment (UE) 20
4.2.2 The E-UTRAN (The access network) 21
4.2.3 The Evolved Packet Core (EPC) (The core network) 21
4.3 2G Versus LTE 21
Chapter 5 GP SWAP: 2G with 4G Modernization 22-35
5.1 BBU (Base Band Unit) 22-23
5.2 Typical BBU Configurations 23-24
5.3 GTMU (GSM Transmission & Management Unit for BBU) 25
5.4 UMPT 26-27
5.5 UBRI 28
5.6 UBBP (Universal Baseband Processing Unit) 28-29
5.7 WBBP 29-30
5.8 MRFU (Multi-Mode Radio Frequency Unit) 31-32
5.9 RRU 33-35
Chapter 6 BTS Tracker and Speed Test 36-38
6.1 BTS Tracker 36
6.2 2G and 4G Net Monitor 36-37
6.3 Speed Test 38
Chapter 7 Conclusion 39
References 40

List of Figures

Figure Name	Page
Fig 2.1 Network Type	4
Fig 2.2 LTE Technology	6
Fig3.1: GSM Network Architecture	8
Fig 3.2: Mobile Station	9
Fig 3.3: Base Station System	10
Fig3.4: BTS Configuration	11
Fig 3.5 BSC	12
Fig 3.6 HLR	13
Fig 3.7 MSC	14
Fig 3.8 VLR	15
Fig 3.9 AuC	15
Fig 3.10 EIR Process	16
Fig 4.1 LTE	17
Fig 4.2 4G | LTE Architecture	19
Fig 4.3 LTE Components	19
Fig 4.4 The User Equipment	20
Fig5.1: BBU 3900	24
Fig 5.2 BBU Cabinet 3900	24
Fig 5.3 GTMU	25
Fig 5.4 UMPT Architecture Board	26
Fig 5.5 UMPT	27
Fig5.6: UBRI Board	28
Fig5.7: UBBP Board	28
Fig5.8: WBBP Board	29
Fig5.9: WBBP Architecture Board	29
Fig5.10: MRFU 1800	32
Fig5.11: RRU 3959a	33
Fig5.12: RRU on BTS	35
Fig 6.1 2G Net Monitor	36

Fig 6.2 4G Net Monitor 36
Fig 6.3 3G Speed 38
Fig 6.4 4G Speed 38

List of Table

Name of Table	Page
Table 1.1 Operators	2
Table 4.1: Difference Of 2G vs 4G	21
Table 5.1: Baseband unit Slot	23
Table 5.2 UMPT	27
Table 5.3 WBBP	29

Chapter1

Introduction

1.1 Introduction

Cell is one of the quickest developing and most requesting broadcast communications applications. Today, it speaks to a consistently expanding level of all cellphone users around the global. To maintain connection user gear and operator need medium which is base transceiver station (BTS). User gear can be cell phone, computer, etc. Base transceiver station actually that medium to provide cellular network in user gear or user equipment. Computer use network Wi-Fi and Wi-MAX those age wireless connectivity.

In order to make the best use of telephone subscription a standard BTS installation process should be followed. In this Internship Report, BTS installation process and Commissioning has been described.

1.2 About Starlink Engineering Limited

Starlink Engineering Limited is a 3rd party company providing or deal with of engineering services like initial BTS Site maintainers, base transceiver station Planning, base transceiver station Installation, base transceiver station Commissioning, base transceiver station Operation and Maintenance as well as network optimization in the Telecommunication and Information field.

Starlink Engineering Limited was started in 2008 by a group of young and passionate Engineering Team to partnership with different vendors, Telecom operators and corporate enterprises in Bangladesh. Star Link believes to maintain the world class standard of its quality products and services and promised to deliver its solution always on time, for making our customer life easy and making work simple.

Star Link is working for all Telecom Operator in Bangladesh has its head office in Dhaka, Bangladesh with 556 employees all are well trained and efficient of doing most of the scope of Telecom Engineering services.

Customer	Major Scope	Remarks
grameenphone	i. Rollout Services	Working Since 2013
banglalink	i. 2G and 3G Site Integration ii. Power and electrical renovation works.	Working Since 2012
Robi	i. Resource support for Drive Test Service	Working Since 2013
HUAWEI	i. Rollout Service ii. RNO/P iii. Enterprise Services	Working Since 2010
ERICSSON	i. Rollout Services ii. Site Maintence (Passive)	Working Since 2013
NOKIA	i. Rollout Services	Working Since 2013
e.co	i. Sit Audit and Asset Reconciliation ii. PAT Services	Working Since 2013

Table 1.1 Operators

1.3 Company Profile

Name	**:**	**Starlink Engineering Limited.**
Address	**:**	Flat# A-1, House# 83, Road# 23, Gulshan, Dhaka-1212
Telephone	**:**	+88029862208
Email	**:**	E-mail: info@starlinkengineering.com
Website	**:**	http://www.starlinkengineering.com

1.4 The main objectives of this report are as follows:

1. To recognize the 2G BTS (Base Transmission Site).
2. Convert 2G BTS site to 4G BTS site.
3. Voice and Data speed test.

1.5 Summary of the Report

The objective of this Internship is to improve an effective knowledge in of 2G with 4G Network Modernization of Starlink Engineering Limited. In ***the First chapter,*** I have termed the Details & objective an overall view that I am going to instrument during this internship work and I would describe the background of Starlink Engineering Limited.

The Second Chapter, mainly discuss about Cellular Communication Network Technologies

The Third chapter is describing, Long Term Evolution (LTE) Technology.
The fourth chapter is describing, GP SWAP: 2G with 4G Modernization.
The Chapter fifth is describing, BTS Tracker and Speed Test

The last one is ***Chapter six*** Conclusion.

Chapter 2

Cellular Communication Network Technologies

2.1 Cellular Network Types

Cellular network is a big part telecommunication technology that ensure the use of user gear properly. A user gear is can't communicate radio frequency that must need a method or medium to communicate with another user gear this type of method is cellular network. This method or network is for cellular phone and come with different types or generation 1G, 2G ,4G 3G.LTE with the time next generation is coming like 5G. 5G come in the 2021 year approximately. With the generation new and exciting user gears or cell phone. Each device come with each generation to support each of generation. Cellular connection is based on the geographical capacity or the strength. Also, division of the connection run for area into cells and within cells.

The typical equipment of all propagation of cellular network connection technologies is must be used radio frequencies (RF), as well as frequency not use. This types of approve the operator of a service to a big number of subscribers while decreasing the band width. It also able the establishment the good communication networks connectivity by fully accommodate the advanced capacity of the user gear. [1]

Now day, in the world cellular network offers GSM, CDMA, 3G, 4G, 5G. Ever since in the initiation of the user equipment, cellular network one of the parts 1G gone with this analog system then come 2nd generation or 2G with the digital system which is generally GSM system.

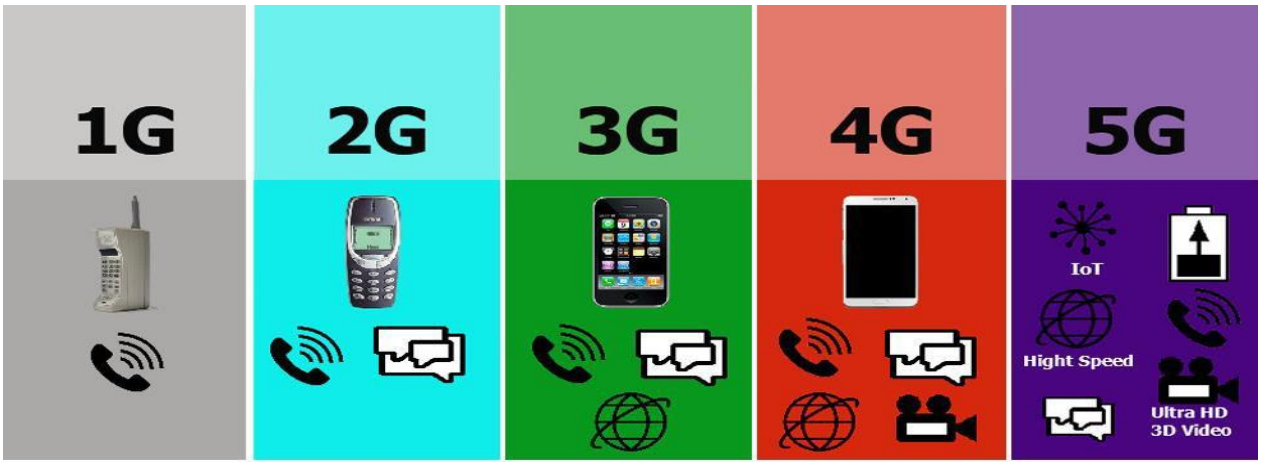


Fig 2.1 Network Type

2.2 Global System for Mobile (GSM) Communications

GSM (Global System for Mobile Communications) must successful and most used method of cellular network in the world. Today almost every old and latest cellular network is based on the GSM network method European Communications Standards Institute (ETSI) developed this method or technology after 1G. GSM is a generally 2G cellular network with digital system. Also have circuit and packet switching system offer 4kpbs data and massaging service and good quality voice call. GSM come to online in 1991. It's had same standard frequency band GSM900MHz, GSM1800MHz, and GSM1900MHz, GSM2100. [2]

2.3 Code Division Multiple Access (CDMA) technology

Code Division Multiple Access (CDMA) is another cellular network technology beside GSM. Used code division multiplexing and frequency factor is k=1. Use in the low population century. In this system use can access at the same no time gap on it. It's can provide more data service then GSM. It is another and develop remote correspondence innovation created from spread range innovation. CDMA is utilized as the entrance strategy in numerous cell phone norms. IS-95, and called "cdmaOne". Its 3G development as a CDMA2000, CDMA2000 have a same configuration as "CDMA", and UMTS, the 3G standard come from GSM bearers, additionally had other versions of "wideband CDMA", or W-CDMA, and TD-CDMA and TD-SCDMA, as its radio advances. [3]

2.4 Universal Mobile Telecommunication Systems (UMTS) technology

UMTS is mark as the third-age radio innovations created inside on 3GPP. The radio access use Frequency Division Duplex and Time Division Duplex variations, and a few chip rates are accommodated in the TDD choice, permitting UTRA innovation to work in an extensive variety of groups and coincide with other radio access advancements. UMTS incorporates the first W-CDMA plot utilizing matched or unpaired 5 MHz wide diverts in comprehensively concurred transfer speed around 2 GHz, however hence, further transmission capacity has been apportioned by the ITU on a local premise. [4]

2.5 Long Term Evolution (LTE) technology

LTE is a mark as another version of 4th generation or 4G cellular system. It's had ability to give 100 Mbps speed to user device where 3G only can offer 3.84 Mbps. LTE use Frequency Division Duplex LTE frame structure and Time Division Duplex LTE frame structure. 50Mbps speed or uplink and downlink capacity in TDD-LTE's. 40Mbps speed or uplink and downlink capacity in FDD-LTE's. It is two little standard use for LTE. [5] Function are:

- LTE is faster download and upload then previous generation.
- High speed internet connection then previous generation like 3G.
- Batter signal and voice.
- Video call and video streaming in full HD.
- Low latency.

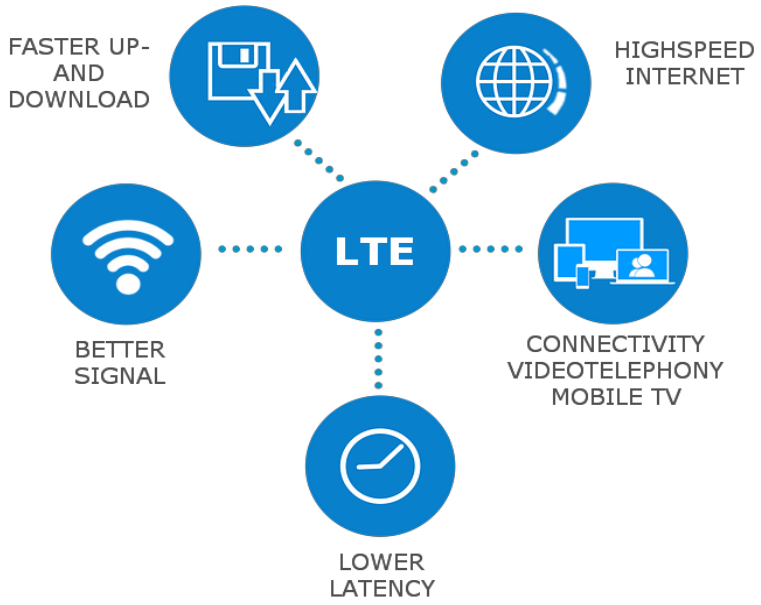


Fig 2.2 LTE Technology

Chapter 3

GSM Network

3.1 GSM system overview

It is a leading call addition apply for transmission mobile a communication and data service. In GSM emerges from a cell established radio frame at BELL Laboratories at mid-1970s. The name of GSM an initialization bunch built up. The most broadcast technology standard is GSM technology for communication. GSM circuit framework is a circuit based and its isolates each 200 kHz channel within 825 kHz schedule vacancies. The GSM communication correspondence groups 900 MHz and 1800 MHz parts of the world. GSM makes of narrowband usages TDMA (Time Division Multiple Access) and this strategy for transmitting signal. It has size 64kbps to 120 Mbps for transmitting rate. At that point GSM digitize and packs information sends through down a channel different client information own time slot. [6] The GSM framework is a recurrence and time-division cell framework, physical channel is described by a bearer recurrence and a schedule opening number. Cell frameworks are intended to work with gatherings of low-control radios spread out over the geological administration zone. The zone served by each gathering of radios is known as a Phone. Uplink and downlink motions for one client are doled out various frequencies; this sort of strategy is called Frequency Division Duplex (FDD). Information for various clients is passed on in time interims called spaces, a few openings make up an edge. This sort of method is called Time Division Different Access (TDMA). [7]

3.2 GSM – Architecture

The GSM specialized particulars characterize the distinctive components inside the GSM arranges design. It characterizes the distinctive components and the manners by which they associate to empower the general framework task to be kept up. The GSM organize design is currently entrenched and with the other later cell frameworks presently settled and other new ones being sent, the essential GSM arrange engineering has been refreshed to interface to the system components required by these frameworks. Regardless of the improvements of the more current frameworks, the fundamental GSM framework design has been kept up and the system

components depicted beneath play out indistinguishable capacities from they did when the first GSM framework was propelled in the mid-1990s. [8]

The GSM network or architecture base on the main four main parts:

- 1st on is User device or the mobile station with SIM (MS).
- 2nd on is known as the base station subsystem (BSS).
- 3rd on is known as the network switching subsystem or switching part (NSS).
- Final on is the operation support subsystem deal with operational part (OSS).

Given the final network architecture or GSM architecture

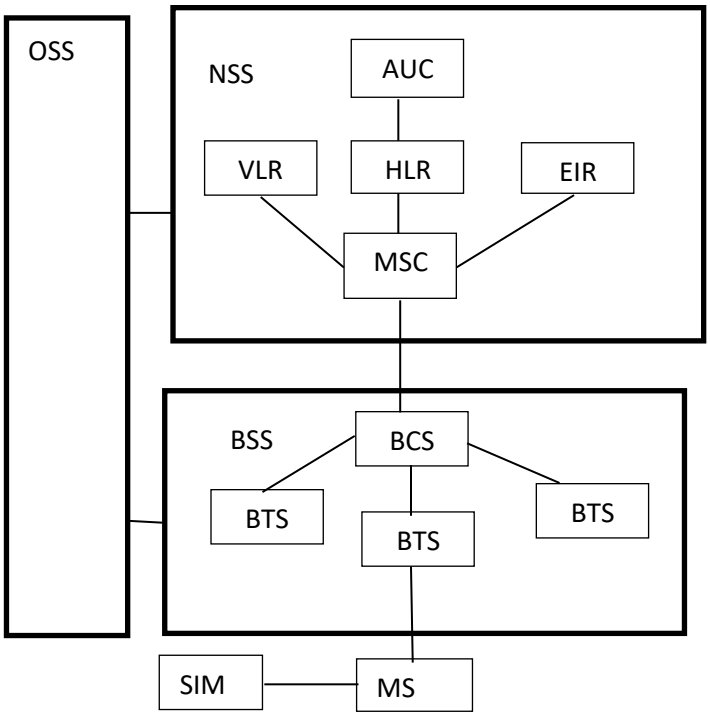


Fig3.1: GSM Network Architecture

3.3 Mobile station

Mobile stations (MS), user equipment or user gear also known as user communication device, can also say cell or cell phones are the segment of a GSM cell network that the client sees and works. Lately their size has fallen significantly while the dimension of usefulness has incredibly expanded. A further favorable position is that the time between charges has altogether expanded.

There are various components to the mobile phone, despite the fact that the two fundamental components are the primary equipment and the SIM. [9]

The equipment itself contains the principle components of the cell phone including the screen, case, battery, and the gadgets used to create the signal, and process the information recipient and to be transmitted. It likewise contains a number known as the International Mobile Equipment Identity (IMEI). This is introduced in the telephone at fabricate and "can't" be changed. It is gotten to by the system amid enlistment to check whether the gear has been accounted for as stolen. [10]

The SIM or Subscriber Identity Module contains the data that gives the personality of the client to the system. It contains are assortment of data including a number known as the International Mobile Subscriber Identity (IMSI). The versatile station speaks to the mobile network segments. They consist of the

Mobile Equipment ME and Subscriber Identity Module SIM: MS = ME + SIM

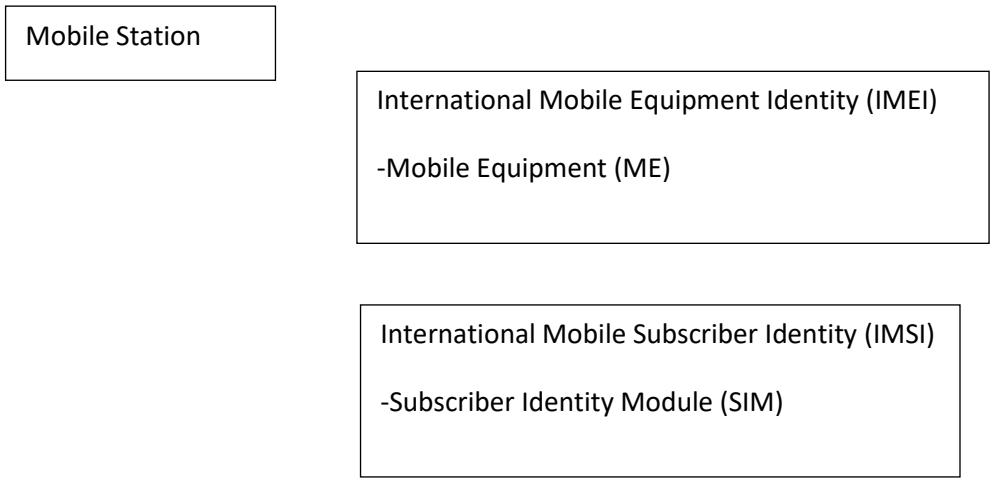


Fig 3.2: Mobile Station

3.4 Base Station Subsystem (BSS)

GSM architecture another important part is The Base Station Subsystem (BSS) area of the GSM organize design that is in a general sense related with speaking with the mobiles on the system. It has to main part or two components:

- 1st on is the physical part which is The Base Transceiver Station (BTS).
- 2nd on operations or controller part The Base Station Controller (BSC).
- This one is Transcoding & Rate Adaptation Unit (TRAU). [11]

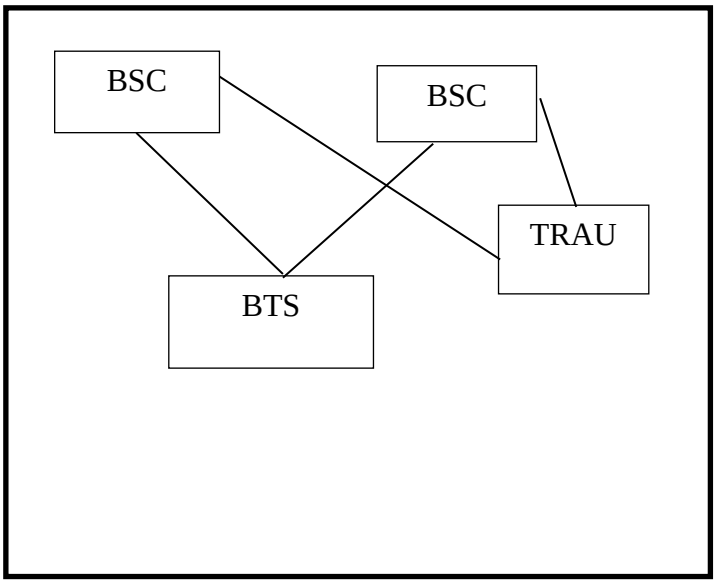


Fig 3.3: Base Station System

3.4.1 The Base Transceiver Station (BTS).

BTS or base transceiver station do transmission and receiving part on GSM system. Transmit on the MSC and receiving form the MS. The BTS utilized in a GSM network contains the radio transmitter beneficiaries, and their related receiving wires that transmit and get to straightforwardly speak with the mobiles. The BTS is the characterizing component for every cell. The BTS speaks with the mobiles and the interface between the two is known as the Um interface with its related conventions. A base handset station (BTS) is a bit of system hardware that encourages remote correspondence between a gadget and system. [12]

A BTS main part are:

- 1st on is the Antennas that main function is relay radio messages
- 2nd is known as Transceivers
- 3rd on is Duplexer
- Final on is the Amplifiers

A BTS is also known as a base station (BS), radio base station (RBS) or node B (eNB).

BTS or base transceiver station also provide following functions:

- Capable do Encoding, do encrypting, do multiplexing, do modulating, and can do transmit the RF signals to the antenna section.
- Capable of do Transcoding.
- Do rate adaptation.
- Provide the Time synchronizing and frequency synchronizing.
- Provide the Voice through full-rate or half-rate type work.
- Also, do Decoding, do decrypting, and can do the equalizing received signals.
- Provide the Random-access detection.
- Provide the Timing advances.
- Provide the Uplink channel measurements. [13]

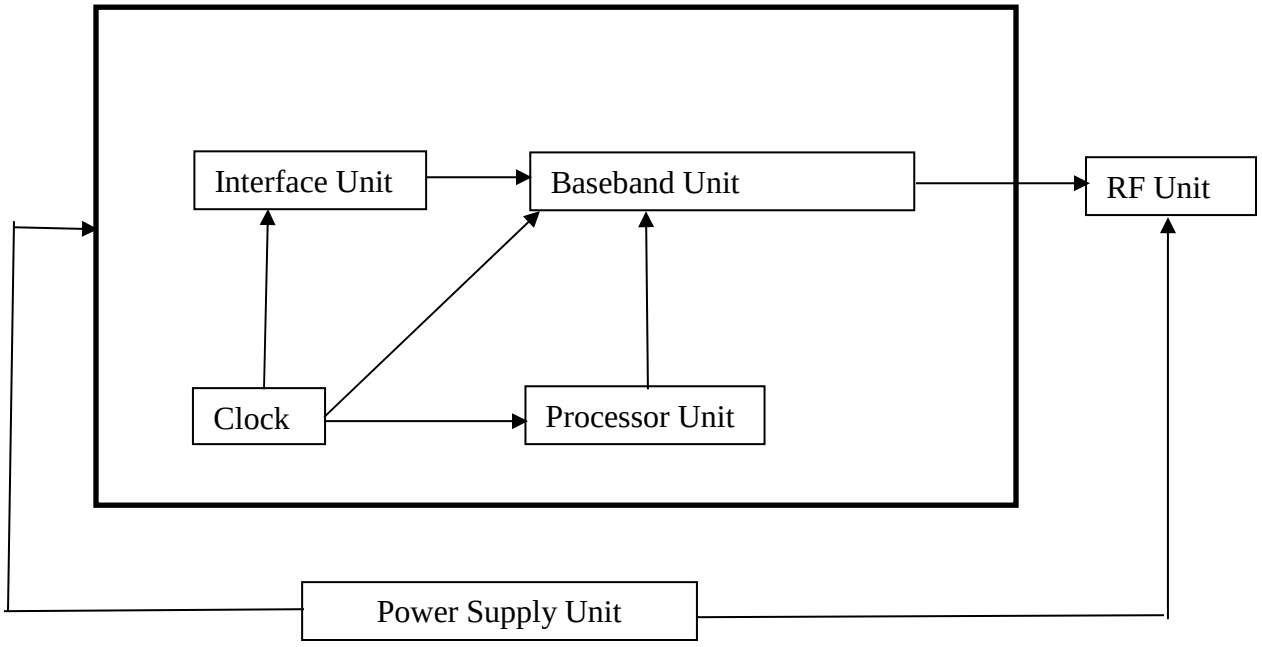


Fig3.4: BTS Configuration

3.4.2 The Base Station Controller (BSC)

The BSC deals with the radio assets for at least one BTS. It handles radio channel setup, recurrence jumping, and handovers. The BSC is the association between the portable and the MSC. The BSC additionally deciphers the 13 Kbps voice station utilized over the radio connect to the standard 64 Kbps station utilized by the Public Switched Telephone Network (PSDN) or ISDN. [14]

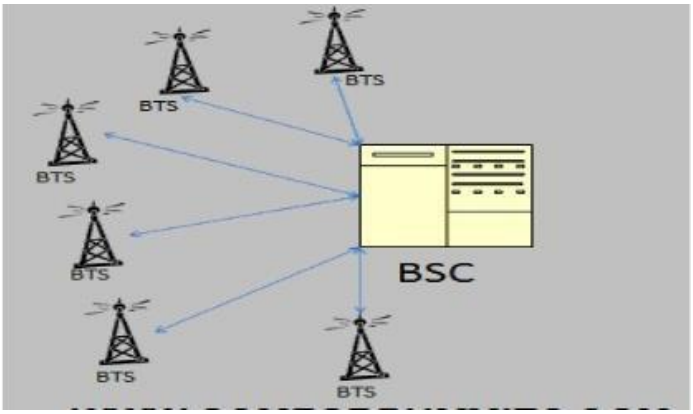


Fig 3.5 BSC

It allots and discharges frequencies and schedule vacancies for the MS. The BSC likewise handles intercell handover. It controls the power transmission of the BSS and MS in its zone. The capacity of the BSC is to dispense the essential vacancies between the BTS and the MSC. It is an exchanging gadget that handles the radio assets. BSC also have Additional functions like:

- 1st on is frequency hopping control.
- 2nd on is reduce the line number from the MSC for Performing traffic concentration.
- 3rd on is Providing the on of the interface for Maintenance and Operations Center for the BSS.
- 4th on is the reallocation BTSs frequencies.
- 5th on is the frequency synchronization and time synchronization.
- 6th on is deal with Power control or the power management system.
- Last on is the measurements the received signals time-delay from the MS. [15]

3.4.3 Transcoding & Rate Adaptation Unit

The Transcoder/Rate Adaptation Unit (TRAU) is the information rate transformation unit. The PSTN/ISDN switch is a switch for 64kbps voice. Current innovation grants to diminish the bit-rate (in GSM radio interface it is 13 kbps for full rate and 6.5 kbps for half rate). Since MSC is fundamentally a PSTN/ISDN switch its bit-rate is still 64 kbps.

3.5 The Network and Switching Subsystem (NSS)

The Network exchanging framework (NSS), the primary part of which is the Mobile Switching Center (MSC), plays out the exchanging of calls between the mobile and mobile network clients, and in addition the administration of versatile administrations, for example, verification. [16]

The switching system based on the following functional elements or the part:

- 1st on is known as home location register (HLR)
- 2nd on is known as Mobile Services Switching Center (MSC)
- 3rd on is known as Visitor Location Register (VLR)
- 4th on is known as Authentication Center (AUC)
- 5th on final is known as Equipment Identity Register (EIR)

3.5.1 Home Location Register (HLR)

The HLR (Home Location Register) is a database utilized for capacity and the executives of memberships. The HLR is viewed as the most vital database, as it stores perpetual information about endorsers, including a supporter's administration profile, area data, and movement status. At the point when an individual purchase a membership as SIM, at that point all the data about this membership is enrolled in the HLR of that administrator. [17]

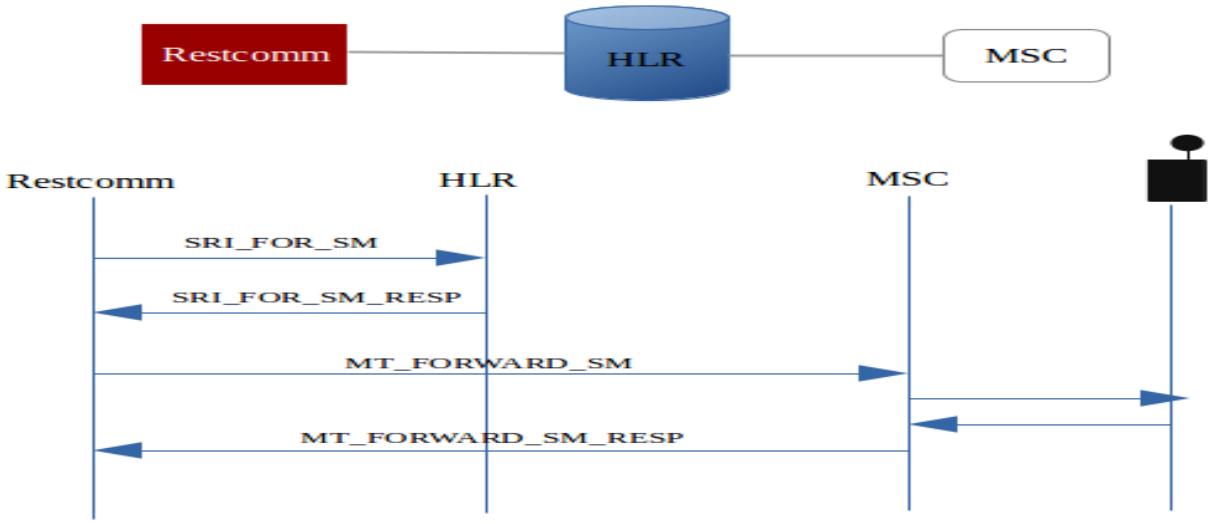


Fig 3.6 HLR

3.5.2 Mobile Services Switching Center (MSC)

The focal segment of the Network Subsystem is the MSC. The MSC plays out the exchanging of calls between the mobile and mobile network clients, and the administration of portable administrations, for example, enlistment, validation, area refreshing, handovers, and call directing to a wandering supporter. It likewise performs such capacities as toll ticketing, arrange interfacing, normal channel flagging, and others. Each MSC is recognized by a one of a kind ID. [18]

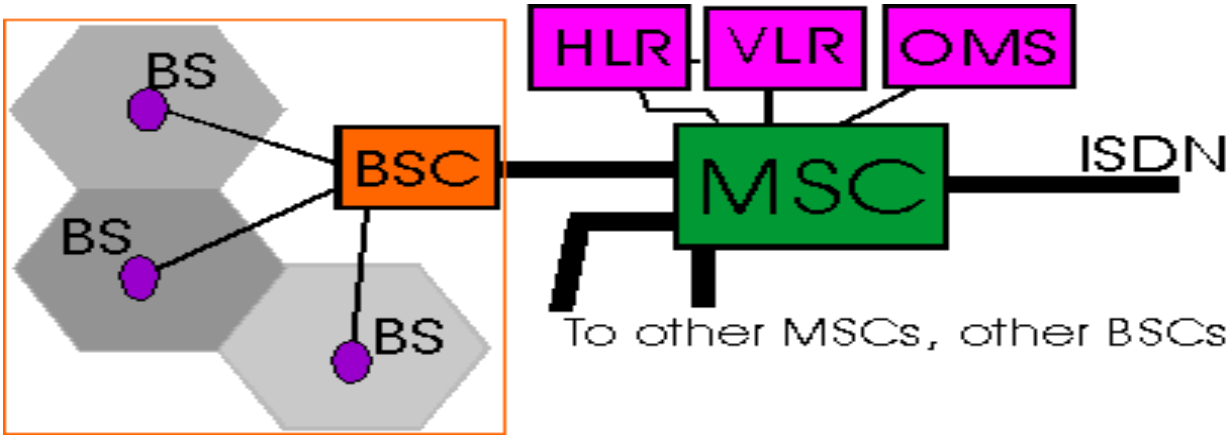


Fig 3.7 MSC

3.5.3 Visitor Location Register (VLR)

The VLR is a database that contains transitory data about endorsers that is required by the MSC so as to benefit visiting supporters. The VLR is constantly incorporated with the MSC. At the point when a portable station wanders into another MSC territory, the VLR associated with that MSC will ask for information about the versatile station from the HLR. Afterward, if the versatile station makes a call, the VLR will have the data required for call setup without cross examining the HLR each time. [19]

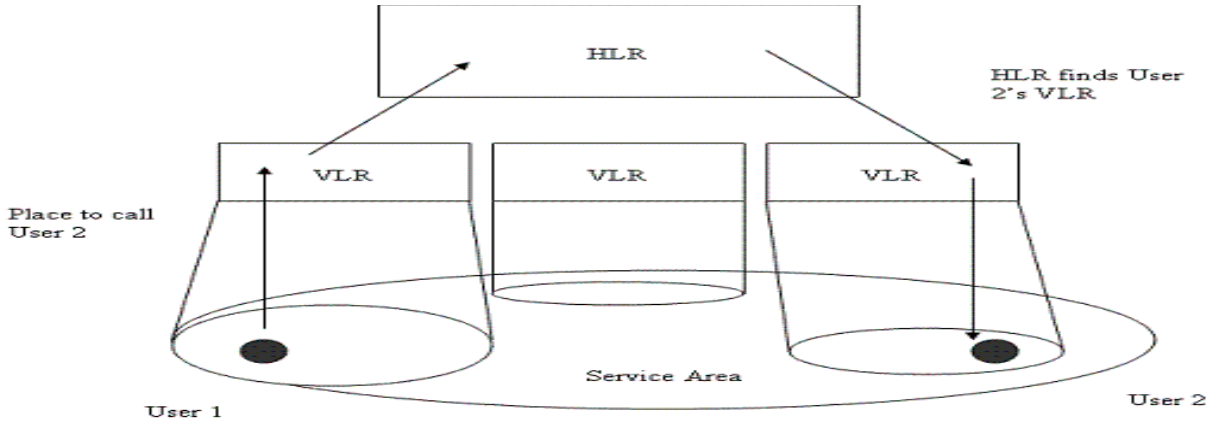


Figure 2: HLR/VLR architecture, Example of Call Process

Fig 3.8 VLR

3.5.4 Authentication Center (AUC)

The Authentication Center is a secured database that stores a duplicate of the mystery enter put away in every endorser's SIM card, which is utilized for validation and figuring of the radio channel. The AUC shields arrange administrators from various sorts of misrepresentation found in the present cell world. [20]

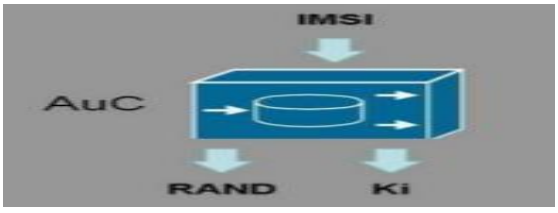


Fig 3.9 AuC

3.5.5 Equipment Identity Register (EIR)

The Equipment Identity Register (EIR) is a database that contains a rundown of all substantial portable gear on the system, where its International Mobile Equipment Identity (IMEI) distinguishes every MS. An IMEI is set apart as invalid on the off chance that it has been accounted for stolen or isn't type endorsed. The EIR contains a brought together database for approving the International Mobile Equipment Identity (IMEI). This database is concerned exclusively with MS hardware and not with the supporter. [21] The EIR database comprises of arrangements of IMEIs composed as pursues: 1. WHITE LIST contains those IMEIs that have been doled out to legitimate

portable Equipment. 2. Boycott Contains IMEIs of mobiles which have been accounted for stolen or which are have prohibited administration for some other reason. 3. Dim LIST Contains IMEIs of mobiles that have issues (e.g. defective programming). These are not adequately noteworthy to go into a "black list".

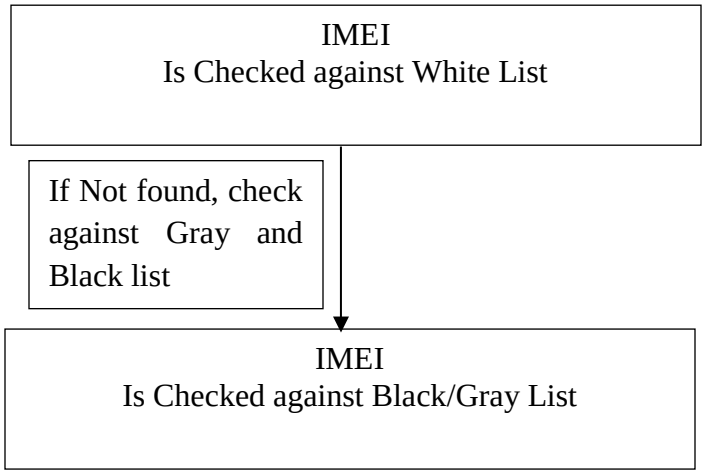


Fig 3.10 EIR Process

Chapter 4

Long Term Evolution (LTE) Technology

4.1 Long Term Evolution (LTE)

LTE (both radio and center system advancement) is currently available on the market with great deal in voice and data services. In December 8, 2008 its was Discharge and that have been the main reason for the main influx of LTE hardware. LTE details are truly steady, with the additional facture and improvements in 4G that make perfectly LTE system fully releases in the market.

Why LTE:

- Need to make sure the continuity of competitiveness of the 3G system for the future.
- User demand use for high quality voice service and high-quality data rates.
- Packet Switch system is over circuit switch system.
- Continued demand use for low cost proses (CAPEX and OPEX).
- Low complexity in the LTE system.
- For paired and unpaired band operation ignore unnecessary fragmentation of technologies.
- It's a mobile broadband.
- High security.
- Develops many app bases on LTE.

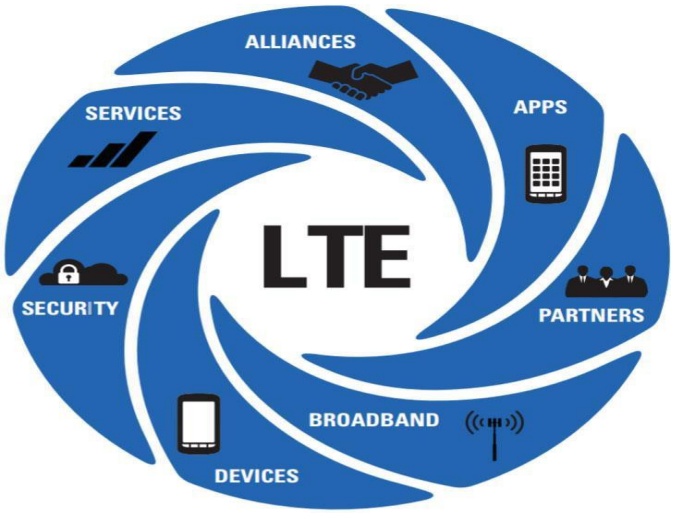


Fig 4.1 LTE

In LTE-Advanced mark on the higher limit: The main impetus to additionally create LTE towards LTE– Advanced - LTE Release10 was to give higher bitrates in a cost-productive manner and, in the meantime, totally satisfy the prerequisites set by ITU for IMT Advanced, likewise alluded to as 4G.

- Increased package data rate which is uplink must be 1.5Gbps approximately and downlink must be 3Gbps approximately.
- LTE offer Higher spectral efficiency which is minimum of 16bps par Hz in R8 to maximum 30 bps par Hz in R10
- Increased number of simultaneously active user equipment or client.
- Cell edges have been performance Improved e.g. for downlink use 2x2 MIMO at least 2.40 bps par Hz par cell.

The principle new implementation introduces in LTE Advanced was Carrier Aggregation and modify or improve utilization of the multi reception apparatus technology and capable support for Relay Nodes (RN). [22]

4.2 LTE Architecture Overview

LTE architecture basically base on the 4G with additional service. Generally, follow GSM architecture to build the LTE system. For client gear arrange pocket information the EPS utilizes bearers to course IP traffic from a passage. It's depends vigorously on bearers. LTE use packet switching system over circuit switching system that provide fast switching in hole system. IP parcel stream with a normal administration (QoS) and interconnection with user gear. Multiple bearers can be established for a user in order to provide different QoS streams or connectivity to different PDNs. For example, a user might be engaged in a VoIP call while at the same time performing web browsing or FTP download." Paly different roles EPS network utilized its elements to protect the network. [23]

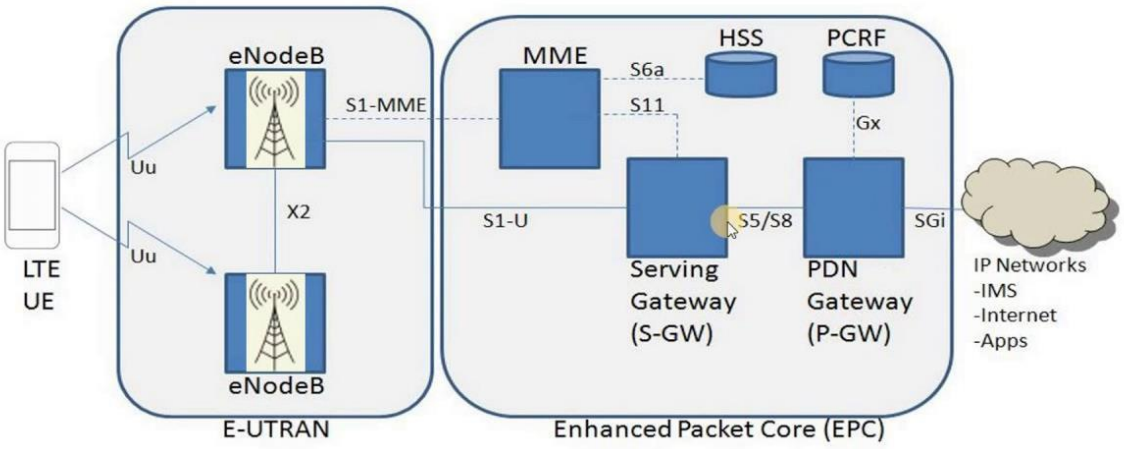


Fig 4.2 LTE Architecture

Advance LTE is consisting of following three main components:

- At 1st component is the User Equipment or user gear or client (UE).
- 2nd on is The Evolved Packet Core (EPC).
- And another is or final on is The Evolved UMTS Terrestrial Radio Access Network (E-UTRAN).

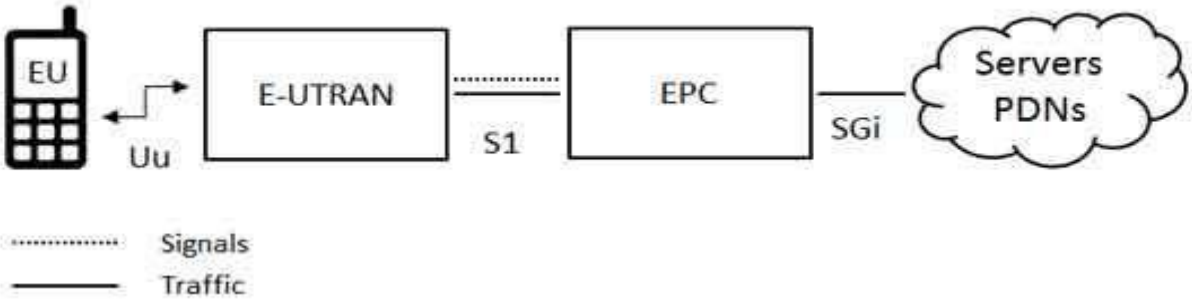


Fig 4.3 LTE Components

The advanced bundle center speaks with parcel information arranges in the outside world, for example, the web, private corporate systems or the IP mixed media subsystem.

4.2.1 The User Equipment (UE)

To use LTE system user be have must LTE support mobile equipment or user gear. This type device of user equipment come with extreme function for LTE. The user gear or user equipment come with the following important function:

- 1st on is Mobile Termination (MT) which deal with all the communication functions or matter.
- 2nd on is a Terminal Equipment (TE) which main function is the data streams terminates.
- 3rd on is the Universal Integrated Circuit Card (UICC) which is also defined as the SIM card for LTE elements. Universal Subscriber Identity Module (USIM) is known as SIM. SIM consist of user or user gear identity. Help with that can found user information or user location and also find out which types of gear is user and that gear configuration. If the configuration high that device support LTE

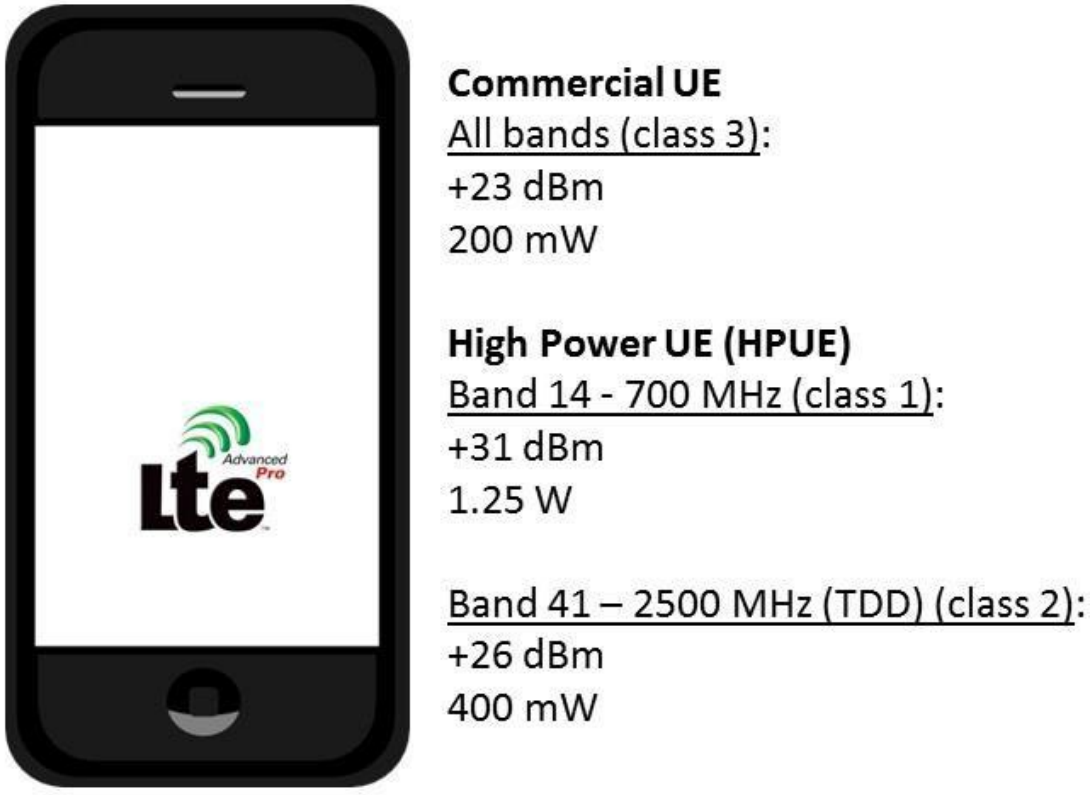


Fig 4.4 The User Equipment

4.2.2 The E-UTRAN (The access network)

Evolved Universal Terrestrial Radio Access Network is the radio innovation utilized between cell phone terminals and the base stations of 3GPPTM frameworks. This is conventionally known as 'Universal Terrestrial Radio Access' (UTRA) and the entrance arrange as 'Universal Terrestrial Radio Access Network' (UTRAN). E-UTRA is a radio access network (RAN) which is alluded to under the name EUTRAN standard intended to be a substitution of the UMTS and HSDPA/HSUPA advances indicated in 3GPP discharges 5 and past. Not at all like HSPA, LTE's E-UTRA is a totally new air interface framework, random to and inconsistent with W-CDMA. It gives higher information rates, bring down inactivity and is improved for parcel information. [24]

4.2.3 The Evolved Packet Core (EPC) (The core network)

Evolved Packet Core (EPC) is a framework for providing converged voice and data on a 4G Long-Term Evolution (LTE) network.

4.3 2G Versus LTE

Features	2G	4G
Data Bandwidth	14.4kbps-64kbps	200mbps to 1Gbps for low mobility
Standard	GSM, CDMA, GPRS	Single unified standard
Technology	Digital cellular network	LAN, WAN, WLAN
Service	Digital voice, short message,	Dynamic Information access, wearable device
Multiplexing	TDMA, CDMA	CDMA
Switching	Circuit for access network and air interface	All packet
Core Network	PSTN	Internet

Table 4.1: Difference Of 2G

Chapter 5

GP SWAP: 2G with 4G Modernization

5.1 BBU (Base Band Unit)

A baseband unit (BBU) is a unit that forms baseband in telecom frameworks. A run of the mill remote telecom station comprises of the baseband handling unit and the RF preparing unit (remote radio unit - RRU). The baseband unit is put in the hardware room and associated with RRU by means of optical fiber. The BBU is in charge of correspondence through the physical interface. A BBU has the accompanying qualities: particular structure, little size, low power utilization and can be effortlessly sent.

A BBU in a phone cell site is included an advanced flag processor to process forward voice signals for transmission to a portable unit and to process turn around voice signals got from the versatile unit. The computerized flag processor likewise serves to create a first supervisory sound tone (SAT) for transmission to the portable unit by producing progressive advanced SAT tests which are decoded into a consistent tone. At last, the computerized flag processor recognizes the nearness of a second SAT produced by the portable unit by testing and handling progressive examples of the second SAT and estimating the power.

- The BBU supports multimode applications.

When being configured with boards supporting GSM, UMTS, and LTE, a BBU can support these modes. In separate-MPT scenarios, one BBU supports two modes, and two BBUs support three or four modes. In co-MPT scenarios, one BBU supports three or four modes.

- RRUs and RFUs are radio frequency units and support multimode and multiband applications.

– To meet operators' requirements, the software defined radio (SDR) technology is introduced, which enables RF modules to support any two or three modes among GSM, UMTS, and LTE using different software configurations. A base station can be configured with single-mode RF modules of GSM, UMTS, and LTE and multimode RF modules to support any single mode as well as two or three modes including GSM, UMTS, and LTE. [25]

– RF modules working in different frequency bands can be used together to support multi-band applications.

– High-power RFUs are as follows: MRFUd/MRFUe/WRFUd/WRFUe/LRFUe/ CRFUd/CRFUe. These RFUs are used together with the BTS3900 (Ver.C)/(Ver.D)/ (Ver.E) cabinets.

– High-power RRUs are as follows: RRU3829/RRU3929/RRU3942/RRU3841/ RRU3961/ RRU3832/RRU3839/RRU3939/RRU3952/RRU3959/RRU3262/RRU3953/RRU3962/RRU3962 d/RRU3965/RRU3965d. These RRUs are used together with the DCDU-11B or DCDU-12B. Ultra-high-power RRUs are used together with the DCDU-12B. Except the preceding RRUs, other RRUs are low power ones. In addition, the 2100 MHz AAU3910, AWS AAU3910, AAU3920, AAU3940, and AAU3911 are also high-power modules.

– Blade RRUs are as follows: RRU3962/RRU3965/RRU3936/RRU3938/RRU3939/RRU3953/ RRU3952/RRU3959/RRU3958/RRU3971/RRU3668/RRU3824/RRU3826/RRU3838/RRU3832 /RRU3839 and RRU3268/RRU3260/RRU3262/RRU3249/RRU3269/RRU3281.

5.2 Typical BBU Configurations

The BTS is the Base Transceiver Station within a GSM Network & supports the GSM Cells, normally between 3 & 6 Cells. The BTS & the BSC are forming the Base Station Subsystem (BSS) / GERAN which is connected to the Network Subsystem (Core Network).

BBU Slot Assignments

Slot 16	Slot 0	Slot 4	Slot 18
	Slot 1	Slot 5	
	Slot 2	Slot 6	Slot 19
	Slot 3	Slot 7	

Table 5.1: Baseband unit Slot

Fig5.1: BBU 3900

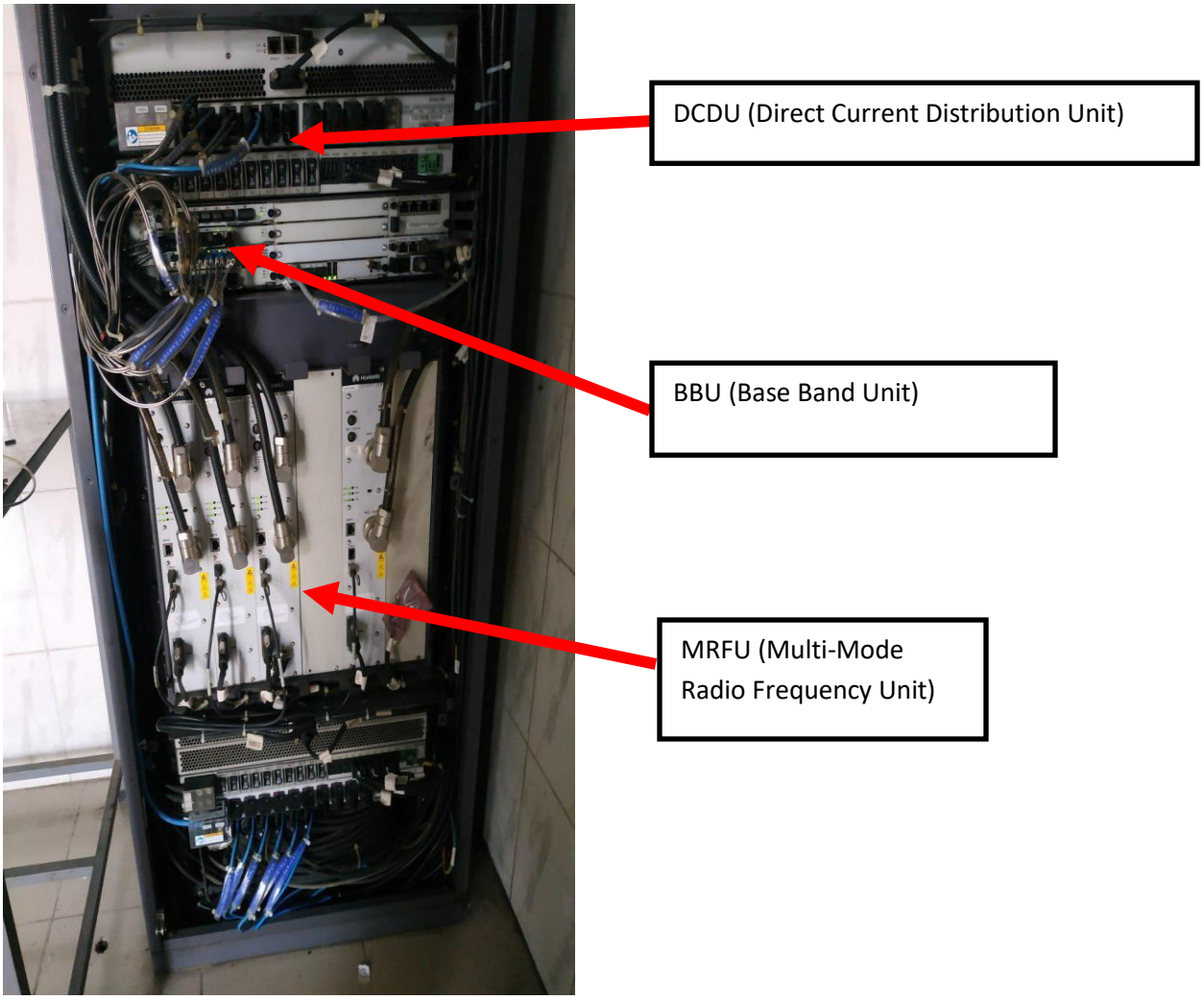


Fig 5.2 BBU Cabinet 3900

5.3 GTMU (GSM Transmission & Management Unit for BBU)

The GSM transmission, timing, and management unit for BBU (GTMU) controls and manages the entire BTS. It provides interfaces related to the reference clock, power supply, OM, and external alarm collection. Maintenance and Transmission Unit for GSM – always in Slot 5&6.

The GTMU performs the following functions:

- Controls and manages the BTS.
- Monitors fans and power modules.
- Provides transmission over 4xE1 ports.
- 2xFE ports – FE0 (electrical) & FE1(optical).
- Provides 6 CPRI ports for communication between GTMU and GSM RRUs/RFUs.
- Support fault management system, configuration management system.
- Performance management system and security management service.
- Provides Ethernet Port "ETH" for local Commissioning.

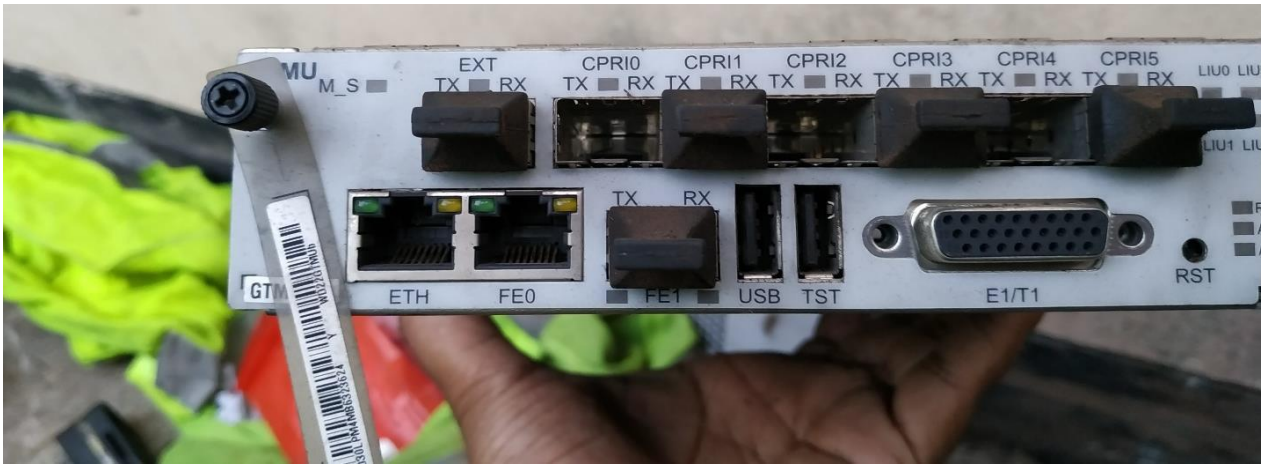


Fig 5.3 GTMU

5.4 UMPT (Universal Main Processing and Transmission)

The universal main processing and transmission unit (UMPT) can serve as a main control board working in any mode. Maintenance and Transmission Unit for GSM – always in Slot 7. The UMPT performs the following functions:

- Manages configurations and devices.
- Monitors performance.
- Processes signaling.
- Provides the USB port.
- Transmission port.
- Interconnection port to achieve BBU maintenance on the local maintenance terminal (LMT).
- Signal transmission.
- BBU interconnection.

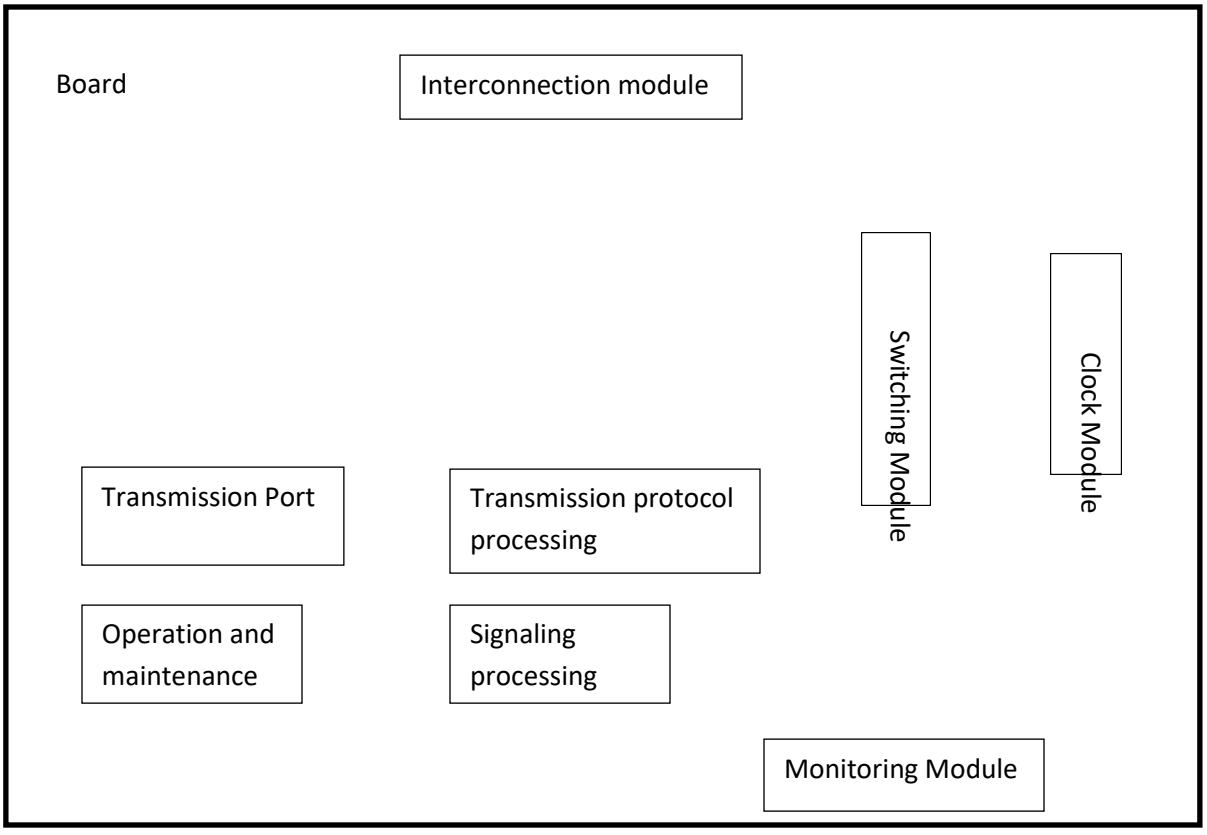


Fig 5.4 UMPT Architecture Board

The types of UMPT boards

From SRAN9.0 onwards, UMPT boards are classified into the following types:

- l UMPTa series boards: UMPTa1, UMPTa2, and UMPTa6
- l UMPTb series boards: UMPTb1 and UMPTb2

Board Type	Applicable Mode
UMPTa1 or UMPTa2	GSM, UMPT, LTE(FDD), and co-MPT multiple modes
UMPTa6	LTE(FDD), LTE(TDD)

Table 5.2 UMPT

The application scenarios of those UMPT boards

We use umptb1 card for multimode. Because multimode work GSM, UMTS, LTE FDD, and LTE TDD modes. [26]

The Working mode of a UMPT:

Indicators R0, R1, and R2 on the UMPT panel are used to determine the working mode of the UMPT board.

Fig 5.5 UMPT

R0 Green	R1 Green	R2 Green

- R0 Green = The Board is working GSM mode.
- R1 Green = The Board is working UMPT mode
- R2 Green = The Board is working LTE mode.

5.5 UBRI (Universal Baseband Radio Interface)

Fiber Port Extension Unit in case more than 6 RRUs need to be connected to 1 BBU. 1 UBRI Board can only support 1 Technology, if more than 6 RRUs are needed for GSM and more than 6 RRUs for UMTS, 2 UBRI Boards are needed. UBRI will be installed in slot 2.

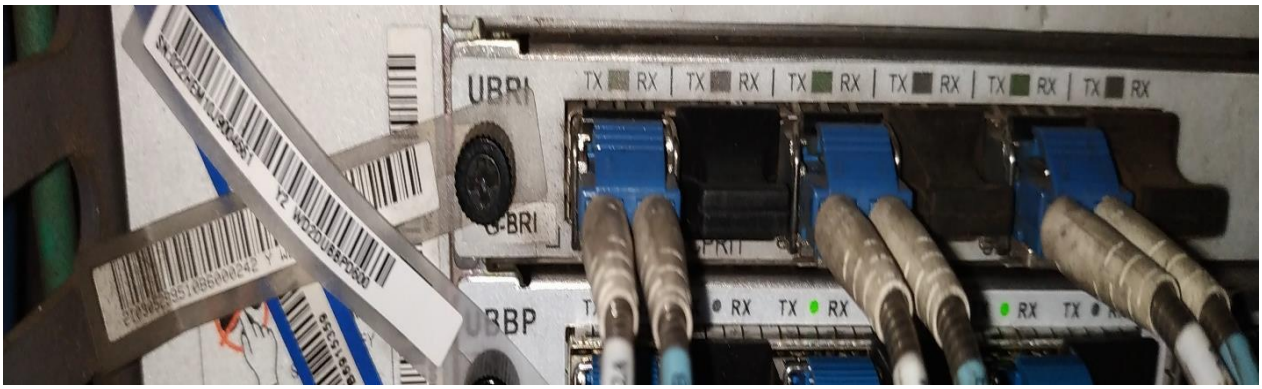


Fig5.6: UBRI Board

5.6 UBBP (Universal Baseband Processing Unit)

The universal baseband processing unit (UBBP) can serve as a baseband processing board working in any mode. the functions and working principle of a UBBP board.

The UBBP performs the following functions:

- Multiplexes baseband resources among different modes, thereby supporting multimode concurrency.
- Provides CPRI ports for communication with RF modules and processes uplink and downlink baseband signals.

Fig5.7: UBBP Board

Modes are supported by UBBP boards:

We use UBBPd6 model UBBP boards. The UBBPd6 application mode are**:**

- l GSM single mode
- l UMTS single mode
- l LTE FDD single mode
- l LTE TDD single mode
- l GU baseband concurrency
- l GL baseband concurrency
- l UL baseband concurrency
- l GUL baseband concurrency

If the base station now works in GSM mode and needs to work in GUL mode in the future, only the UBBPd6 board can be used. UBBP boards in different slots provide different capabilities. l In UMTS mode, only the UBBP board in slot 2 or 3 can provide CPRI ports. [27]

5.7 WBBP (WCDMA baseband processing)

A WBBP is a WCDMA baseband processing unit and can be installed in a BBU3900. The WBBP is classified of WBBPf3 and baseband processing board in slot 2 or 3 in a BBU3900 can transfer received CPRI data to other boards.

Board	Number of Cells	Number of UL CEs	Number of DL CEs	Number of HSDPA Codes	Number of HSDPA UEs	Number of HSUPA UEs
WBBPf3	**6**	**384**	**512**	**6x15**	**256**	**256**

Table 5.3 WBBP

Fig5.8: WBBP Board

Function

- Processing uplink and downlink baseband signals.
- Providing CPRI ports for communication with RF modules.
- Supporting interference cancellation (IC) within the board.
- When CPRI cables connect RF modules carrying corresponding cells to a WBBPd, the WBBPd installed in slot 2 or 3 supports interference cancellation (IC) of uplink data.
- A WBBPf installed in slot 2 or 3 supports baseband interconnection between BBUs

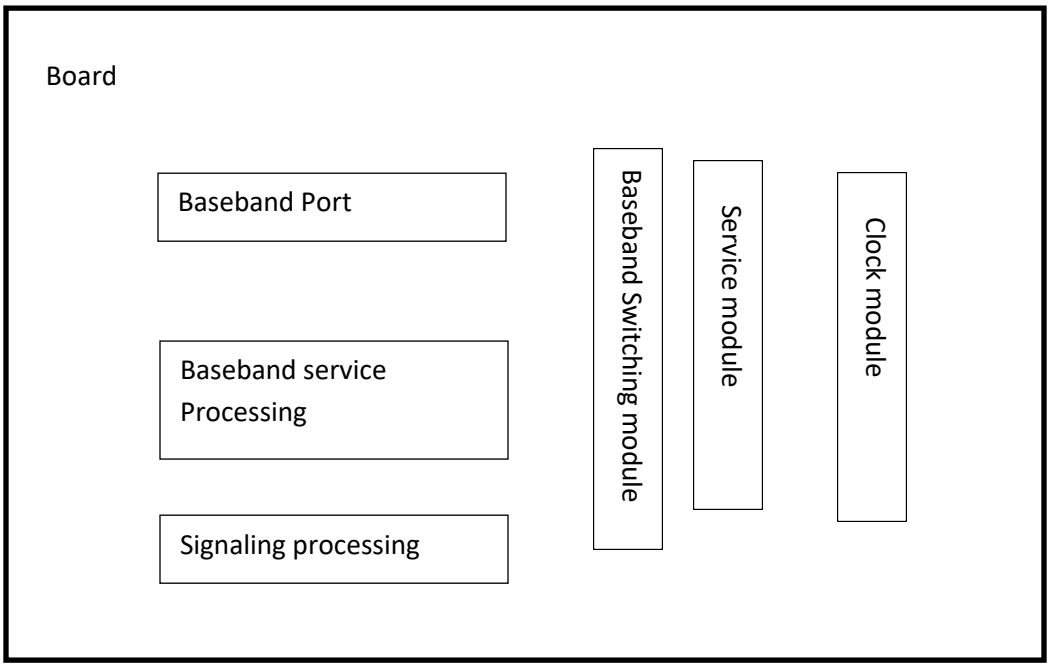


Fig5.9: WBBP Architecture Board

5.8 MRFU (Multi-Mode Radio Frequency Unit)

One Multi-Mode Radio Frequency Unit (MRFU) supports a maximum of six carriers.

The MRFU has the following functions:

- Modulates and converts the signals to the TX band by up-converting the IF signals, filters and amplifies the signals, and then transmits the signals to the antenna through the duplexer.
- Receives RF signals from the antenna and performs down-conversion, amplification, analog-to-digital conversion, digital down-conversion, matched filtering, and Digital Automatic Gain Control (DAGC), and then transmits the signals to the BBU for further processing.
- Performs power control.
- Provides Voltage Standing Wave Ratio (VSWR) detection.
- Supplies power to the TMA and controls the RET antenna.
- Controls DPD feedback signals.
- Generates the CPRI clock, recovers the CPRI clock from loss of synchronization and detects alarms.

Principle

The MRFU consists of the high-speed interface unit, signal processing unit, power amplifier, and duplex unit. [28]

The high-speed interface unit has the following functions:

- Transmits the signals received from the BBU to the signal processing unit
- Transmits the signals received from the signal processing unit to the BBU

The signal processing unit consists of two uplink RX channels and one downlink TX channel.

- ➢ The uplink RX channels have the following functions:
    - Down-convert the RF signals to IF signals.
    - Amplify the IF signals and performing IQ demodulation.
    - Convert analog signals to digital signals.
    - Sample digital signals.
    - Perform matched filtering.

- Support the digital automatic gain control (DAGC).
- Encapsulate data.

➢ The downlink TX channel has the following functions:

- Decapsulates the clock signals, control signals and data signals from the BBU and sends them to associated units.
- Shapes and filters downlink signals.
- Performs digital-to-analog conversion and IF output of IQ analog signals.
- Performs orthogonal up-conversion of IF signals to the TX band.

The power amplifier amplifies the low-power RF signals from the signal processing unit.

➢ The duplexer has the following functions.
➢ Multiplexes the RX signals and TX signals.
➢ Combines the RX signals and TX signals so that they share the same antenna channel.
➢ Filters the RX/TX signals.

Fig5.10: MRFU 1800

5.9 RRU (Remote Radio Unit)

Radio Remote Unit (RRU) is the distributed and integrated frequency unit that connects to an operator’s network with the User Equipment's (UE's) like Cell Phone and mobile devices.

Fig5.11: RRU 3959a

The legitimate term "circulated and incorporated" is on the grounds that customarily the radio engineering for cell framework depends on a solitary independent framework (Base Stations) as a rule introduced indoor however now, the phone design is partitioned.

So now the BTS (Base Transceiver Station) is the coordination of different radio unit like BBU and RRU. In spite of introducing just in indoor, radio units are currently introduced in the pinnacle beneath the Antenna.

The RRU is associated with the base station by means of the fiber optic connection which is bi-directional connection. The optical interface connect is otherwise called CPRI (Common Public Radio Interface). CPRI is an interface convention created by blend of real telecom gear's assembling organization.

The RRU decreases the coaxial feed line misfortunes, increment framework productivity and give abnormal state of adaptability in cell site development. Without a doubt, this causes in moving up to new gear's and gadgets all the more effectively.

The RRU3959 is an outside remote radio unit which is controlled by a power bureau. It is the RF module of the disseminated base station and is introduced near the reception apparatus. The RRU3959 performs regulation, demodulation, information preparing, and blend and division of baseband signs and RF signals. The RRU3959/RRU3959w has a double transmitter and double collector structure, which further enhances the yield control and the transporter limit

RRU Functions:

1) Goes about as a handset transmit and get the client signs to the base station and the other way around.

2) Provides consecutive help and availability between client hardware resembles control, delayed.

3) Control and process the EM signals got from the Antenna by means of Jumper.

4) Provide interface between two physical links: Optical and EM(Electromagnetic).

5) Provide Controlling support of the Auxiliary equipment's like RCU (Remote Control Unit) for electrical tilt adjustment generally known as RET (Remote Electrical Tilt).

6) Generate and sends the different signals like VSWR, RET, ACT, etc.

Fig5.12: RRU on BTS

A remote base station (otherwise called a phone site or remote base handset station, BTS) is a bit of hardware that encourages remote correspondence between user equipment (UE) and a network. UEs are gadgets like cell phones (handsets), WLL telephones, PCs with remote web availability, WiFi and WiMAX gadgets. The system can be that of any of the remote correspondence innovations like 4G LTE, GSM, CDMA, Wireless neighborhood circle, WAN, WiFi, WiMAX, and so forth. The BTS itself comprises of the pinnacle, transmitter, radio receiving wire and other gear that are utilized to speak with the cell phones. [29]

Chapter 6

BTS Tracker and Speed Test

6.1 BTS Tracker

A wireless network monitor and drive test tool and we use a app for monitoring and logging of mobile network parameters without using specialized equipment.

6.2 2G and 4G Net Monitor

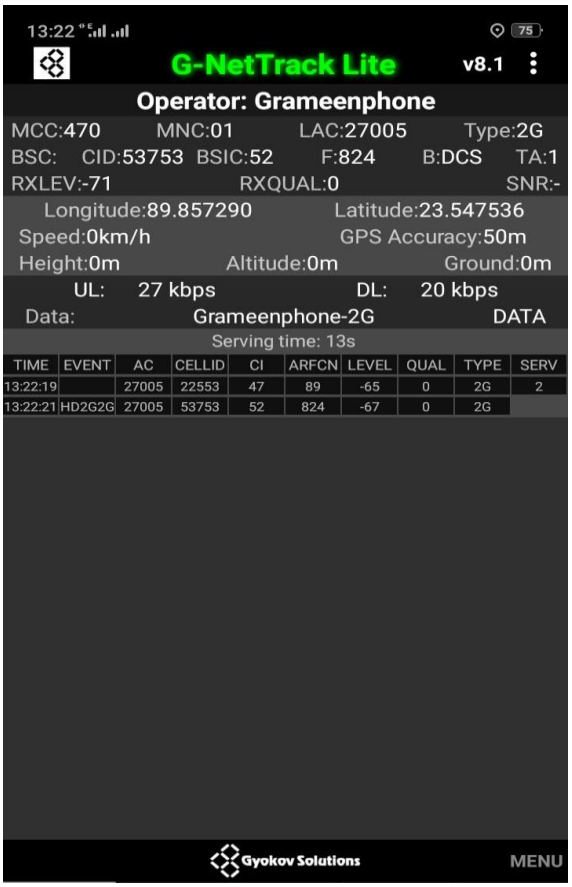


Fig6.1: 2G Net Monitor

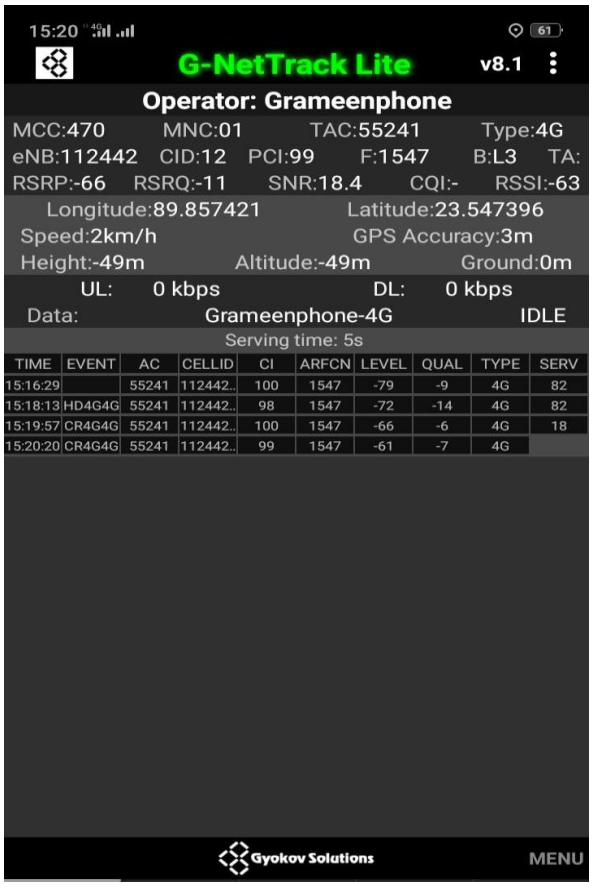


Fig6.2: 4G Net Monitor

MCC	MNC	Network	Operator or brand name
470	1	GrameenPhone Ltd	GramenPhone
470	2	Axiata Bangladesh Ltd.	Robi
470	3	Orascom Telecom Holding	Banglalink

The shown information is:

- MCC - Mobile Country Code - it is a 3-digit code specific for each country. Bangladesh specific code is 470.
- MNC - Mobile Network Code - it is 2- or 3-digits code and is specific for each operator in the country.
- LAC - location area code - the network is split by location areas, in which the subscriber is paged in all cells simultaneously. LAC is the code of the current area.
- RNC - Radio Network Controller - when on 3G it shows the ID of the RNC that controls the current serving cell.
- CELLID - the ID of the current serving cell.
- Type - the network technology mode (like GPRS, EDGE on 2G or UMTS, HSPA etc... on 3G).
- LEVEL - the current signal strength in dBm. For different technologies the caption is different - RXLEV for 2G, RSCP for 3G and RSRP for 4G.
- QUAL - the signal quality of the network. For different technologies the caption is different - RXQUAL for 2G, ECNO for 3G and RSRQ for 4G. This value is not reported by most phones.
- SNR - signal to noise ratio. It is measured on LTE only.
- CQI - channel quality indicator. It is measured on 4G only.

6.3 Speed Test

When all work is done then we test data speed and confirmed 4G and 2G network data speed test. But 2G network cannot data speed test by app. So, I figure out difference of 3g speed and 4G speed.

The speed finds out upload and downlink meter.

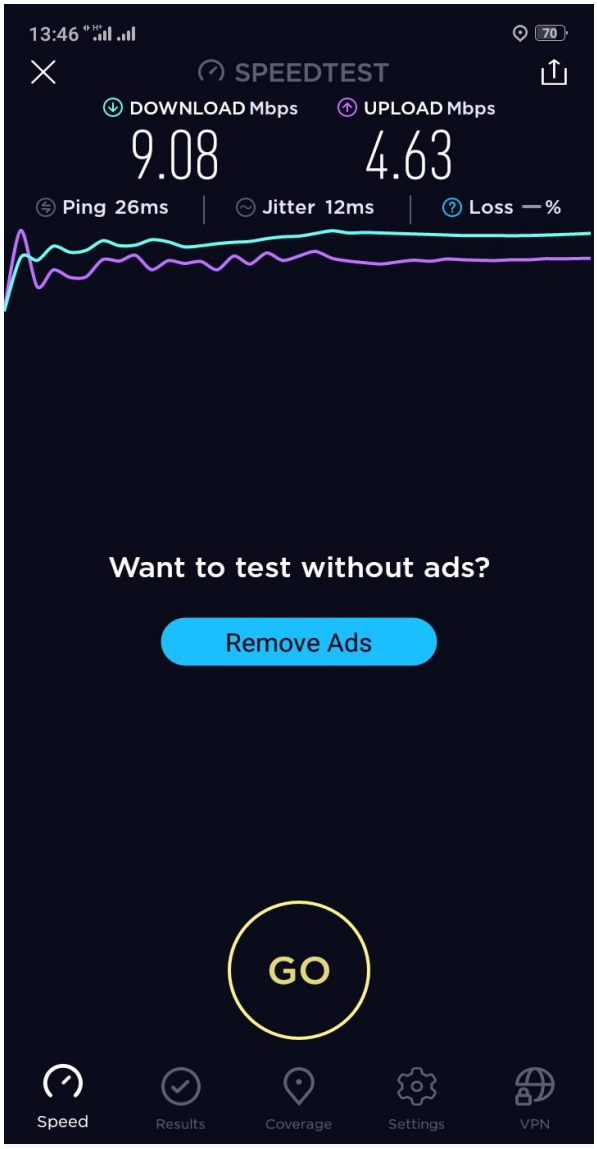


Fig6.3: 3G Speed

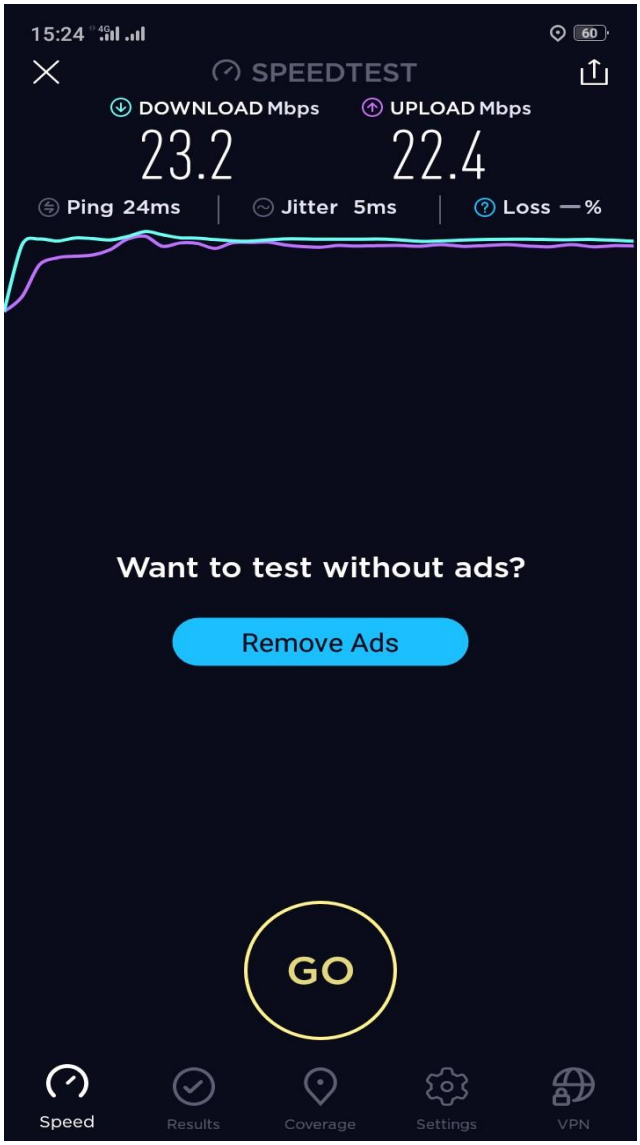


Fig6.4: 4G Speed

Chapter 7

Conclusion

It was a great occasion to work under Starlink Engineering Ltd. The fundamental purpose of the program was to see the genuine state. The disputable information isn't well bounty to contend with genuine area. This temporary position bundle was useful to confront the genuine pursued climate. In Starlink Engineering Ltd. I have paid a decent time in intelligence and was fulfilled for my best sweats, figured out how to manage distinctive states, had understanding of common working area which influences a representative demonstration and mentality towards work, had great time in information and execution. I have likewise gathered understanding about the strife of the inconvenience times while standard was experiencing one of its preeminent change stages. Balance, on time basic leadership, unfaltering quality, diligent work, group join, searching triumph out of dim, beginning, innovativeness, authoritative industriousness is the key grant's out of my work and I might want to state that it resolves be one of my best expertise that would remain per mean help me in forthcoming which will offer numerous assignments. I might want to top this, that my ability with Starlink Engineering Ltd. was extremely striking and brimming with societies, where I found a considerable measure of supportive changes in my pomposity, learning and execution. In this company I have experience many new things. Its my pleasure to work with this company. I am basically work on BTS tower and how to upgrade 2G to 4G transmission tower. Which techniques use in the BTS tower to upgrade 4G. Which transmission card have to use in 4G. Also known about IBS techniques like active IBS and passive IBS. BTS Commissioning. I have followed EHS rule in the site. I was working 25 days here and visited many BTS. My internship in this company is over in 15 December.

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[5] http://www.tutorialspoint.com[Accessed Time: 9:35 AM 10-Oct-18]
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[7] http://www.exfo.com[Accessed Time: 9:51 AM 10-Oct-18]
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