Empirical Study on Cell Addition and Splitting of 3G Cellular System

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

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Certificate of Training

Industrial attachment on Telecommunication Hardware installation & commissioning (3 Months)

This is to certify that

MD.MORTUZA IMRAN Son of NUR MOHAMMAD

Under Internship ID: SLI_0013

Successfully completed the above course.

Signed: .....

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APPROVAL

This Internship Report Titled **"Empirical Study on Cell Addition and Splitting of 3G Cellular System"** is submitted by Mortuza Imran to the Department of Information and 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 ETE, Daffodil International University & Starlink Engineering Limited. I also declare that neither this report nor any part of it has been submitted away for award of any degree or diploma.

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At First, I am like to convey my gratitude to the Almighty for charitable me the right path while trying the duty.

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.

This internship report would not consume been possible without the provision and direction of **Engr. Md. Zahirul Islam, Assistant Professor,** Department of Information and Communication Engineering, Daffodil International University, Dhaka, under whose direction I chose this topic.

I would like to rapid my heartiest gratitude to **Md. Taslim Arefin, Associate Professor and Head,** Department of Information and Communication Engineering, for his kind help to surface our thesis and also to other faculty participants, the staffs of the ICE Department of Daffodil International University.

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

Md. Mortuza Imran

Abstract

As the spectral efficiency of a point-to-point link in cellular networks approaches its theoretical limits, with the forecasted explosion of data traffic, there is a need for an increase in the node density to further improve network capacity. However, in already dense deployment in today's network, cell splitting gains can be severely limited by high inter-cell interference. Moreover, high capital expenditure cost associated with high power macro nodes further limits viability of such an approach. In this report, 3G cell addition and cell splitting at BTS site is addressed through which the coverage of cell area is increased and same time channel will be increased.

Table of contents

List of Figures

CHAPTER 1

Introduction

1.1 Introduction

Media transmission is the transmission of signs, signals, messages, words, compositions, pictures and sounds or data of any nature by wire, radio, optical or electromagnetic frameworks. Media transmission happens when the trading of data between correspondence members incorporates the utilization of innovation. It is transmitted either electrically over physical media, for example, links, or by means of electromagnetic radiation [1]. Such transmission ways are regularly separated into correspondence channels which manage the cost of the upsides of multiplexing. Since the Latin expression correspondence is viewed as the social procedure of data trade, the term broadcast communications is frequently utilized in its plural frame since it includes a wide range of innovations like GSM and CDMA. 3G, short for third era, is the third era of remote versatile media communications innovation. It is the overhaul for 2G and 2.5G GPRS systems, for quicker web speed. ... 3G media transmission systems bolster benefits that give a data exchange rate of in any event 0.2 Mbit/s [3]. Now, in cell addition we use 3 Cell in the 3G Base Transceiver Station (BTS) which is A cell, B cell, C cell. In cell addition or expansion we add extra cell which is D cell. Cell Splitting is the way toward subdividing a blocked cell into littler cell. Each with its very own base station and a comparing decrease in reception apparatus stature. Prompts increment in limit.

1.2 About Starlink Engineering Ltd.

Starlink Engineering Limited its 3rd party company do work like subcon work or tower maintains. Generally do BTS tower installation, commissioning, maintenance as well as network optimization in the different Telecommunication sector and data Information Technology. 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.

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 Environment, health and safety

Condition, wellbeing and security is an order and claim to fame that reviews and actualizes down to earth parts of natural assurance and security at work. In straightforward terms it is the thing that associations must do to ensure that their exercises don't make hurt anybody

- All the employees must use Helmet while working in BTS/MW or Tower sites
- All the employees must use SHOES while working
- All the employees must use SFETY BELT while working on TOWER
- All the employees must use HAND GLOVES while working
- All the employees must be educated or informed enough so that they can understand and oblige by any safety requirements that are imposed by the CUSTOMER
- All the employees must not wear any metallic or conductive equipment's while working on power materials
- Concern persons must arrange meeting or training in each 3 months or beginning of a major project to train the employees about maintaining the safety and quality of installation and commissioning
- Consecutive breach of safety regulations will result in punishment or termination of any employee

1.5 Objective of the Report

The main objectives of this report are as follows:

1. Cellular system and GSM Technology.
2. Types of Cellular Network
3. 3G Cell Addition and Splitting.

1.6 Summary of the Report

The objective of this Internship is to improve an effective knowledge in 3G Cell Addition and Cell Splitting 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 System and GSM Technology.

The Third chapter is describing, About Types of Cellular Network.

The last one is Chapter ***Four*** that is 3G Cell Addition and Cell Splitting and ***Chapter five*** Conclusion.

CHAPTER 2

Cellular System and GSM Technology

2.1 Cellular System

A cellular system or portable system is a correspondence organize where the last connection is remote. The system is conveyed over land territories called cells, each served by no less than one settled area handset, however more regularly three cell destinations or base handset stations. These base stations furnish the cell with the system inclusion which can be utilized for transmission of voice, information, and different kinds of substance. A phone commonly utilizes an alternate arrangement of frequencies from neighboring cells, to stay away from obstruction and give ensured benefit quality inside every phone [4].

At the point when combined, these cells give radio inclusion over a wide geographic zone. This empowers countless handsets (e.g., cell phones, tablets and PCs outfitted with portable broadband modems, pagers, and so forth.) to speak with one another and with settled handsets and phones anyplace in the system, by means of base stations, regardless of whether a portion of the handsets are traveling through more than one cell amid transmission.

Cellular systems offer various alluring highlights:

- More limit than a solitary expansive transmitter, since a similar recurrence can be utilized for various connections as long as they are in various cells
- Mobile gadgets utilize less power than with a solitary transmitter or satellite since the cell towers are nearer
- Larger inclusion region than a solitary earthbound transmitter, since extra cell towers can be included inconclusively and are not constrained by the skyline

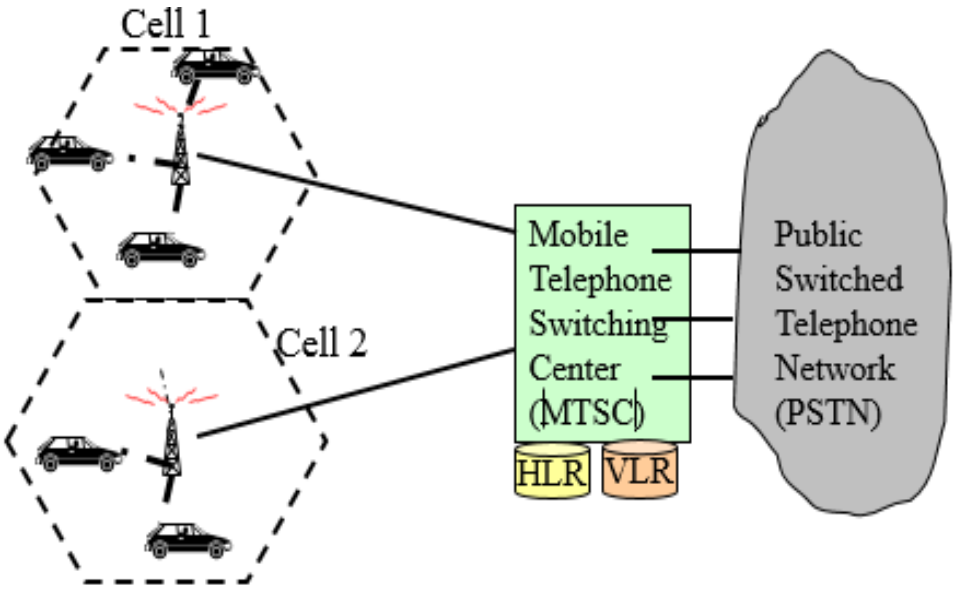

Figure 2.1: Cellular System

2.2 Cellular System Capacity

Let, a cell framework has an aggregate of S duplex channels accessible for use and every cell is assigned a gathering of K channels. On the off chance that the S channels are separated among N cells (bunch) with the end goal that every cell has a similar number of channels, the aggregate number of radio channels can be communicated as

S=KN

The N cells which utilize the total arrangement of accessible frequencies is known as a group.

In the event that a group is imitated M times, the aggregate number of duplex channels (C) can be utilized as a proportion of limit and given by

C= MKN=MS

In this way, limit of a cell framework is straightforwardly corresponding.

2.3 Enhancing Capacity in Cellular Systems:

1) Conventional Microcell Approach-

In this case, much smaller cells compared to the normal cells are used to accommodate more users. It doesn't give knowledge since when the cell measure winds up littler, the control of impedance among the cells ends up more diligently. Handoffs might not have enough time to finish.

2) Cell Splitting-

Cell Splitting is the way toward subdividing a clogged cell into littler cells to such an extent that each littler cell has its very own base station with lessened receiving wire tallness and decreased transmitter control. It expands the limit of a cell framework since number of times channels are reused increments.

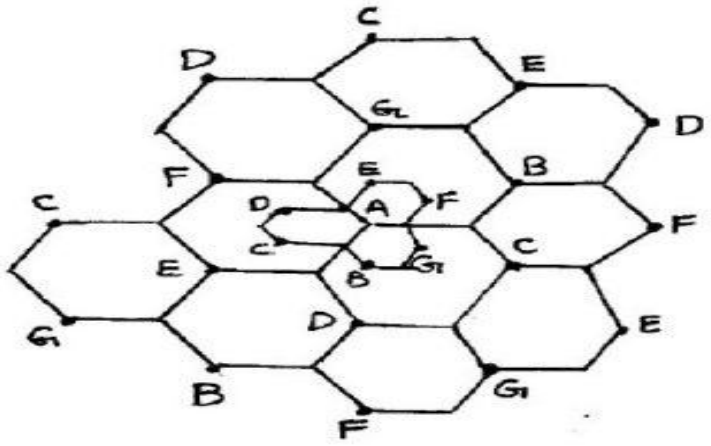

Figure 2.2: Cell Splitting

2.4 Cellular Frequency Reuse

In the cellular idea, frequencies distributed to the administration are re-utilized in an ordinary example of territories, called 'cells', each secured by one base station. In cell phone nets these

cells are normally hexagonal. In radio telecom, a comparable idea has been produced dependent on rhombic cells.

Standards of cell recurrence reuse. In the phone idea, frequencies assigned to the administration are re-utilized in a standard example of zones, called 'cells', each secured by one base station. In cell phone nets these cells are generally hexagonal Frequency reuse plan for C = 7 (I =2, j =1) [6].

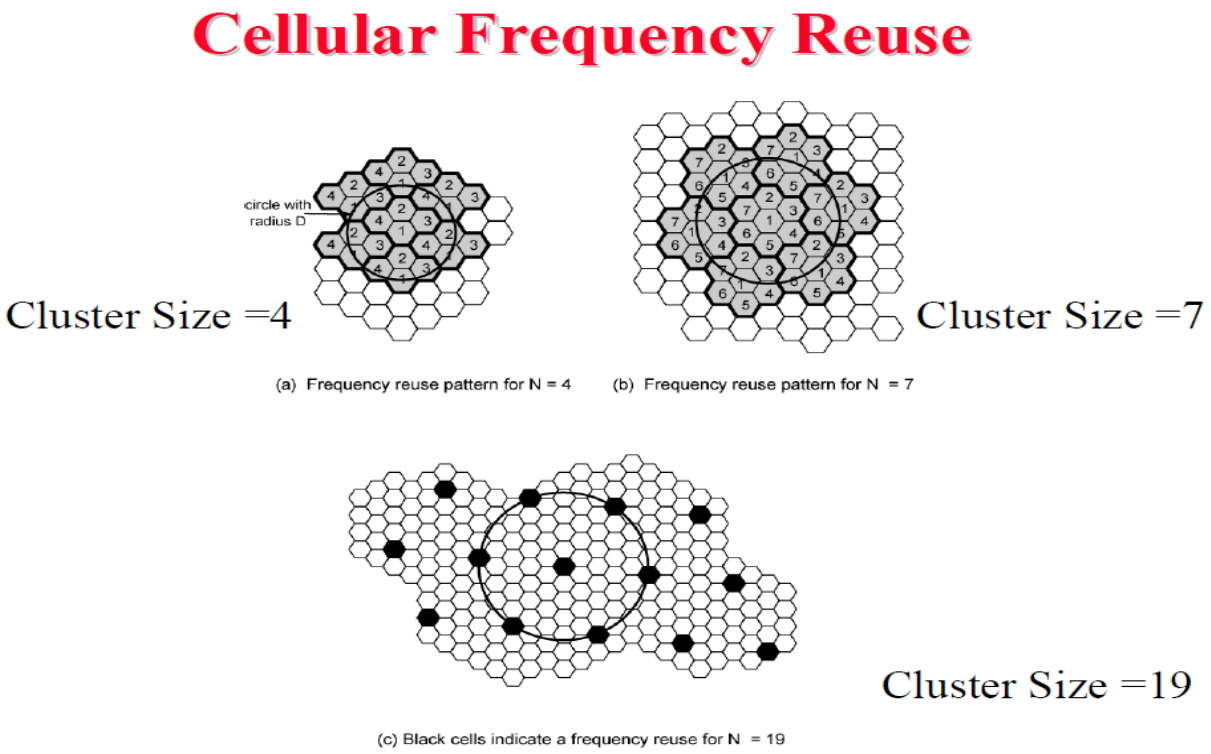

Figure 2.3: Cellular Frequency Reuse

2.5 Cellular Network Organization

- Cell structure (around 10 mile range)
  - Served by base station comprising of transmitter, beneficiary, and control unit
  - Base station (BS) radio wire is set in high places (houses of worship, tall structures) - Operators pay around $500 every month for BS
  - 10 to 50 frequencies doled out to every cell
  - Cells set up to such an extent that radio wires of all neighbors are equidistant (hexagonal example)

- n North America, two 25-MHz groups apportioned to AMPS
  - One for transmission from base to portable unit
  - One for transmission from portable unit to base [5].

2.6 Cell Design

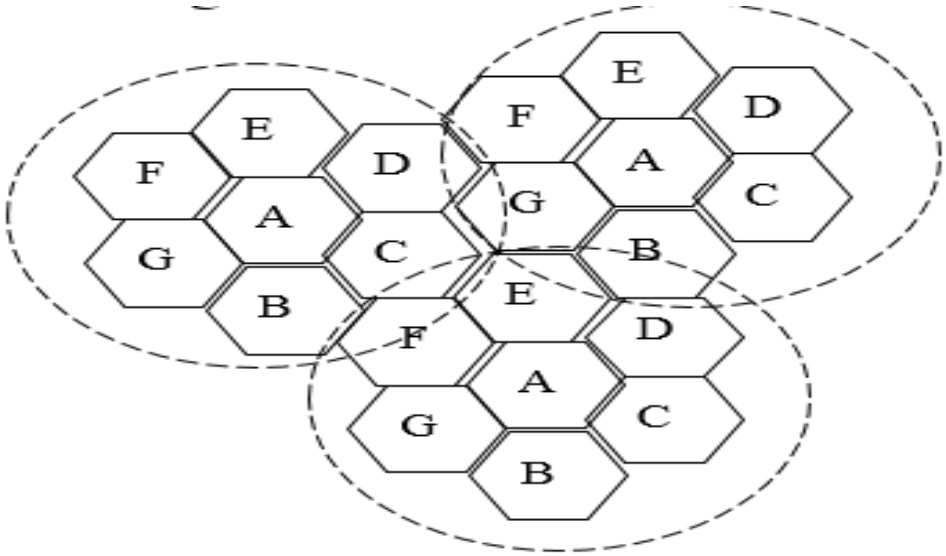

Figure 2.4: Cell Design

- Cells assembled into a bunch of seven
- Letters show recurrence use
- For every recurrence, a support of two cells is utilized before reuse
- To include more clients, littler cells (microcells) are utilized
- Frequencies should not be diverse in CDMA (delicate handoff)

2.7 Cellular networks: From 1G to 3G

- 1G: First era remote cell: Early 1980s
  - Analog transmission, fundamentally discourse: AMPS (Advanced Mobile Phone Systems) and others
- 2G: Second era remote cell: Late 1980s
  - Digital transmission

- Primarily discourse and low piece rate information (9.6 Kbps)
- High-level: GSM, IS-95 (CDMA), and so on.
- Low-level (PCS): Low-cost, low-control, low-portability e.g. PACS

- 2.5G: 2G advanced to medium rate (< 100kbps) information
- 3G: future Broadband sight and sound
  - 144 kbps - 384 kbps for high-portability, high inclusion
  - Mbps for low-portability and low inclusion

2. 8 Cellular Systems Terms

Base Station (BS) – incorporates a radio wire, a controller, and various collectors

- Mobile broadcast communications exchanging office (MTSO) – associates calls between versatile units
- Two kinds of channels accessible between versatile unit and BS
  - Control channels – used to trade data having to do with setting up and looking after calls
  - Traffic channels – convey voice or information association between clients [5].

2.9 GSM Technology

GSM (Global System for Mobile interchanges) is a standard created by the European Telecommunications Standards Institute (ETSI) to portray the conventions for second-age advanced cell systems utilized by cell phones, for example, tablets. It was first sent in Finland in December 1991. Starting at 2014, it has turned into the worldwide standard for versatile interchanges with over 90% piece of the pie, working in more than 193 nations and regions. 2G systems created as a substitution for original (1G) simple cell systems, and the GSM standard initially portrayed an advanced, circuit-exchanged system upgraded for full duplex voice communication. This extended after some time to incorporate information interchanges, first by circuit-exchanged transport, at that point by bundle information transport through GPRS (General Packet Radio Services) and EDGE (Enhanced Data rates for GSM Evolution, or EGPRS). Along these lines, the 3GPP grew third-age (3G) UMTS benchmarks, trailed by fourth-age (4G) LTE Advanced measures, which don't frame some portion of the ETSI GSM standard [7].

2.10 GSM Services

1. Tele-administrations
2. Bearer or Data Services
3. Supplementary administrations

TELE ADMINISTRATIONS

- Telecommunication benefits that empower voice correspondence by means of cell phones
- Offered administrations
    - ✓ Mobile communication
    - ✓ Emergency calling

BEARER SERVICES

- Include different information administrations for data exchange among GSM and different systems like PSTN, ISDN and so forth at rates from 300 to 9600 bps
- Short Message Service (SMS)

- ✓ Up to 160 character alphanumeric information transmission to/from the versatile terminal

- ❖ Voice letter drop

SUPPLEMENTARY ADMINISTRATIONS

- ❖ Call related administrations:
  - ✓ Call Waiting-Notification of an approaching call while on the handset
  - ✓ Call Hold-Put a guest on hold to accept another call
  - ✓ Call Barring-All calls, active calls, or approaching calls
  - ✓ Call Forwarding-Calls can be sent to different numbers characterized by the client
  - ✓ Multi Party Call Conferencing - Link various assembles

2.11 GSM Architecture

System Switching Subsystem the GSM framework engineering contains a wide range of components, and is frequently named the center system. It gives the primary control and interfacing for the entire versatile system. Interfaces to different MSCs are given to empower calls to be made to mobiles on various systems [7].

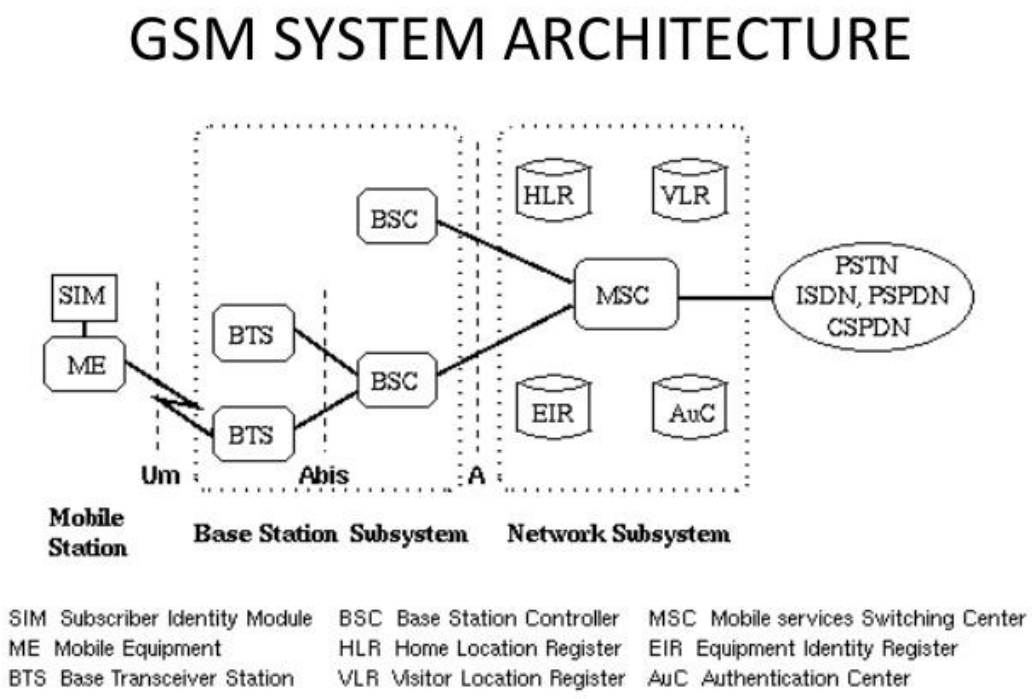

Figure 2.5: GSM Architecture

- **Mobile Station (MS)**
  - Mobile for Equipment (ME)
  - Subscriber of Identity Module (SIM)
- **Base Station Subsystem (BSS)**
  - Base of Transceiver Station (BTS)
  - Base of Station Controller (BSC)
- **Network Switching Subsystem (NSS)**
  - Mobile for Switching Center (MSC)
  - Home of Location Register (HLR)
  - Visitor to Location Register (VLR)
  - Authentication of Center (AUC)
  - Equipment for Identity Register (EIR)

2.11.1 System Architecture Mobile Station (MS)

The Mobile Station is comprised of two substances:

1. Mobile for Equipment (ME)
2. Subscriber of Identity Module (SIM)

Mobile Equipment (ME)

- Portable, vehicle mounted, hand held device
- Uniquely identified by an IMEI (International Mobile Equipment Identity)
- Voice and data transmission
- Monitoring power and signal quality of surrounding cells for optimum handover
- Power level : 0.8W – 20 W
- 160 character long SMS

Subscriber of Identity Module (SIM)

- Smart card contains the International Mobile Subscriber of Identity (IMSI)
- Allows client to send and get calls and get other bought in administrations
- Protected by a secret phrase or PIN
- Can be moved from telephone to telephone – contains key data to initiate the telephone [8].

2.11.2 System Architecture Base Station Subsystem (BSS)

Base Station Subsystem is made out of two sections that convey over the institutionalized Abis interface permitting activity between segments made by various providers.

1. Base of Transceiver Station (BTS)
2. Base of Station Controller (BSC)

Base of Transceiver Station (BTS):

- Encodes, scrambles, multiplexes, regulates and encourages the RF signs to the radio wire.
- Communicates with Mobile station and BSC
- Consists of Transceivers (TRX) units

Base of Station Controller (BSC):

- Manages Radio assets for BTS
- Assigns Frequency and schedule vacancies for all MS's in its region
- Handles ring set
- Handover for every MS
- It speaks with MSC and BTS

2.11.3 Framework Architecture Network Switching Subsystem (NSS)

The framework contains the accompanying utilitarian units

1. Mobile for Switching Center (MSC)
2. Home of Location Register (HLR)
3. Visitor to Location Register (VLR)
4. Authentication of Center (AUC)
5. Equipment for Identity Register (EIR)

Mobile for Switching Center (MSC)

- Heart of the system
- Manages correspondence among GSM and different systems
- Billing data and accumulation
- Mobility the executives
    - ✓ For Registration
    - ✓ Location of Updating
    - ✓ Inter BSS and bury MSC call handoff

Home of Location Registers (HLR)

- Stores data about every supporter that has a place with it MSC in perpetual and transitory design [8].

- As soon as portable supporter leaves its present neighborhood, data in the HLR is refreshed.
- Database contains IMSI, MSISDN, paid ahead of time/postpaid, meandering confinements, valuable administrations.

Visitor to Location Register (VLR)

- Temporary database which refreshes at whatever point new MS enters its region, by HLR database
- Assigns a TMSI to every MS entering the VLR region which continues evolving.
- Controls those mobiles wandering in its region
- Database contains IMSI, MSISDN, Location Area, validation key

Authentication of Center (AUC)

- Contains the algorithms for authentication as well as the keys for encryption.
- Protects network operators from fraud.
- Situated in special protected part of the HLR.

Equipment for Identity Register (EIR)

- Stores all gadgets recognizable pieces of proof enlisted for this system.
- Database that is utilized to follow handsets utilizing the IMEI (International Mobile Equipment Identity)
- Prevents calls from stolen, unapproved or blemished cell phone

2.11.4 Operation and Maintenance Centre (OMC)

- The brought together task of the different units in the framework and capacities expected to keep up the subsystems.
- Dynamic checking and controlling of the system.
- The Functions:
  - configuration the possessing unit or board
  - care of the fault report and
  - care of caution taking
  - performance supervision/the executives
  - storage of framework programming and information

2.12 GSM Channels

In media communications a channel, alludes either to a physical transmission medium, for example, a wire, or to a sensible association over a multiplexed medium, for example, a radio channel [9]. The divert utilized noticeable all-around interface is partitioned into two sorts:

1. Physical channel and
2. Logical channel

2.12.1 Physical channel:

- It is that the medium over that the information is conveyed.
- When relate degree MS and a BTS impart, they are doing in this manner on a specific consolidate of recurrence (RF) transporters, one for the up-connect and furthermore the diverse for the down-interface transmissions, and among a given time interim. This blend of your schedule opening and bearer recurrence shapes what's named a physical channel.
- One RF channel can bolster eight physical diverts in schedule openings zero through seven [9].

2.12.2 Logical channel:

- It includes information extended a physical channel.
- It transports either client information amid a call or flagging data for MS or base station.
- The information, regardless of whether client traffic or flag information, remapped onto the physical channels by process assortment of sensible channels.
- Two groups of consistent channels:
    - Traffic Channels, for choice data and
    - Control channels, to convey benefit information between system gear hubs [9].

From Physical Channel to Logical

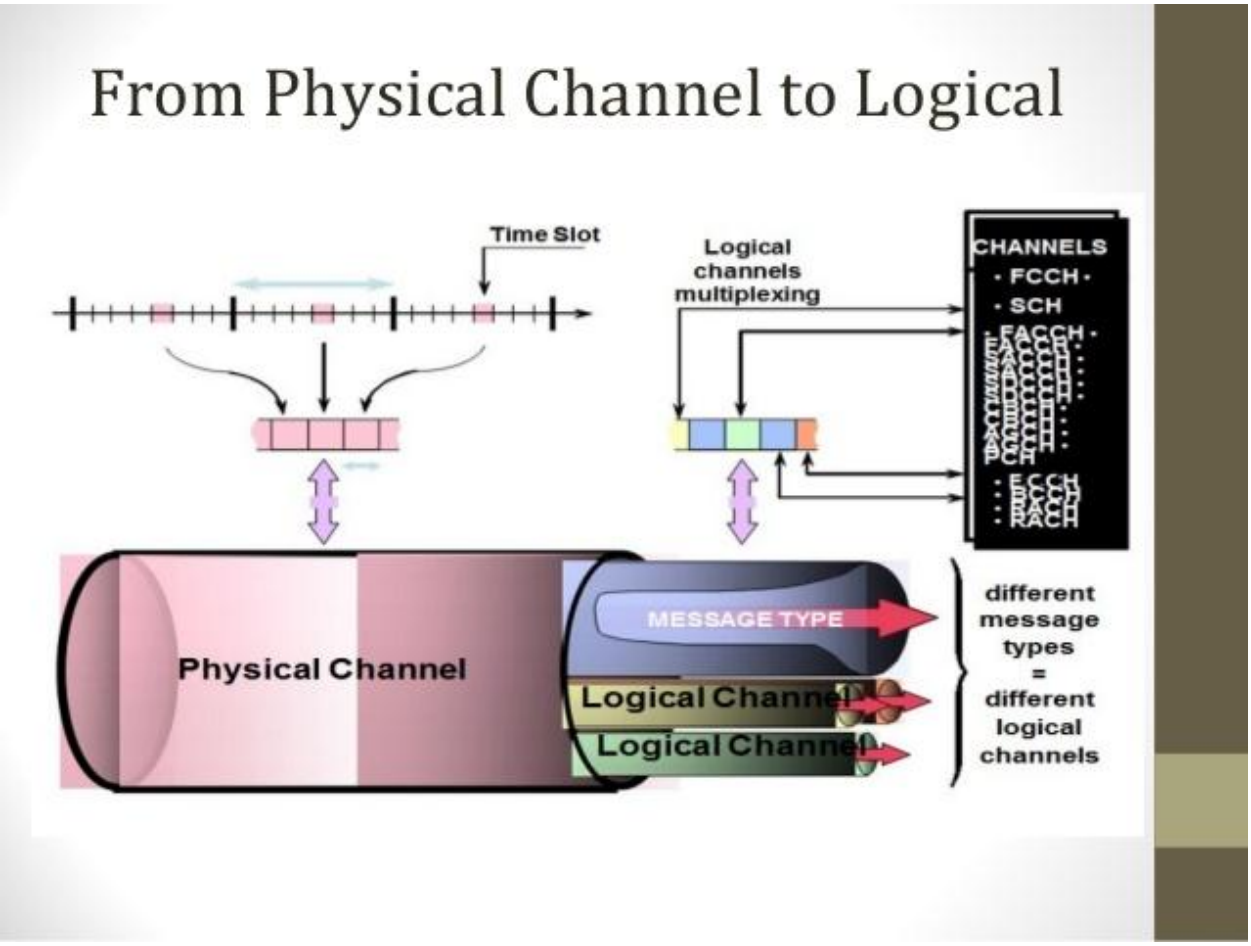

Figure 2.6: From Physical Channel to Logical

Traffic Channels (TCH):

Traffic channels are proposed to convey encoded discourse and client information.

- Full rate traffic channels at a net piece rate of 22.8 Kb/s (TCH/F)
- Half rate traffic channels at a net piece rate of 11.4 Kb/s (TCH/H)

Control Channels (CCHs):

Control channels convey sign data between partner MS and a BTS. There square measure numerous styles of the board direct in GSM, and that they will more often than not be partitioned into 3classes reliable with the style amid which they're upheld on the radio interface and accordingly the kind of sign information they convey. There 3 types of control channel on the board Channels, which is-

1. Control channel for Broadcast
2. Control channel for Common
3. Control channel for Dedicated

1. Broadcast control channels:

- Broadcast control channel is transmitted on direction of downlink only. Use Base transceiver station for transmission.
- Broadcast control channel build for synchronization information on the network to all MS cell.
- Broadcast control channel provide Maximum number of output and location area identity Such as Location Area Identity (LAI) and most extreme yield control.

That consists of 3 port: frequency Correction Channel (FCCH), Broadcast Control Channel (BCCH) and Synchronization Channel (SCH)

2 Frequency correction channel used for the recurrence rectification/synchronization of a portable station and the rehashed (each 10 sec) transmission of Frequency Bursts is called FCCH. Also use for FCCH is transmitted on the downlink, point-to-multipoint.

Synchronization channel allows the user equipment to synchronize time shrewd with the base transceiver station. Bursts synchronization of repeated broadcast is call synchronization channel. SCH is transmitted on the direction of downlink which is point to multipoint.

3 Broadcast control channel (BCCH) is utilized to communicate the board data to any MS among a cell. Base transceiver station use control channel configuration for information includes details. Neighboring base transceiver station also use BCCH carrier frequencies and MS use number of parameter when accessing the base transceiver station. BCCH is only allow to transmitted on the downlink which is point to multipoint

4 Common Control Channel: when we do MS paging and access use CCCH. It's a Random Access Control Channels. Also work as a paging channel and call broadcast channel.

Random Access Control Channel (RACH)

- ✓ Transmitted by the portable when it wishes to access to the framework
- ✓ This happens when versatile starts a call or reacts to a page.

Paging Channel (PCH)

- ✓ Transmitted by the BTS when it wishes to contact a portable.
- ✓ The explanation behind contact might be an approaching call or short message.

Access Grant Control Channel (AGCH)

- ✓ It conveys information which trains the versatile to work in an explicit physical channel (Time space).
- ✓ The AGCH is utilized by the system to concede, or deny, Associate in Nursing MS access to the system by movement it with subtleties of an intense channel, i.e. TCH or SDCCH, to be utilized for later correspondences.

Cell Broadcast Channel (CBCH)

- ✓ This channel is utilized to transmit messages to be communicated to all mobiles inside a cell e.g. traffic information.
- ✓ The CBCH will take time from SDCCH.

5 Dedicated Control Channel:

- ➢ Signaling data is conveyed between a MS and a BTS utilizing related and devoted control channels amid or not amid a call.
- ➢ There are of following sort:-
  - ❖ Standalone Dedicated and Control Channel (SDCCH)
  - ❖ Associated and Control Channel (ACCH)
  - ❖ Slow Associated and Control Channel (SACCH)
  - ❖ Fast Associated and Control Channel (FACCH)

Standalone Dedicated and Control Channel (SDCCH)

- ❖ It additionally conveys data for call sending and Transmission of short message.
- ❖ The MS is on the SDCCH educated about which physical channel to use for traffic (TCH).

Associated and Control Channel (ACCH)

- ✓ These Channel Could be related with either a SDCCH or a TCH.
- ✓ They are utilized for completing data related with the procedure being done on either SDCCH or TCH.

Slow Associated and Control Channel (SACCH)

- ✓ Conveys control the board and worldly request data inside the downlink heading.
- ✓ Receive flag quality Indicator and connection quality report in transmission heading.
- ✓ It involves one timeslot in every twenty six. SACCH messages could likewise be sent once each 480ms, i.e. pretty much each a couple of s.

Fast Associated and Control Channel (FACCH)

- ✓ FACCH is transmitted as opposed to a TCH.
- ✓ The FACCH take the TCH bust and embeds its very own data.
- ✓ The FACCH is utilized to hold out client verification and giving up.
- ✓ A finish FACCH message is additionally sent once in each 20ms.

2.13 Security in GSM

- ➢ On air interface, GSM utilizes coding and TMSI as opposed to IMSI.
- ➢ SIM is given 4-8 digit PIN to approve the ownership of SIM.
- ➢ algorithms are determined :
    - ❖ A3 calculation for confirmation
    - ❖ A5 calculation for encryption
    - ❖ A8 calculation for key age [10].

2.14 Attributes of GSM Standard

- ➢ Fully digital system using 900, 1800 MHz frequency band.
- ➢ User/terminal authentication for fraud management.
- ➢ Full international roaming capability.
- ➢ Low speed information services (up to 9.6 Kb/s).
- ➢ Compatibility with ISDN.
- ➢ Support of Short Message Service (SMS).

2.15 GSM Applications

- Blue chart of Mobile communication.
- GSM architecture of all mobile generation 1G to 5G
- Telemetry System
    - The board get Fleet
    - Automatic meter perusing
    - Its offer Remote control unit and blame revealing of DG sets
- Value Connect benefit.

CHAPTER 3

Types of Cellular Network

3.1 Introduction

Mobile or user communication device or cell phone uses network is knowns as cellular network in came at the year of 1980. Now day cellular is 2G,3G,4G no more use of 1G and 5G about to in the year 2020. Every generation came with new facilities like data service(2G). High speed data service (3G). Broadband speed data service (4G).

1G to 4G voice service become so much batter. Now day without cellular network life is impassable. It's a part of our modern civilization. Business, shopping, marketing all part of cellular. Different types of service operator provide the cellular network. Bangladesh service operator are ROBI, AIRTEL, TELETALK and GP.

Rank	Operator	Technology	Subscribers (in millions)	Ownership
1	Grameenphone	GSM-900/1800 MHz (GPRS, EDGE) 2100 MHz UMTS, HSPA, HSPA+, DC-HSDPA 900/1800/2100 MHz FDD-LTE	71.413	Telenor (55.8%), Grameen Telecom (34.2%) and General Public & other Institutions (10%)
2	Robi	GSM-900/1800 MHz (GPRS, EDGE) 900/2100 MHz UMTS, HSPA, HSPA+, DC-HSDPA 900/1800/2100 MHz FDD-LTE, LTE-A	46.753	Axiata Group Berhad (68.7%), Bharti Airtel (25%) and NTT DoCoMo (6.3%)
3	Banglalink	GSM-900/1800 MHz (GPRS, EDGE) 900/2100 MHz UMTS, HSPA, HSPA+, DC-HSDPA 900/1800/2100 MHz FDD-LTE	33.699	VEON
4	Teletalk	GSM-900/1800 MHz (GPRS, EDGE) 2100 MHz UMTS, HSPA, HSPA+, DC-HSDPA	3.945	State-owned

3.2 Types of Cellular Network

Generally cellular network have many types of cellular system. Most common is 1G, 2G, 3G, 4G and 5G. Also have Wi-Fi WIMAX. Now going for discuss about cellular network family like 1G to 5G [11].

3.2.1 1st Generation

1G is 1st generation mobile communication system come with analog signal. This technologies are so limited and expansive. Its came to life in the 1980 its have few user. Only capable of make a call. Also known as Advanced mobile phone system

1st Generation future:

- Allows only voice call service.
- Poor signal.
- voice of quality so poor came with so much noise
- user gear battery is so limited.
- Large user gear use in that time
- More traffic in channel
- Worst handoff system
- Use Bad quality security

It presents portable innovations like Mobile Telephone System (MTS), Advanced Mobile Telephone System (AMTS), Improved Mobile Telephone Service (IMTS), and Push to Talk (PTT). It's low ability, questionable handoff, poor voice joins, and no security in any regard since voice gets back to where fight in radio towers, making these calls vulnerable to undesirable listening stealthily by outsiders [12].

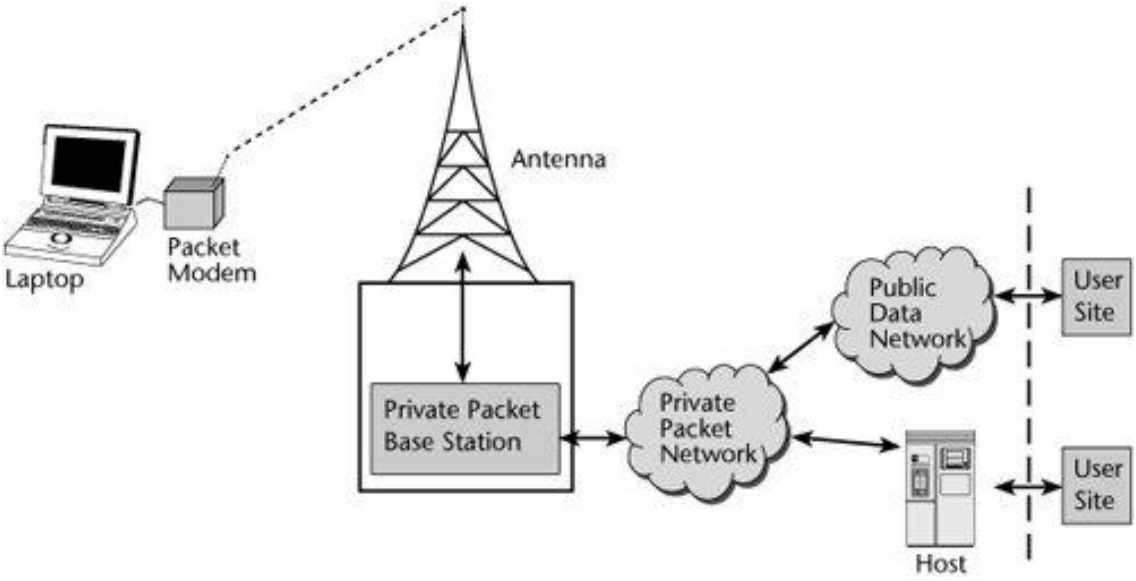

Figure 3.1: 1G Analog Network Architecture

3.2.2 2nd Generation

2G is brief for second-age remote phone innovation. Second era 2G cell medium systems were financially propelled on the GSM ordinary in European nation by Radiolinja (presently part of Elisa Oyj) in 1991. 2G innovations empowered the shifted transportable systems to deliver the administrations like instant messages, picture messages and MMS (Multimedia messages). All instant messages sent over 2G square measure carefully encoded, allowing the move of data in such how that exclusively the alleged collector will get and peruse it [13].

2G alludes to the second era upheld GSM and was developed in late 1980s. It utilizes advanced signs for voice transmission. Principle focal point of this innovation was on computerized flags and gives administrations to convey content and picture message at low speed (in kbps). It utilize the data proportion of 30 to 200 KHz. By 2G, 2.5G framework utilizes bundle exchanged and entryway exchanged space and supply rate up to 144 kbps. GPRS, CDMA and EDGE. The fundamental highlights of 2G and a couple of 2.5G are:

2G:

- 1st invention data system in the network.
- Data rete obtain in 2G 64kbps
- Use advanced signing system to run like GMPT card.
- 2G come with this type of features picture messages, messages and MMS
- Obtain higher quality and capacity in 2G

2.5 G:

- In GSM 2.5G come after in this 2G.
- 2.5 G also known as GPRS
- 1st technology which offer email messages
- 1st technology which offer Web service
- 1st technology which offer 64-144 kbps at that time.
- Birth smart Camera telephones

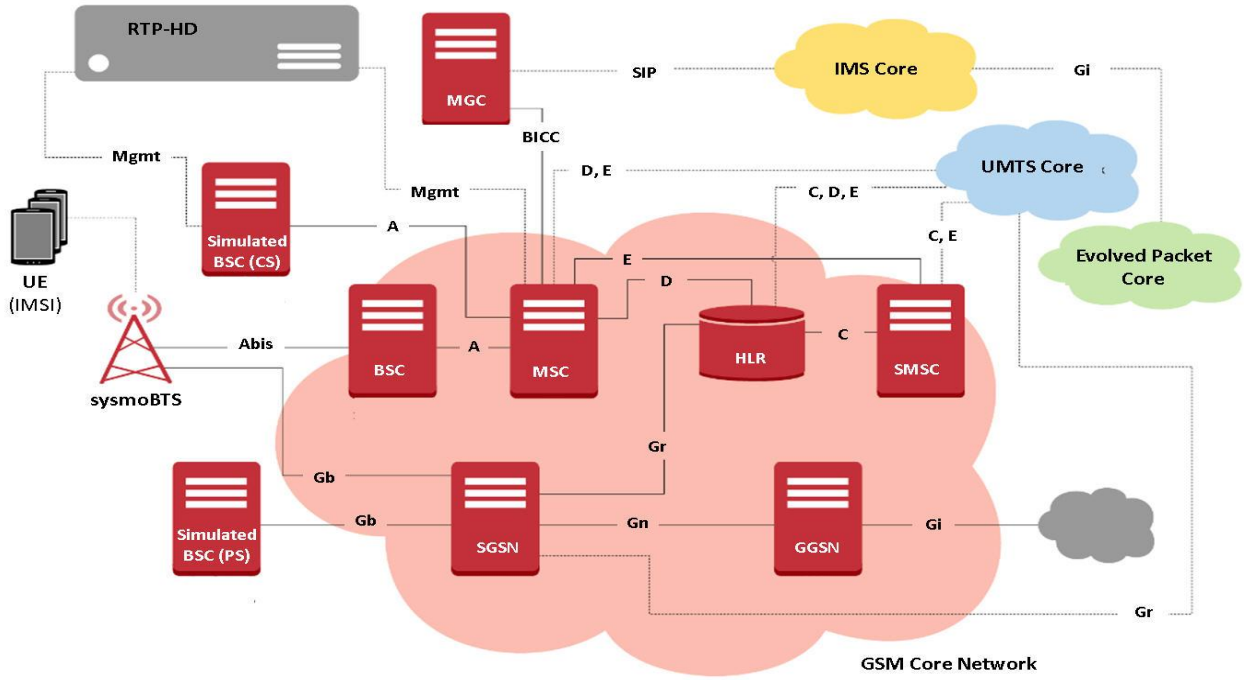

Figure 3.2: 2G & 2.5G Wireless Network Simulation

3.2.3 3rd Generation

3G or third generation network came after 2.7G. This cellular network introduces first high speed internet in Mbps like 21Mbps maximum. This is same thing like broadband connection for user gear. Its become popular in year of 2003.[3]. Now day every base transceiver station have 3G and 4G configuration, 3G come with batter voice and data quality. That decrease the demand of 2G. Its offer GPS, Map, navigation , online radio, tv, game sport. Its come online on 2001. Fast movie music online wap series etc.[14].for 3G use 2100MHz frequency. Also need GSM antenna which support 3G and need RRU 2100 for remote the call.

The most alternatives of 3G are:

- Data exchange rates so high to complete the demand of electronic applications and sound and video files.
- More fast video call then 2.7G
- Can sent email messages so fast with this speed.
- High speed in every online activity then 2.7G
- Act like mobile broadband
- In 3G cell phone become many thing like TV.
- Require 3G support phone to run 3G
- Cell and data cost become get lo

3G part of the GSM network and also part of UMTS family(Universal Mobile Telecommunication System) in Europe, [14].

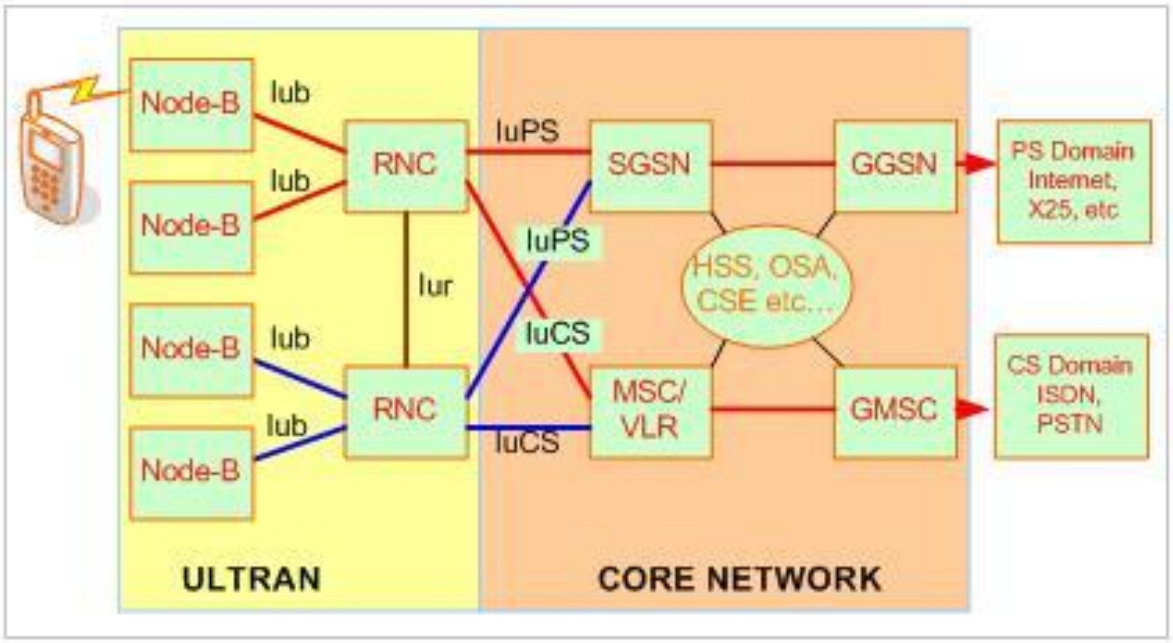

Figure 3.3: UMTS-3G Network Architecture

3.2.4 4th Generation

4G or generation come after 3G its most use mobile cellular technology in the hole word. Its only high speed internet in the Bangladesh. Its offer 15Mbps to 1Gbps. Help of this speed mobile become HDTV. Increase the demand of 3DTV. Increase the demand of HDTV. Increase the demand of high quality video. Increase the demand of online game. decrease the demand of broadband internet .4G have other version LTE consider as upgraded version 4G. In Bangladesh now every place have 4G network video and voice call quality more high then other.

Offer and requirement:

- Deal with High security in this system.
- Almost fulfill client demand.
- Offer low cost in the network.
- Battery requirement is high to run minimum require 3000 mA
- User gear must be support 4G

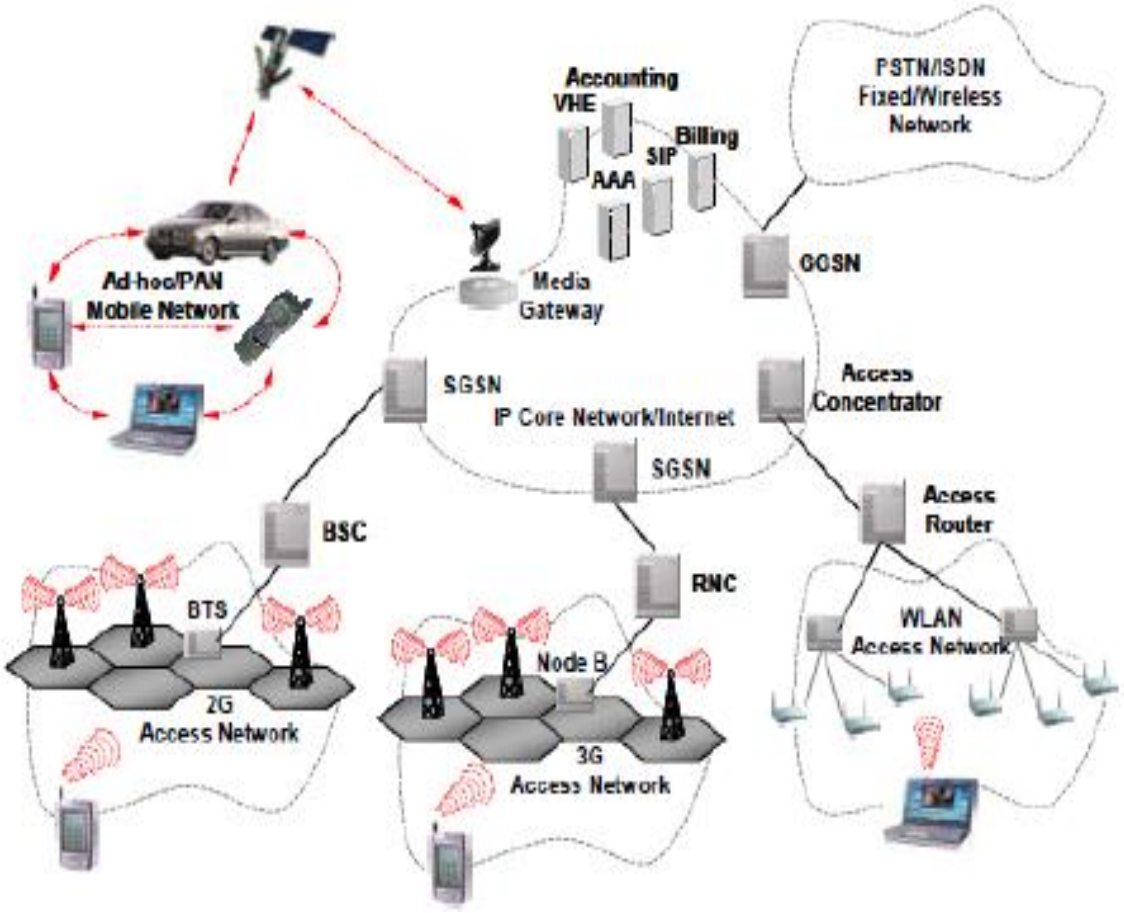

Figure 3.4: 4G Network Architecture

3.2.5 5th Generation

5G or fifth Generation Mobile network is the latest mobile technology of all previous generation. Capable of give Gbps speed. Its on the test mode or research mode. Maybe releases in the 2020.In near future 5G innovation gives a phone that is kind of an individual advanced right hand then the aggregate work environment will be in our fingertips/in our telephone. In a not very many years, we tend to could likewise be prepared to exchange a full-length HD picture appear in six seconds, while 4G require seven minutes and 3G require a significant hour to exchange a comparable. Also video visits will be in this way vivid that it'll need we can connect and bit the contrary individual all through the screen. 5G could be a bundle exchanged remote framework with wide space inclusion and high yield. 5G remote uses OFDM and metric direct unit remote that permits give minimum 25mbps and 2GHz band wave. The fifth generation correspondence framework is envisioned on the grounds that the genuine remote system, fit for supporting remote World Wide Web (www) [16].

5G is also commented as on the far side 2020 versatile correspondences advancements. 5G doesn't depict any express determination in any archive uncovered by any media transmission institutionalization body.

5G research start at begun from late 2010s. The most focal point of 5G will be on world-Wireless World Wide Web (WWWW). It's an entire remote correspondence without any constraints. The most alternatives of 5G are:

- It is to a great degree middle of the road to WWWW (remote World Wide Web)
- High velocity, high ability
- Provides monster broadcasting of information in Gbps.
- Multi-media papers, stare at the TV programs with the clarity (HD Clarity)
- Faster information transmission that of the past age
- Large telephone memory, dialing speed, clearness in sound/video
- Support hypermedia framework, voice, gushing video, web and unique
- More successful and tempting.

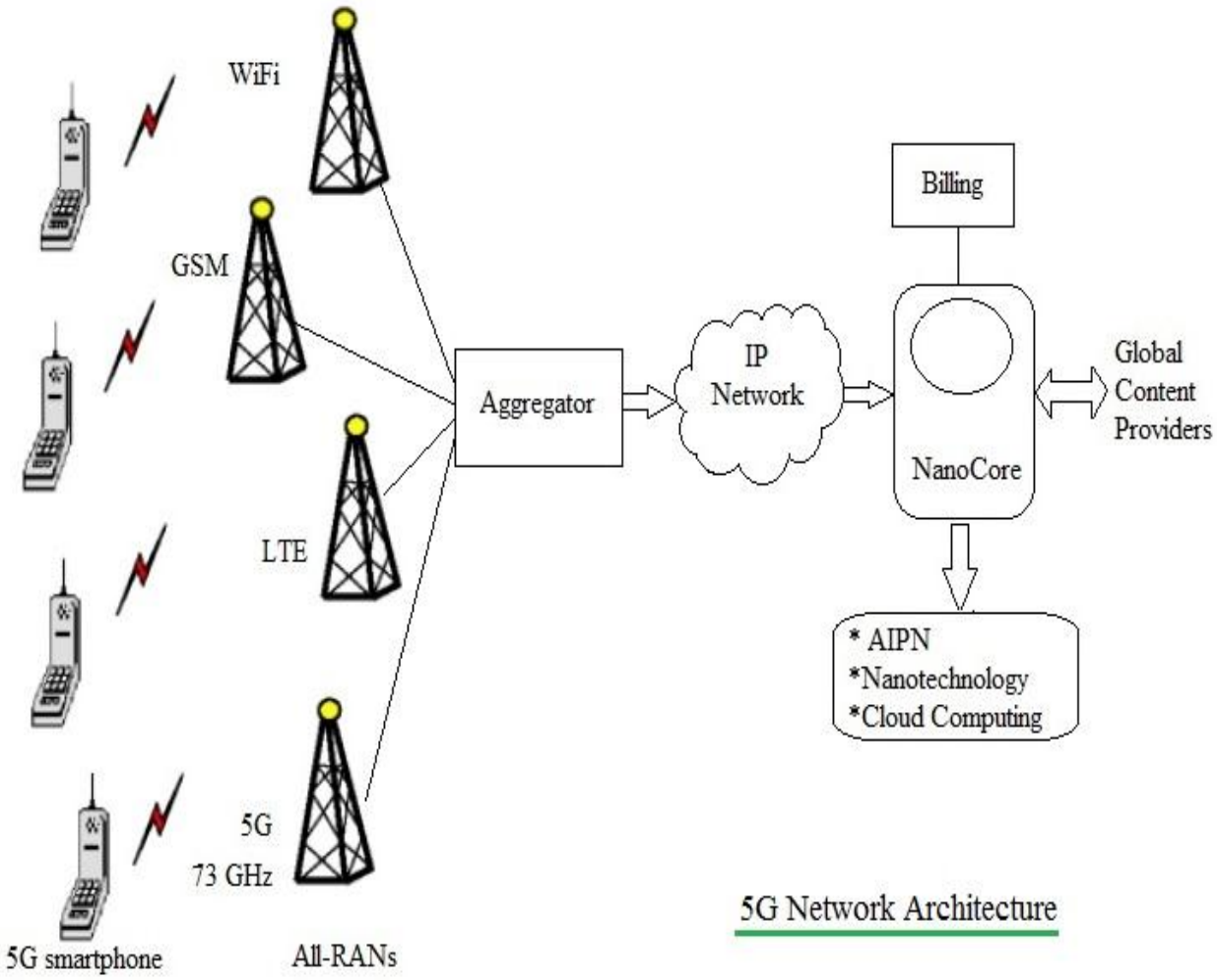

Figure 3.5: 5G Network Architecture

3.3 Evolution of mobile network generation.

Table 1. Comparison of Mobile Generation: 1G To 5G [17]

Generation→ Features↓	1G	2G	3G	4G	5G
Deployment	1970 – 1980	1990 - 2001	2001-2010	2011	2015-20 onwards
Data Rates	2kbps	14.4-64kbps	2Mbps	200 Mbps to 1 Gbps	1Gbps and higher
Technology	Analog Cellular Technology	Digital Cellular Technology: Digital narrow band circuit data Packet data	Digital Broadband Packet data: CDMA 2000 EVDO UMTS EDGE	Digital Broadband Packet data: WiMax LTE Wi-Fi	wwww Unified IP seamless combination of broadband LAN PAN MAN WLAN
Service	Analog voice service No data service	Digital voice with higher clarity SMS, MMS Higher capacity packetized data	Enhanced audio video streaming video conferencing support Web browsing at higher speeds IPTV support	Enhanced audio, video streaming IP telephony HD mobile TV	Dynamic Information access, Wearable devices with AI Capabilities
Multiplexing Switching	FDMA	TDMA, CDMA	CDMA	CDMA	CDMA
Core Network	PSTN	PSTN	Packet N/W	Internet	Internet
Standards	MTS AMTS IMTS	2G:GSM 2.5:GPRS 2.75:EDGE	IMT-2000 3.5G-HSDPA 3.75G:HSUPA	Single unified standard LTE, WiMAX	Single unified standard
WEB Standard		www	www(IPv4)	www (IPv4)	wwww (IPv6)
Handoff	Horizontal only	Horizontal only	Horizontal & Vertical	Horizontal & Vertical	Horizontal & Vertical
Shortfalls	Low capacity, Unreliable handoff, Poor voice links, Less secure	Digital signals were reliant on location & proximity, required strong digital signals to help mobile phones	Need to accommodate higher network capacity	Being deployed	Yet to be implemented

CHAPTER 4

3G Cell Addition and Cell Splitting

4.1 Introduction

3G or third generation network came after 2.7G. This cellular network introduces first high speed internet in Mbps like 21Mbps maximum. This is same thing like broadband connection for user gear. Its become popular in year of 2003.[3] .

There are lot of part of 3G network such as,

1. 3G Cell addition
2. 3G Cell Splitting
3. 2T4R and
4. Tri Sector/9th Sector

We are describe two major part 3G cell addition and 3G cell splitting

4.2 3G Cell Addition

Basically we use 3 Cell in the 3G Base Transceiver Station (BTS) which is A cell, B cell, C cell. In cell addition or expansion we add extra cell which is D cell.

With the time number of user increase under the on of the BTS cell. It's difficult handle large number of user by dose cell. So we add extra cell to handle the user or increase the speed.

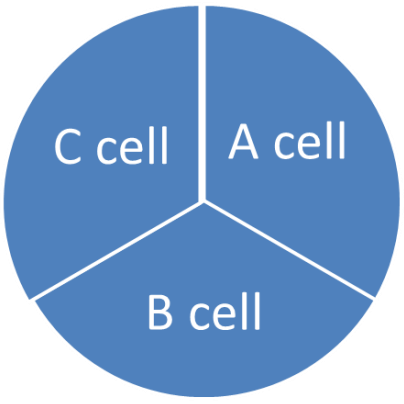

Figure 4.1: Before Cell Addition

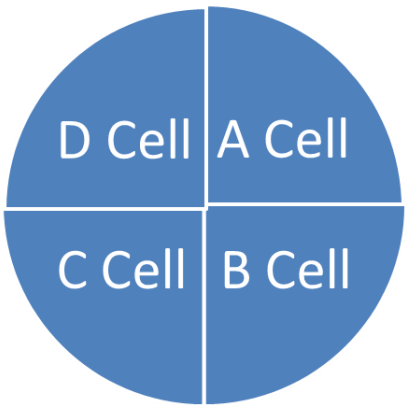

Figure 4.2: After Cell Addition

4.2.1 Cell Addition Equipment

1. Dual Band GSM Antenna
2. CPRI Cable
3. Power Cable
4. RRU 2100
5. UMPT

4.2.2 Dual Band GSM Antenna:

Worldwide System for Mobile correspondence frameworks square measure speedy changing into the quality in cell phones everyplace. The GSM framework licenses clients to talk about wherever inside the world. It's basically a world meandering administration that is bolstered satellite interchanges, and it offers unprecedented adaptability and opportunity for versatile clients who have grasped this remote innovation. Like each remote innovation, be that as it may, GSM correspondences square measure snared in to recieving wires. Which implies that GSM administrations, and later ages of the innovation like EDGE, UMTS, and HSDPA, square measure in consistent might want of custom recieving wire fashioners to help them proceed with customer request and to acquaint new developments with the commercial center [18].

There are numerous focal points to utilizing GSM innovation, for example,

- Global wandering
- The capacity to alter administrations though keeping a comparable telephone
- The capacity to send instant messages
- A all-inclusive crisis assortment, in this way crisis administrations are frequently known as wherever inside the world while not knowing the local assortment

Figure 4.3: Dual Band GSM Antenna

4.2.3 CPRI Cable:

The Common Public Radio Interface (CPRI) is a optical fiber cable. Generally use to connection between Remote Radio Unit and Base band unit. Its so must fester then other types of cable its communicate as speed of light. So help of CPRI cable inter exchange of data between BBU and RRU become so fast that's why processing and control unit become so fast. Its capable of transmit data at 100Mbps or 1Gbps in the distance of 5 Km. [18].

Its have single or multimode (layer 1 and layer 2). This capable of create free innovation advancement (on either side of the interface), with a confined need for equipment adjustment. Additionally, product differentiation terms of practicality, management, and characteristics isn't restricted.

Figure 4.4: CPRI Cable

4.2.4 Power Cable:

Power cable is power the BTS instrument. Basically this power cable come from rectifier and DCDU. A power cable is associate degree assembly of two or a lot of electrical conductors, sometimes control beside associate degree overall sheath. The assembly is employed for transmission of wattage. Power cables is also put in as permanent wiring inside buildings, buried within the ground, run overhead, or exposed.

Figure 4.5: Power Cable

4.2.5 RRU 2100:

RRU 2100 or remote base station basically in the 3G GSM cellular network. Its take client gear cell for control and prosses. To adding extra cell in the base transceiver station(BTS) generally need two RRU 2100 one is single band other one in must be dual band and with the GSM antenna and BBU on the indoor . In other word RRU 2100 remote the cell. RRU single band have one Rx and one Tx port. RRU dual band have two Rx and two Tx port. Rx port use for

receive and Tx port is use for transmit. Tx connected with GSM antenna Tx port. Rx connected with GSM antenna Rx port. RRU Tx and Rx port also connected with BBU.

Remote Radio Units are usually put in towers and are controlled by a controller placed within a closed shelter on the bottom close the tower. The affiliation between the RRU and also the controller is mostly optical. The RRU and also the controller kind the BTS or Base Transceiver Station that is wide utilized in cellular communication.

Figure 4.6: RRU 2100

4.2.6 UMPT:

The universal main process and transmission unit (UMPT) will function a main instrument panel operating in any mode.

The UMPT plays out the resulting capacities:

- Manages setups and gadgets,

- Monitors execution and
- Processes sign.

Provides the USB port, transmission port, and interconnection port to realize BBU maintenance on the native maintenance terminal (LMT), signal transmission, and BBU interconnection [18].

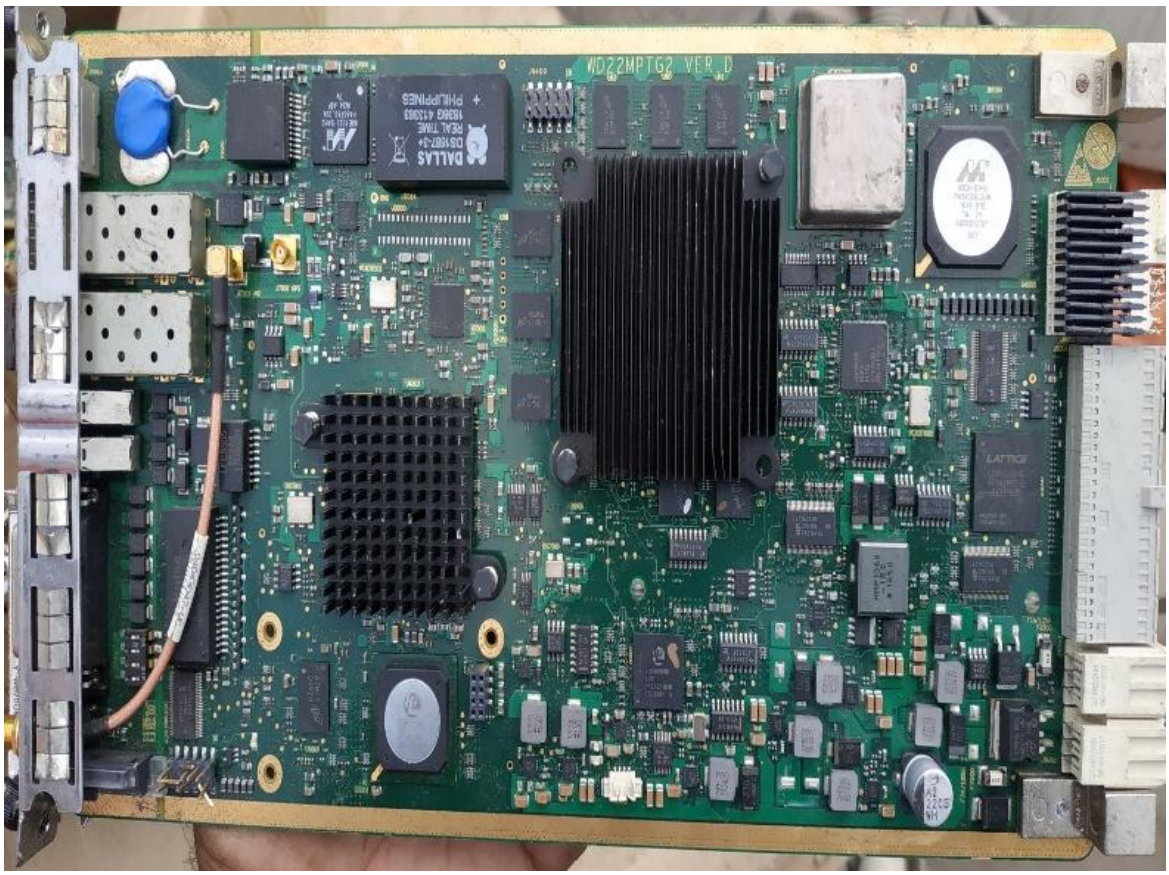

Figure 4.7: UMPT

4.3 3G Cell Splitting

In 3G cell splitting is way of divide single cell into dual cell without adding extra cell in the base transceiver station. If the single cell angle is 120 on the BTS its can divide into 60 and 60 degree angle like full different 2 cell. Its increased capacity and coverage on that cell direction. Also say that increased the cell ability double.

The way toward subdividing a full cell into littler cell. Cell part increment the cell ability while not including extra cell. Cell splitting is additional coverage. As users will increases channel rate decreases. Cell splitting and sectoring will increases capability [18].

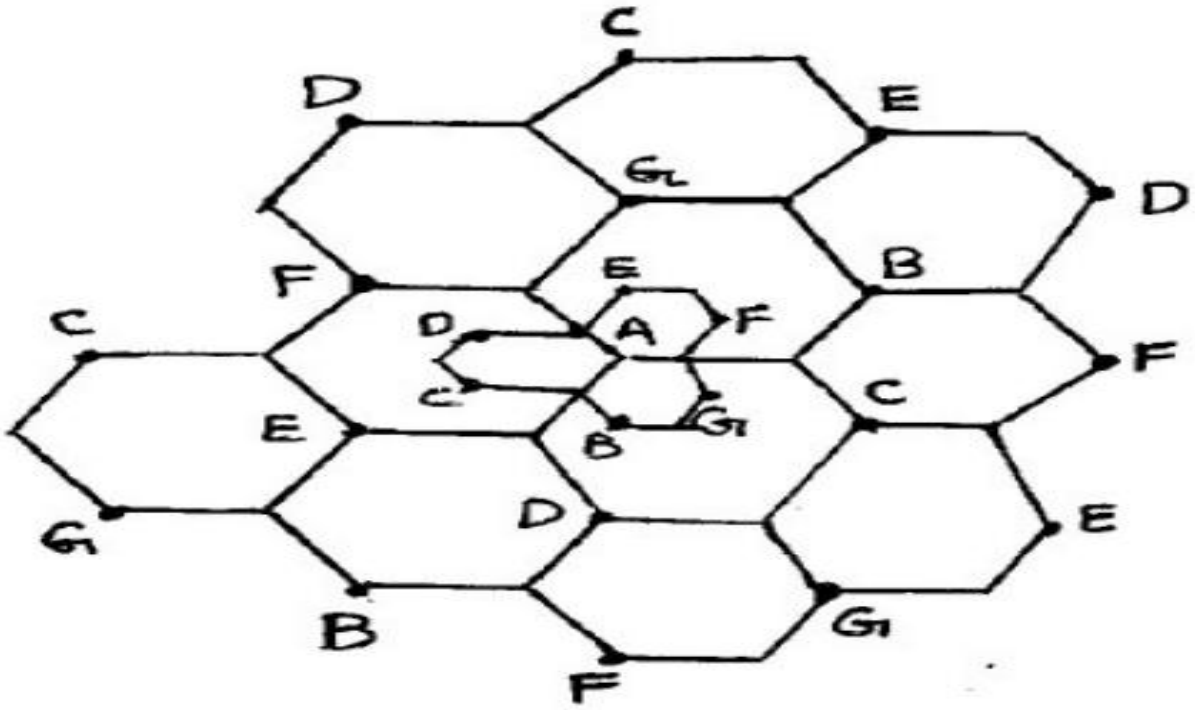

Figure 4.8: 3G Cell Splitting

4.3.1 3G Cell Splitting Equipment

1. Dual Band Antenna
2. Tri-Band Antenna
3. Dual Band RRU
4. UBBPD3
5. Power Cable

4.3.2 Tri-Band GSM Antenna:

Basic requirement of cell splitting is tri-band antenna. It's have 6 port for connection with RRU help of this extra port can easy do cell splitting. This GSM antenna connection with RRU by short jumper shown in the fig 4.9. tri-band also known as 9 sector. Tri-band GSM antenna have more capacity then single band or dual band. its little bit heavy compare to single and dual band GSM antenna. Its cover more area. In the ongoing years, there has been relate degree expanding dependence on remote correspondence to supply expanded common sense for stock and administrations. This spots swelled requests on the radio wires utilized in remote correspondence frameworks. Amid this unique circumstance, three noteworthy square measure as of movement related with receiving wires are estimate decrease, band or multiband activity, and adjustment design the executives.

With the presentation of 3G cell correspondence frameworks in a few components of the globe, the interest for one reduced radio wire to help each 900 MHz and 1800 MHz task is self-evident. What's more, mix of GPS activity with the specialized gadgets is likewise attractive to help Intelligent Transportation Systems, and to incorporate area discovering administration with cell user equipment to update client wellbeing. When the GSM antenna need straight polarization, GPS, fixed at 1575 MHz, needs minus roundabout polarization. This makes the occasion of partner degree receiving wire which will oblige the three groups very troublesome [18].
Various methodologies have been accounted for in the writing for accomplishing multi-recurrence activity utilizing printed reception apparatuses.

Figure 4.9: Tri-Band Antenna

4.3.3 Dual Band RRU:

A double band GSM receiving wire joins 900 MHz and 1800 MHz into a solitary unit. A double band GSM reception apparatus joins both 900 MHz and 1800 MHz into a solitary unit. It likewise joins a low-clamor enhancer (LNA) for the 1800 MHz band. The antenna is designed for upgrading existing sites to dual band with low-cost and minimized down time. Available configurations include dual polarized, 60-deg. and 120 deg. sectors with various tilts and gains. The antenna comes equipped with a cross-band coupler and control unit [18].

Conveyed base station embraces the structure of isolated baseband unit (BBU) and remote radio unit (RRU), which not just encourages adaptable arrangement and diminishes the development cost, yet in addition spares feeder misfortune and improves organize inclusion. It is generally acknowledged by administrators around the globe. Consequently, RRUs with various highlights are redone for a wide range of situations, for example, high yield control, ultra broadband, high joining, multi-PA and so forth.

Figure 4.10: Dual Band RRU

4.3.4 UBBPD3:

The universal baseband processing unit (UBBP) can serve as a baseband processing board working in any mode.

The UBBP performs the following functions:

- Multiplexes baseband assets among various modes, along these lines supporting multimode simultaneousness.
- Provides CPRI ports for correspondence with RF modules and procedures uplink and downlink baseband signals.

Figure 4.11: UBBPD3

4.4 After Cell Splitting (Using G-nettrack lite)

G-NetTrack could be a wireless network monitor and drive take a look at tool for automation OS devices. It permits observation and work of mobile network parameters while not exploitation specialized instrumentation. It is a tool and it is a toy. It are often employed by professionals to induce higher insight on the network or by radio enthusiasts to be told a lot of concerning wireless networks. It are often used though you wish simply to form simple illustration of your traveled route [19].

Using application you'll be able to simply pinpoint network issues like:

- bad coverage - low RXLEVEL
- low uplink and downlink data throughput
- lack of dominant server causing lot of cell reselections and frequent service interruptions
- when the serving cell time is small
- weak 3G coverage
- when you have a lot of reselections between cells on 3G and 2G
- blocked calls
- dropped calls

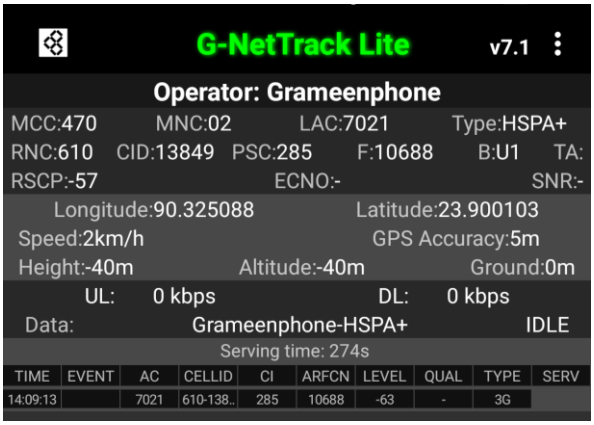

Figure 4.12: Before Cell Splitting

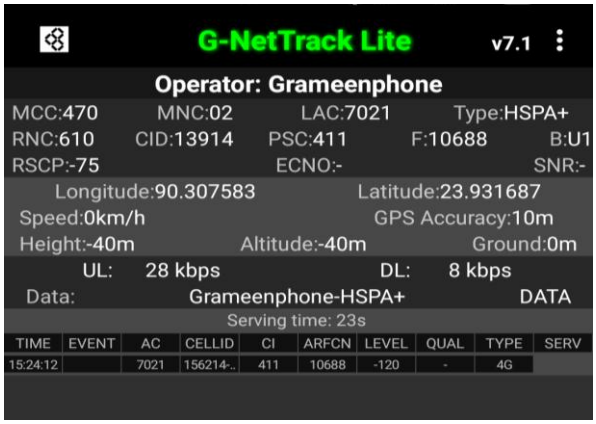

Figure 4.13: After Cell Splitting

4.5 Cell Direction

Compass in the base transceiver station to find out the cell types or location. Help of the compass can find out where is A cell location, where is B cell, and where is C cell. When engineers go to site fix the cell service operator give the cell location which degree cell is exist.The attractive field applies a torsion on the needle, activation the North complete or post of the needle around toward the Earth's North attractive shaft, and incitation the inverse toward the Earth's south attractive post. The magnetic compass use for cell heading framework [20].

Figure 4.14: Magnetic Compass

CHAPTER 5

Conclusion

5.1 Conclusion

Having internship in the Starlink Engineering Limited is big opportunity to work in this company. In this company work as support engineer. Generally have go to the site survey to find out the problem and fixed it. Basically do cell addition and cell splitting types of work also known that which type of equipment normally use in the base transceiver station like RRU,GSM antenna, MW antenna, BBU many types of transmission card. To do that type of work visits many places same time have to deal with problem to find the right places. Now I believed can deal with any base transceiver station problem.

5.2 Limitation of the work

3G Cell Addition:

- Can't possible add more than 4 cell in the same base transceiver station.

3G Cell Splatting:

- Handoffs are increasingly visit.
- Channel assignments end up troublesome.
- All cells are not part at the same time so exceptional consideration must be taken for appropriate designation of issue.
- A cell can be divided maximum two parts not more than that.
- Same time cost overlapping of call
- Have do cell splitting in different direction cell.

References

1. https://en.wikipedia.org/wiki/Telecommunication[Last Accessed Time: 9:20 AM 2nd October, 2018]
2. https://study.com/directory/category/Computer_Sciences/Networking_and_Telecommunications.html[Last Accessed Time: 10:35 AM 10th October, 2018]
3. https://en.wikipedia.org/wiki/3G[Last Accessed Time: 11:24 PM 4th October, 2018]
4. https://en.wikipedia.org/wiki/Cellular_network[Last Accessed Time: 8:50 PM 20th October, 2018]
5. https://www.tnuda.org.il/en/physics-radiation/radio-frequency-rf-radiation/cellular-communication-network-technologies[Last Accessed Time: 10:30 PM 20th October, 2018]
6. https://www.vskills.in/certification/tutorial/wimax-4g-2/frequency-reuse/[Last Accessed Time: 11:20 PM 3rd November, 2018]
7. https://en.wikipedia.org/wiki/GSM[Last Accessed Time: 3:40 PM 5th October, 2018]
8. http://www.mobilecomms-technology.com/projects/gsm/[Last Accessed Time: 7:40 PM 6th October, 2018]
9. http://www.rfwireless-world.com/Tutorials/gsm-channel-types.html[Last Accessed Time: 9:00 PM 1st November, 2018]
10. https://www.tutorialspoint.com/gsm/gsm_security.htm[Last Accessed Time: 10:20 AM 12th November, 2018]
11. https://itstillworks.com/types-mobile-networks-6923312.html[Last Accessed Time: 10:40 AM 16th September, 2018]
12. https://en.wikipedia.org/wiki/1G[Last Accessed Time: 8:20 PM 10th September, 2018]
13. https://en.wikipedia.org/wiki/2G[Last Accessed Time: 11:27 PM 10th September, 2018]
14. https://en.wikipedia.org/wiki/3G[Last Accessed Time: 12:20 AM 12th September, 2018]
15. https://en.wikipedia.org/wiki/4G[Last Accessed Time: 10:50 PM 13th September, 2018]
16. https://en.wikipedia.org/wiki/5G[Last Accessed Time: 10:20 AM 13th September, 2018]
17. https://en.wikipedia.org/wiki/List_of_mobile_phone_generations[Last Accessed Time: 9:40 AM 4th September, 2018]

18. https://www.thinksmallcell.com/Technology/four-ways-to-add-capacity-from-sectorisation-to-small-cells.html[Last Accessed Time: 10:20 AM 22th October, 2018]
19. https://en.wikipedia.org/wiki/GNet[Last Accessed Time: 11:20 AM 25 October, 2018]
20. https://en.wikipedia.org/wiki/Compass[Last Accessed Time: 10:28 PM 18th October, 2018]