Bachelor of Science in Computer Science & Engineering

Industrial Attachment in Teletalk Bangladesh Limited

by

Team Members	**ID**
Tasfirul Alam Siyam	1804010
Pranta Sarkar	1804047
Md.Mushfikur Rahman	1804048
Md.Fahim Hossain Saikat	1804077
Souhardyo Bhattacharjee	1804079
Ashraful Hoque Eusha	1804081
Nymul Hasan	1804083
Raiyan Bashir Mahin	1804097
Md. Nahid Imtiaz	1804101
Abir Hassan	1804110
MD.Shahrear Hossain	1804115

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Department of Computer Science & Engineering

Chittagong University of Engineering & Technology (CUET)

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Department of Computer Science & Engineering

Chattogram-4349, Bangladesh.

Project Report

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Submitted to : **Prof. Dr. A.H.M. Ashfak Habib**
Professor
Department of Computer Science & Engineering,
Chittagong University of Engineering Technology
Sharmistha Chanda Tista
Assistant Professor
Department of Computer Science & Engineering,
Chittagong University of Engineering Technology
Hasan Murad
Lecturer
Department of Computer Science & Engineering,
Chittagong University of Engineering Technology
Saadman Sakib
Lecturer
Department of Computer Science & Engineering,
Chittagong University of Engineering Technology

Level : 4
Term : I

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Acknowledgement

We have done an industrial attachment of 2 working cycles in TELETALK BANGLADESH LTD. We made our effort to this industrial attachment. However,it would not have been possible without the kind support and help of many individuals and organizations. First and foremost, we obliged and grateful to our creator for providing us the strength.Our heartiest gratitude goes to our honourable course teachers. Our gratitude extends to Dr. Abu Hasnat Mohammad Ashfak Habib, Head of Department of Computer Science and Engineering, Chittagong University of Engineering and Technology, for his encouragement and motivations. And finally, we are paying our gratitude to Teletalk Bangladesh Limited for letting us work with them and also for helping us whenever we had asked for. We would like to earnestly acknowledge the sincere efforts and valuable time given by:

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  Teletalk Bangladesh Limited

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  Deputy Manager, System Operations (CTG)
  Teletalk Bangladesh Limited

Finally, we want to express our sincere gratitude and respect to all other teachers of our department.

Abstract

Teletalk Bangladesh Limited is a public limited company, registered under the Registrar of the Joint stock companies of Bangladesh. Total shares owned by the Government of the People's Republic of Bangladesh. Their mission is to innovate and constantly find new ways to enhance services to customer's current needs and desires for the future. They visioned at knowing customers and meeting their needs better than anyone else. This report is submitted as a partial fulfillment of the regular course "Industrial Training and Attachment". Teletalk uses GSM system in their communication system.

1 Teletalk Overview

1.1 Company Overview

A public limited company, Teletalk Bangladesh Limited is listed with the Registrar of Joint Stock Companies of Bangladesh. Total shares held by the People's Republic of Bangladesh government. Through our steadfast dedication to providing top-notch goods and services as well as industry-leading customer retention and loyalty programs, they keep expanding and retaining our customers. Teletalk is still a part of the global connectivity revolution that is bringing millions of Bangladeshis together. The creation of Teletalk Bangladesh Limited was done with a specific function in mind. As the sole Bangladeshi mobile operator and the only operator with hundred percent domestic technical and engineering talent, Teletalk has moved ahead, strengthened its course, and accomplished remarkable things truly to be proud of.

Basic objectives for which the Company was formed are highlighted here under:

1. To give public sector employees with cell phone service
2. To protect the public interest by ensuring fair competition between the public and private sectors
3. To help with some of the unrelentingly high demand for cell phones
4. To give the government a new stream of income.

1.2 Teletalk's Network Expansion

In order to meet its expanding client base and uphold its promise to all Bangladeshi residents to provide better service, Teletalk Bangladesh Limited has continuously extended its network. In addition to the majority of highways, Teletalk has built a network presence in 64 Districts and 402 Upazilas. Teletalk keeps expanding its network to cover more of Bangladesh, mostly concentrating on difficult-to-reach locations (such as the Chittagong Hill Tracks, the Sundarbans, the Haor-Baor region, the coastal belt, etc.).

1.3 Digital Services Of Teletalk

For the benefit of the government, Teletalk offers numerous distinctive Value-Added Services (VAS) and Digital Services. Value-Added Services (VAS) Wing of the organization continually identifies novel approaches to digitize government services. The following are a few of Teletalk's main digital services:

- Exam result processing (PSC, JSC, SSC, HSC).
- Digital admissions (schools, colleges, universities).
- Utility bill payments (BREB).
- Covid-19 & disaster support.
- Free online university classes.
- 'Alljobs by Teletalk' (govt. job applications).

1.4 Alljobs By Teletalk

Teletalk has digitalized the application process for government positions in order to support the concept of "Digital Government." 'Alljobs by Teletalk' is the name of the company's specific job application website. It is the nation's biggest online job application portal for the government. For Bangladesh's millions of job seekers, the burdensome old manual application process has been eliminated. Along with expanding commercial businesses, the following are some government departments that make use of this service:

- Bangladesh Public Service Commission
- Bangladesh Police
- Bangladesh Ansar and VDP
- Bangladesh Telecommunication and Regulatory Commission
- National Board of Revenue

- The Ministries and Divisions of Bangladesh
- DC Offices of Bangladesh
- State-owned Enterprises and Companies

1.5 Mission & Vision Of Teletalk

Vision: To be the most affordable brand offering the state-of-the-art mobile voice, digital services and broadband access to every citizen in every corner of Bangladesh

Mission: To acquire significant market share by providing countrywide network coverage and to be one of the leading Mobile network operators of Bangladesh.

2 Overview of GSM(2G), WCDMA(3G) LTE(4G), NR(5G)

2.1 Network Generation Evolution

	Introduced	Frequency	Technology	Service	Net Speed	Access System
1G	1979	800-900MHz	**AMPS, TACS**	Voice	2.4Kbps	**FDMA**
2G	1991	1.8GHz	**GSM**	Digital Voice, SMS	64Kbps	**TDMA/CDMA**
3G	2001	2GHz	**WCDMA**	High Quality Audio, Voice and Data	2Mbps	**CDMA**
4G	2010	1800MHZ	**WiMAX, LTE**	Dynamic Info Access	1Gbps	**CDMA**
5G	2019	24-47GHz	**MIMO**	Dynamic Info Access With Ai Capability	10Gbps	**OFDM/BDMA**

Figure 2.1: Different Generation Evaluation

2.2 History of GSM

In the early 1980s, Europe experienced a surge in analog cellular phone systems. However, each country had its own incompatible system, limiting equipment use within national borders. Recognizing the need for a unified approach, the Conference of European Posts and Telegraphs (CEPT) established the Groupe

Spécial Mobile (GSM) in 1982. GSM aimed to create a pan-European mobile system with criteria like good call quality, low costs, international roaming, and more. By 1989, responsibility for GSM shifted to the European Telecommunication Standards Institute (ETSI), with commercial service starting in 1991. It rapidly expanded globally, with over 200 networks in 110 countries. GSM, originally a European standard, eventually became a global system for mobile communications, serving millions of subscribers. Developers chose a pioneering digital system over analog, banking on advancements in compression and digital signal processing. GSM standards provided flexibility for innovation while ensuring compatibility among system components, making it a milestone in mobile technology.

2.3 Services provided by GSM

GSM offers various services, striving for ISDN compatibility. Its basic services include telephony, digital speech transmission, and an emergency service (similar to 911). Data services enable data transmission at speeds up to 9600 bps to various networks, including POTS and ISDN. GSM uniquely supports Short Message Service (SMS) for sending short messages. Supplementary services, like call forwarding and call barring, enhance the user experience, with more to come in Phase 2 specifications, such as caller identification and call waiting.

2.4 GSM Frequency Bands

The following table summarizes the frequency bands and their details. Among the frequencies:

2.5 GSM System along with The Signal Flow

- Mobile Station (MS): The mobile station refers to the user's device, such as a mobile phone, which is the endpoint for communication in the 2G network.
- Base Transceiver Station (BTS): BTS is a key component that interfaces

System	GSM-900	GSM-1800	GSM-1900
Uplink (MHz)	890-915	1710-1780	1.85-1.91
Downlink (MHz)	935-950	1805-1880	1930-1990
Bandwidth (MHz)	25	75	60
Duplex distance (MHz)	45	95	80
Carrier separation (KHz)	200	200	200
Radio channels	125	375	300
Modulation	GMSK	GMSK	GMSK
Transmission rate	270 kbps	270 kbps	270 kbps

Figure 2.2: Various GSM frequency Bands

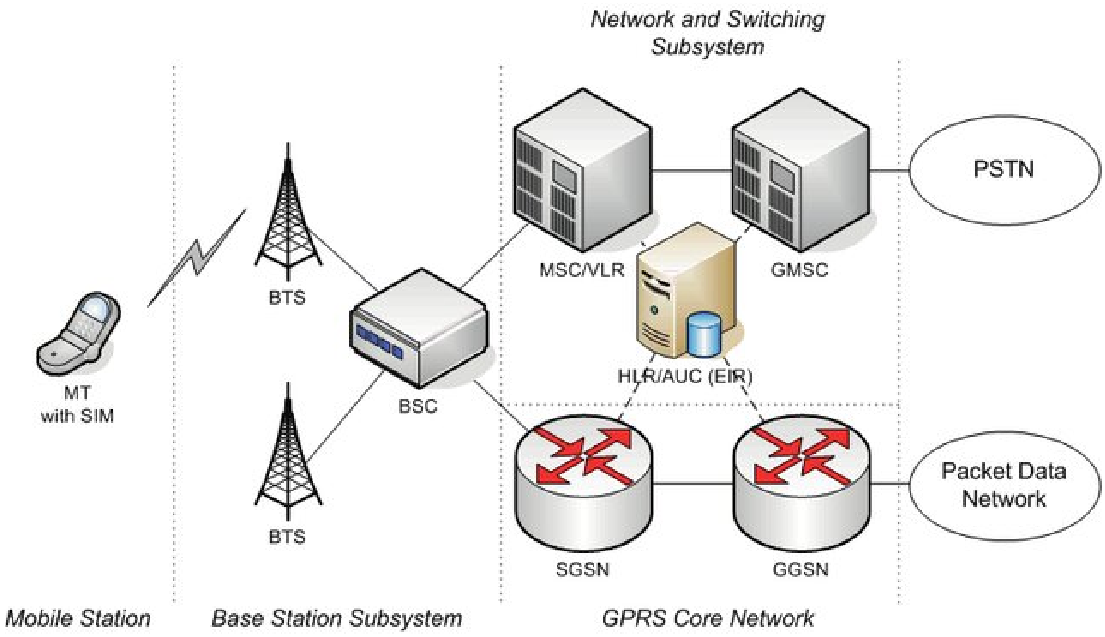

Figure 2.3: Simple GSM Core Network

with the mobile station, managing the radio communication and handling tasks like call setup, call control, and radio frequency management.

- Base Station Controller (BSC): BSC is responsible for managing multiple BTSs, controlling their functionalities, and efficiently allocating radio resources.

- GPRS Core Network: The GPRS core network involves several critical elements, including MSC (Mobile Switching Center), GMSC (Gateway Mobile Switching Center), HLR (Home Location Register), AUC (Authentication

Center), SGSN (Serving GPRS Support Node), GGSN (Gateway GPRS Support Node), PSTN (Public Switched Telephone Network), and Packet Data Network.

- MSC (Mobile Switching Center): MSC is a central component that manages circuit-switched connections, call routing, and traditional telephony services.
- GMSC (Gateway Mobile Switching Center): GMSC serves as a gateway to external networks, facilitating call routing and connecting to other telecommunication networks.
- HLR (Home Location Register): HLR is a vital database that stores subscriber information, including user profiles and authentication data, enabling efficient call routing and management.
- AUC (Authentication Center): AUC handles subscriber authentication and encryption functions, ensuring the security and privacy of user communications.
- SGSN (Serving GPRS Support Node): SGSN manages packet-switched data traffic, ensuring efficient data routing and connectivity within the GPRS network.
- GGSN (Gateway GPRS Support Node): GGSN acts as the interface between the GPRS network and external packet-switched networks, facilitating data transfer between the GPRS core network and the internet or other packet data networks.

2.6 History of WCDMA(3G)

International Mobile Telecommunications-2000 (IMT-2000), better known as 3G or 3rd Generation, is a generation of standards for mobile phones and mobile telecommunications services fulfilling specifications by the International Telecommunication Union. 3G technologies make use of TDMA and CDMA. 3G technologies make use of value-added services like mobile television, GPS (global positioning system) and video conferencing. The first commercial launch of 3G was also by

NTT DOCOMO in Japan on 1 October 2001, although it was initially somewhat limited in scope.

2.7 Properties of WCDMA(3G)

W-CDMA stands for Wideband Code Division Multiple Access is a third generation's important feature based on the radio transmission system. It is designed by the ETSI Alpha organization. It is quite challenging to apply it because of its complex features and versatile properties. Properties of WCDMA:

- Make a hybrid with IS-95 (digital cellular standard) component of 2G technology responsible for the high frequency.
- It is able to download 14.7 Mb/s.
- Provide wideband known as Spread Spectrum in addition to code division multiple accesses.
- Improved audio-visual effects.

2.8 3G Core Network Architecture

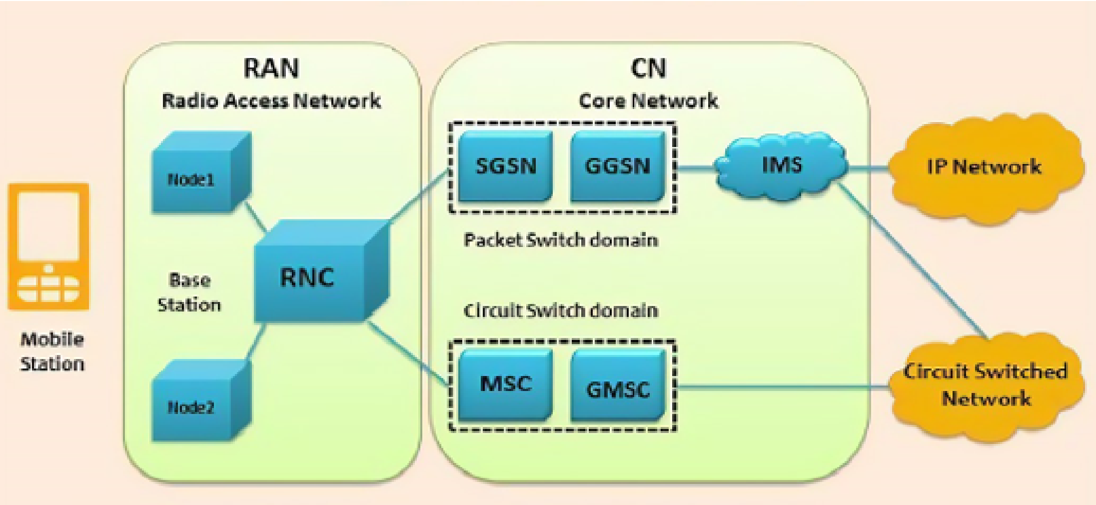

Figure 2.4: 3G Network Architecture

- Mobile Station (MS): The mobile station includes the user's device (e.g., smartphone), acting as the endpoint for communication in the 3G network.
- Radio Access Network (RAN): RAN consists of NodeB (Node1) and RNC

(Node2). NodeB manages the air interface, while RNC controls and manages NodeB, handling tasks like handovers and radio resource allocation.

- Circuit Switched Network (CS Network): The CS network handles traditional voice calls and circuit-switched data services, connecting to the mobile switching center (MSC) and gateway mobile switching center (GMSC).
- Core Network (CN): CN includes various key elements like SGSN (Serving GPRS Support Node) and GGSN (Gateway GPRS Support Node). SGSN manages packet-switched data traffic, while GGSN acts as the interface between the mobile network and external packet-switched networks (e.g., the internet).
- MSC (Mobile Switching Center): MSC is a central component in the 3G network responsible for circuit-switched connections, call routing, and management of voice and traditional telephony services.
- GMSC (Gateway Mobile Switching Center): GMSC acts as a gateway to external networks, facilitating the routing of calls and data between the 3G network and other telecommunication networks.
- (IP Multimedia Subsystem): IMS is a framework enabling multimedia services such as VoIP, video calls, and multimedia messaging (e.g., MMS) over IP networks, enhancing communication beyond traditional voice and SMS services.
- IP Network: The IP network forms the backbone for packet-switched data transmission, facilitating the transfer of data between various network elements and external networks.
- Integration of Services: 3G network architecture integrates services from both circuit-switched and packet-switched domains, allowing for a wide range of communication services including voice, data, and multimedia.
- Interoperability: The 3G network architecture ensures seamless interoperability between different network elements, enabling efficient communication and mobility across various components within the network.

2.9 History of LTE(Long-Term Evolution) 4G

4G is known as the fourth Generation of Mobile Communication or wireless communication technology, which is the successor of the 3G network. It provides high data transmission speed and is suitable for HD video calling, fast download and upload, live streaming, online gaming,etc. A 4G system must adhere to the capabilities and features specified by the ITU(International Telecommunication Union) in IMT advanced, including transmission technology and data speed. 4G network provides up to 100 Mbps speed to users, far higher than a 3G network. 4G enables users to stream high-definition audio and videos without interruption due to its high speed. It also facilitates wireless broadband that allows the users to access the internet without any need for fixed wired. Development on 4G – including the development of what would qualify as a 4G network–first began in the 2000s, with standards being formally adopted in 2008. The first service was deployed in Stockholm and Oslo in 2009, and expansion of the network followed shortly thereafter. In retrospect, these systems were too slow to be considered true 4G and later were classified as LTE. Commercial phones were available shortly thereafter. 4G reached the United States in 2012, with five companies making the network available. The wireless generation was largely standard for mobile phone and mobile web use by the mid-2010s. However, in 2019, 5G began to be rolled out. While 5G has not yet supplanted 4G, it is expected to within the next few years. Like 3G, 4G will eventually become an obsolete generation of wireless connectivity.

2.10 Features of LTE

- Speed: 4G mobile communication offers significantly faster data speeds compared to its predecessor, allowing for quicker downloads and smoother streaming experiences.
- LTE (Long-Term Evolution): 4G utilizes LTE technology, enabling higher data transfer rates and improved network efficiency for enhanced connectivity.
- MIMO (Multiple Input Multiple Output): 4G employs MIMO technology,

using multiple antennas for transmitting and receiving data simultaneously, enhancing signal strength and overall network performance.

- IP (Internet Protocol): 4G relies on Internet Protocol (IP) for data transmission, enabling seamless integration with various internet-based applications and services.
- Low Latency: 4G networks achieve low latency, reducing the time it takes for data to travel between devices, crucial for real-time applications like online gaming and video conferencing.
- High Bandwidth: 4G offers a broader bandwidth, accommodating a higher volume of data traffic and supporting multiple users concurrently without compromising performance.
- Enhanced Security: 4G incorporates advanced encryption and security measures to safeguard user data and communications, protecting against potential cyber threats.
- Advanced Voice Services: 4G supports high-quality voice calls using Voice over LTE (VoLTE), delivering clearer audio and better call reliability.
- Carrier Aggregation: 4G employs carrier aggregation, combining multiple frequency bands to increase data speeds and optimize network utilization.
- Improved Coverage: 4G networks provide wider coverage, reaching more remote and rural areas, ensuring a broader and more accessible network for users.

2.11 4G Core Network Architecture

- eNodeB (Evolved NodeB): The eNodeB is a key component in the 4G network architecture, serving as the base station that connects mobile devices to the core network. It manages the radio interface and controls wireless access for users.
- E-UTRAN (Evolved Universal Terrestrial Radio Access Network): E-UTRAN consists of eNodeBs and is responsible for radio communication between

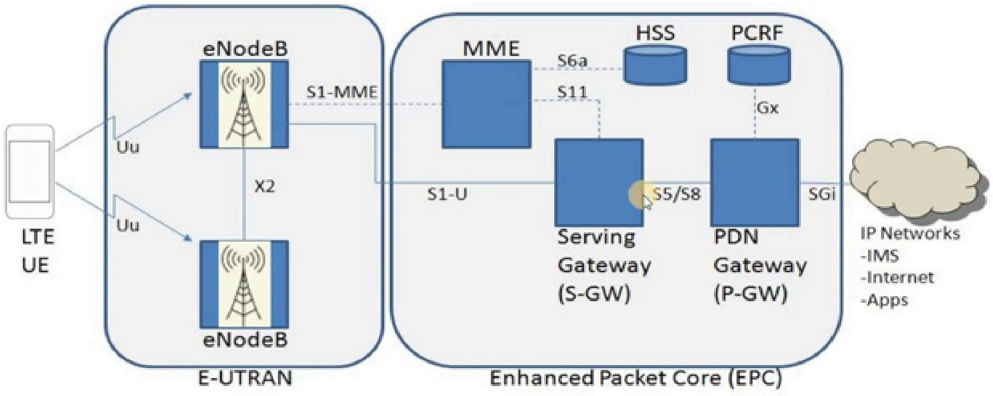

Figure 2.5: 4G Network Architecture

mobile devices and the core network. It ensures high data speeds and low latency for seamless user experience.

- MME (Mobility Management Entity): MME is a critical element in the evolved packet core, handling authentication, tracking, and managing the mobility of mobile devices. It ensures smooth handovers and connectivity during movement across different eNodeBs.
- HSS (Home Subscriber Server): HSS is the main database that stores subscriber information, including authentication data, user profiles, and service-related data. It authenticates users and provides necessary information to enable their access to the network.
- S-GW (Serving Gateway) and P-GW (Packet Data Network Gateway): S-GW and P-GW handle data routing and connectivity between the mobile device and external packet data networks (e.g., the internet). S-GW manages data within the mobile network, while P-GW connects to external networks, ensuring efficient data transfer and routing.

2.12 Introduction to 5G

5G, short for the fifth generation of wireless technology, represents a transformative leap in the world of telecommunications. It is the latest iteration in the evolution of mobile networks, succeeding 4G LTE. What sets 5G apart is its promise of unprecedented speed, reliability, and connectivity. With data rates reaching up to 10 gigabits per second, 5G is set to enable a wide range of applications, from lightning-fast internet browsing and high-quality video streaming to powering the Internet of Things (IoT) and supporting autonomous vehicles.

5G achieves these remarkable capabilities through a combination of advanced technologies, including massive MIMO (Multiple Input, Multiple Output), millimeter-wave frequencies, and network slicing. These innovations promise ultra-low latency, near-instantaneous communication, and network capacity to accommodate the ever-growing demand for data.

Moreover, 5G is not just about faster smartphones; it's a versatile technology with the potential to revolutionize various industries. From healthcare and smart cities to agriculture and manufacturing, 5G's high-speed, low-latency connections will drive innovation and automation, creating new opportunities and changing the way we live and work.

While 5G brings incredible promise, its rollout also comes with challenges, including infrastructure deployment, spectrum allocation, and security concerns. Nevertheless, as the world continues to embrace the digital age, 5G is poised to be a pivotal force in shaping our connected future, opening doors to a world of possibilities that were once confined to the realm of science fiction.

2.13 Features of 5G

- Low Latency: 5G offers significantly reduced latency, enabling near real-time communication and supporting applications that demand rapid responsiveness, such as autonomous vehicles and remote surgery.
- High Bandwidth: 5G provides immense bandwidth, allowing for a massive increase in data transmission rates, supporting ultra-high-definition streaming, augmented reality, and virtual reality applications.
- Enhanced Connectivity: 5G supports a massive number of connected devices simultaneously, promoting the Internet of Things (IoT) and smart city initiatives with seamless device communication.
- NR (New Radio): NR is the new air interface standard for 5G, offering

improved data rates, energy efficiency, and better connectivity in diverse environments.

- MIMO (Multiple Input Multiple Output): 5G extensively utilizes MIMO technology, employing multiple antennas for both base stations and devices to enhance signal quality, capacity, and spectral efficiency.
- Polar Coding: 5G incorporates advanced error-correction techniques like polar coding to enhance data reliability and transmission efficiency, crucial for high-speed, low-latency communication.
- Network Slicing: 5G enables network slicing, allowing the network to be divided into multiple virtual networks, each customized to specific use cases or applications with varying requirements.
- Edge Computing: 5G facilitates edge computing, enabling data processing and analysis closer to the source, reducing latency and enhancing response times for critical applications.
- Beamforming: 5G employs beamforming technology, focusing radio waves toward specific devices, optimizing signal strength and coverage, and enhancing overall network performance.
- Millimeter Wave (mmWave) Spectrum: 5G utilizes the mmWave spectrum, providing incredibly high data speeds but requiring a denser network infrastructure due to shorter propagation distances.

3 Base Transceiver Station Architecture

A Base Transceiver Station (BTS) is a fundamental component in mobile communication networks. It is responsible for facilitating wireless communication by connecting mobile devices to the network. In this report, we will explore the main configuration of equipment inside a BTS, its functions, and its internal components. Additionally, we will discuss different types of BTS deployments to meet various network needs.

3.1 External Components of a BTS

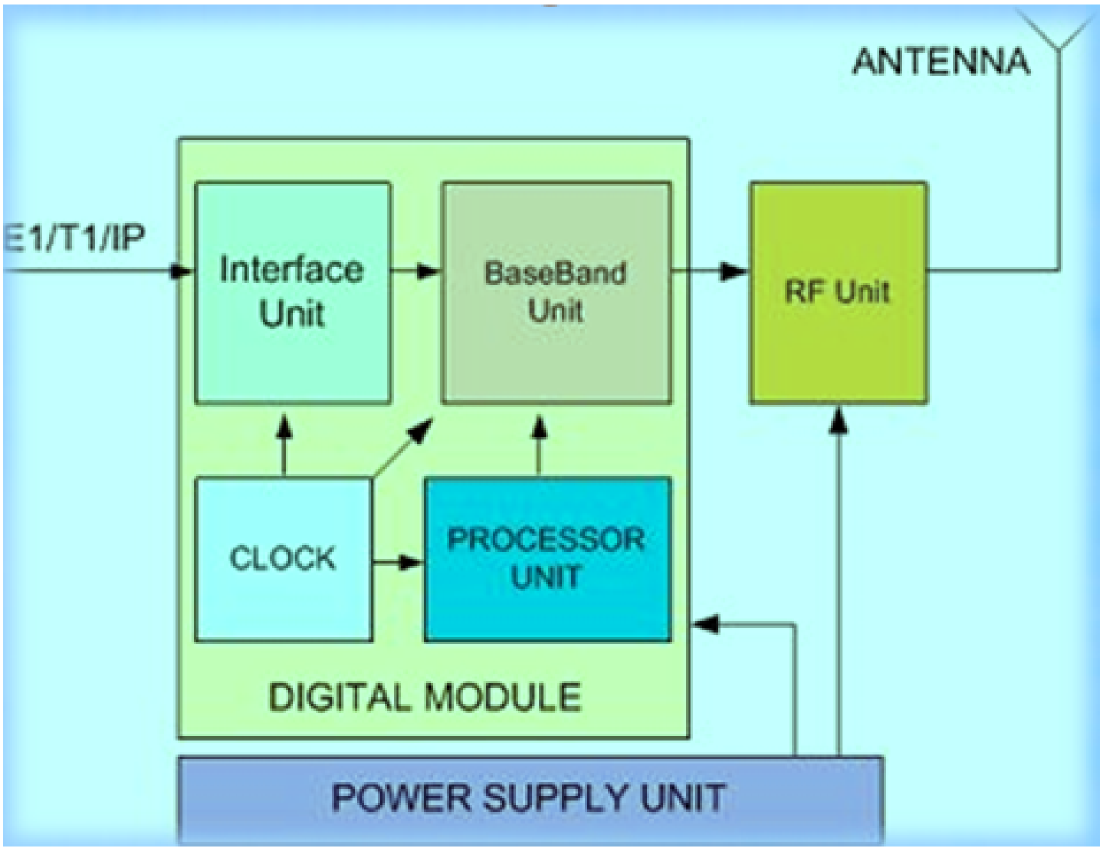

Figure 3.6: External Components of a BTS

Main Processor Unit: The main processor unit serves as the brain of the BTS. Its functions include BTS initialization, configuration, and software download, ensuring the proper functioning of the station.

Clock Source Unit: This unit provides synchronized clock signals to all digital equipment within the BTS, ensuring precise timing for network operations.

Interface Unit: The interface unit handles connections between the BTS and other network elements, enabling data exchange and communication.

Baseband Unit (BBU): Responsible for processing digital data and adhering to GSM standards, the BBU prepares data for transmission by the RF unit, making it ready for wireless communication.

Power Supply Unit (PSU): The PSU is a vital component, converting incoming AC voltage into DC voltage to supply power to all BTS components, ensuring uninterrupted operation.

RF Unit: This unit plays a crucial role in the conversion of digital signals into radio frequency (RF) signals, facilitating wireless transmission and reception.

Antenna Unit: The antenna unit converts electrical signals into electromagnetic signals and helps define the coverage area or cell dimension in the network.

3.2 Internal Components of a BTS

Control and Distribution Unit (CDU): The CDU is integral to managing various functions within the BTS. It orchestrates activities, ensuring efficient operation.

Transceiver (TRX): The TRX is responsible for transmitting and receiving RF signals, enabling voice and data communication with mobile devices.

Transcoding and Multiplexing Unit (TMU): The TMU converts voice signals into digital format and multiplexes them with data, ensuring compatibility across different devices and network protocols.

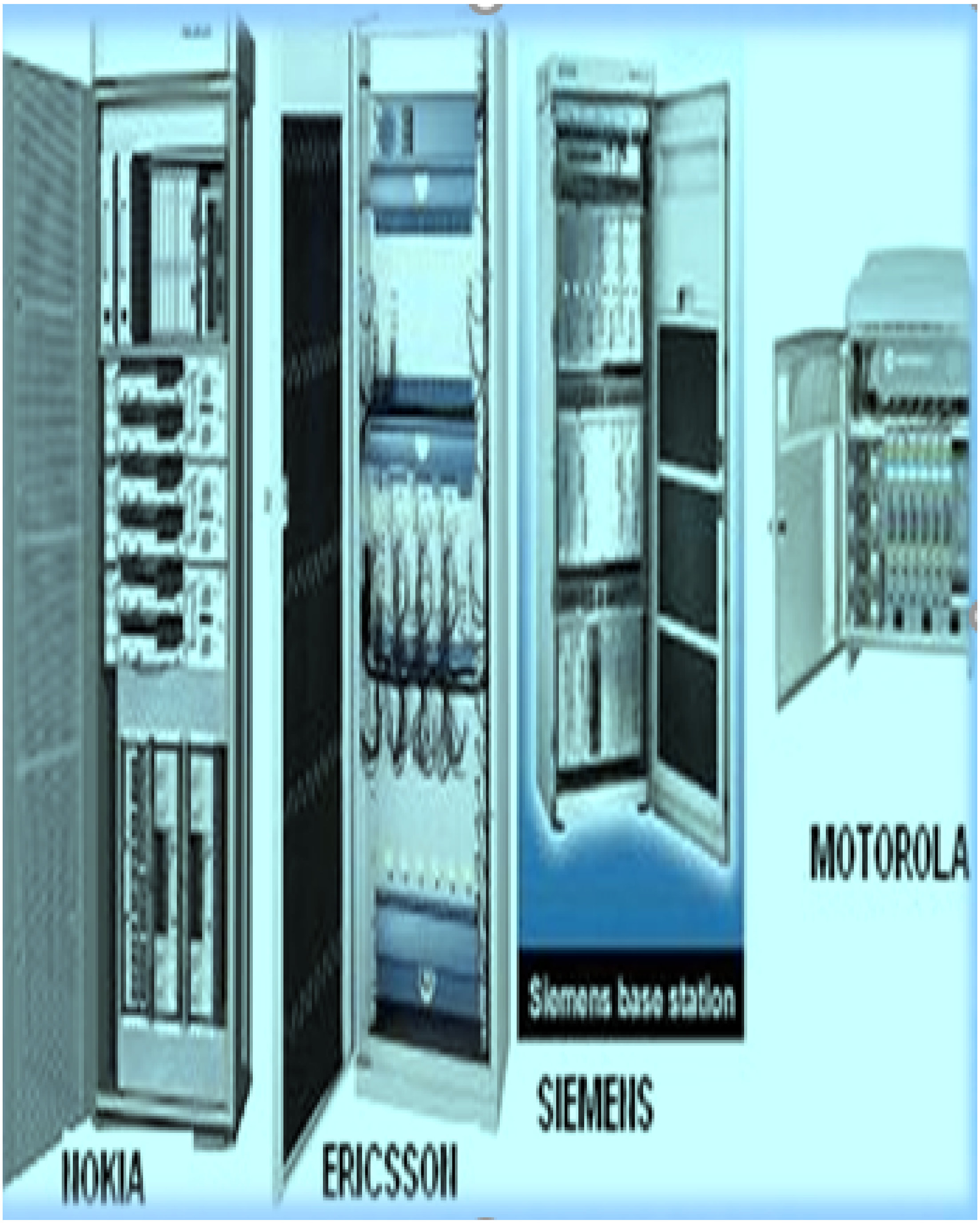

Figure 3.7: Internal Components of a BTS

3.3 Types of BTS Deployments

Tower-Mounted BTS: A typical BTS tower holds the antenna, which is often mistaken for the entire BTS. The tower is essential for elevating the antenna to maximize coverage. The shelter housing the actual BTS can also be seen nearby.

Mobile BTS: Deployed when there is a sudden increase in mobile subscribers, mobile BTS provides additional capacity and coverage in crowded locations like fairs and conferences.

Building-Mounted BTS: In urban areas or locations with space constraints, BTS equipment may be mounted on building rooftops, designed for outdoor applications.

3.4 Power System

The telecommunications power system forms the vital backbone of our interconnected world, enabling the seamless flow of information, data, and communication across vast networks. These power systems are the silent guardians of modern connectivity, ensuring that our phones stay charged, our internet remains accessible, and our digital lives continue without interruption.

At its core, a telecommunications power system is a complex and meticulously engineered infrastructure designed to provide electrical power to the vast array of devices and equipment that make up our modern telecommunication networks. From cell towers to data centers, this system is a critical component that demands efficiency, reliability, and adaptability to meet the ever-increasing demands of our digital age.

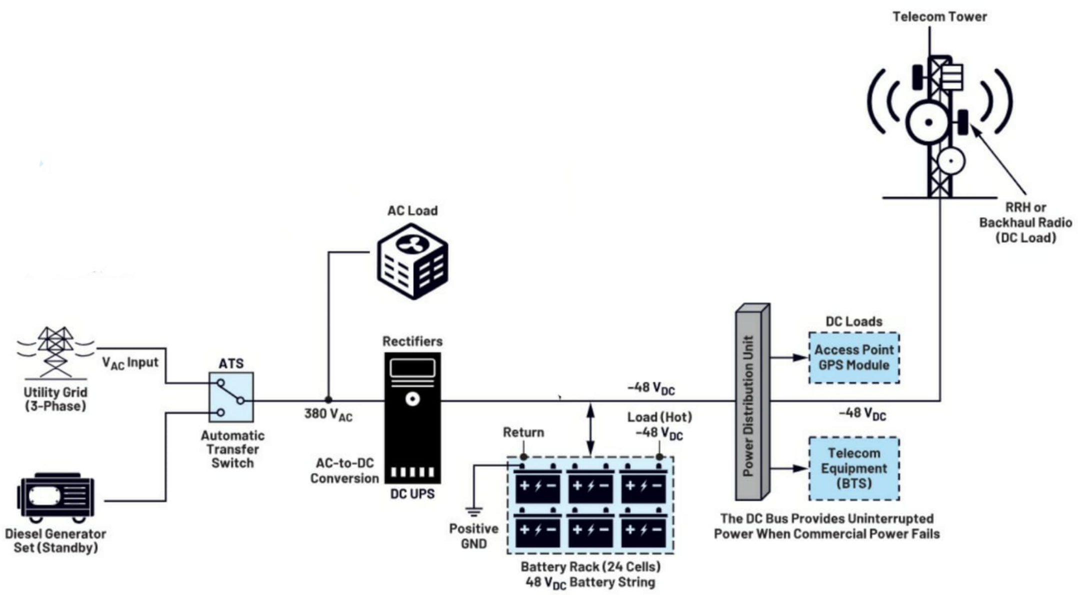

Figure 3.8: Diagram of the Teletalk Power System

Telecommunication and wireless networks commonly rely on a power supply of -48 VDC, chosen for its inherent simplicity. This unique voltage configuration facilitates the development of reliable power backup systems using batteries, obviating the need for cumbersome inverters. The practicality of DC power lies in its capacity to be efficiently stored within batteries, ensuring uninterrupted operations even in the event of a utility power disruption.

Nonetheless, it's important to note that the -48 VDC must undergo an initial transformation into a positive intermediate bus voltage. This voltage alteration is essential for either powering the Power Amplifier (PA) or converting it into a workable positive supply for the digital Baseband Units (BBU). Historically, power supplies ranging from 100 to 350 watts sufficed for a wide array of applications. For these purposes, forward converters have been a reliable choice and have remained a cornerstone in telecom BBUs and RRUs for years.

4 Radio Access Network

In the previous section of this report the equipment of BTS was discussed. In this section we will discuss some other topics related to RAN. We will discuss the call setup method of Same operator and other operators.

4.1 Call Setup in Same Operator

Step 1: When MS1 calls a number the BTS transfers the call to BSC and BSC then transfers the call to MSC1.

Step 2: The MSC checks the prepaid service runs the balance check.

Step 3: If the balance check returns ok the MSC1 checks the HLR for the related VLR address.

Step 4: After finding the VLR address the MSC1 connects with the MSC2

Step 5: MSC2 checks the VLR for the related BSC.

Step 6: A Paging request is broadcasted along all the BTS under BSC2.

Step 7: If the MS is found then a request for call establishment is send to the MSC1 via MSC2.

Step 8: A time slot is assigned to the MS2 and the establishment signal is sent to the MS1.

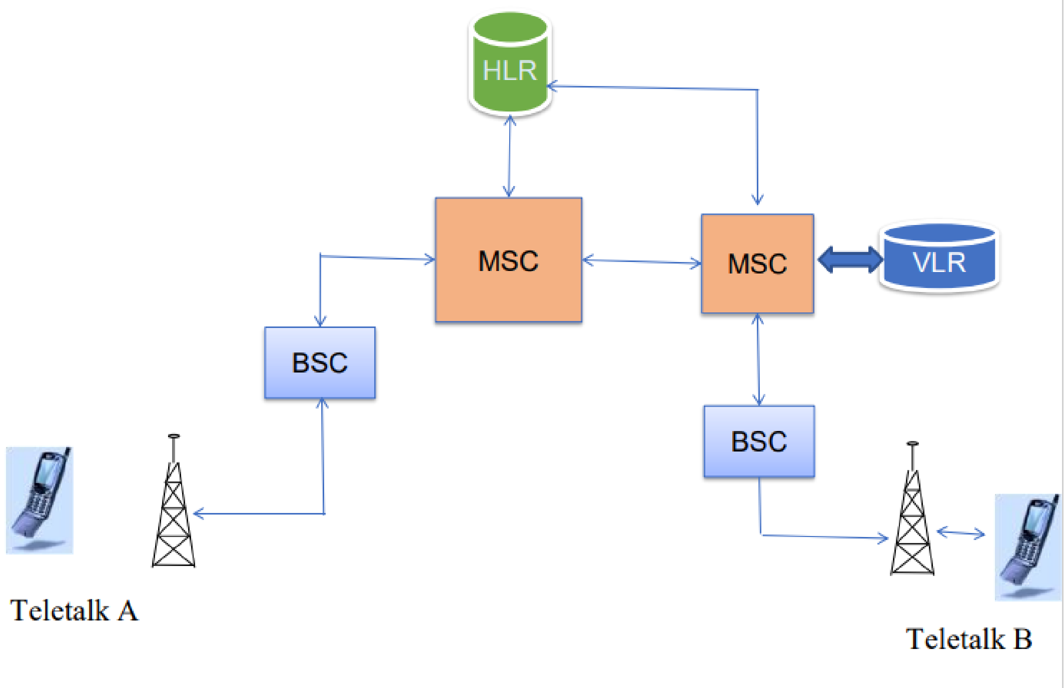

Figure 4.9: Call Setup in Same Operator

4.2 Call Setup in Different Operator

Step 1: When MS1 calls a number the BTS transfers the call to BSC and BSC then transfers the call to MSC1.

Step 2: The MSC checks the prepaid service runs the balance check.

Step 3: If the balance check returns ok the MSC1 checks the number. If it finds different operator then it connects with GMSC for the operator.

Step 4: After connecting with the GMSC2, it finds the related VLR address from the HLR.

Step 5: MSC2 checks the VLR for the related BSC.

Step 6: A Paging request is broadcasted along all the BTS under BSC2.

Step 7: If the MS is found then a request for call establishment is send to the MSC1 via MSC2.

Step 8: A time slot is assigned to the MS2 and the establishment signal is sent to the MS1

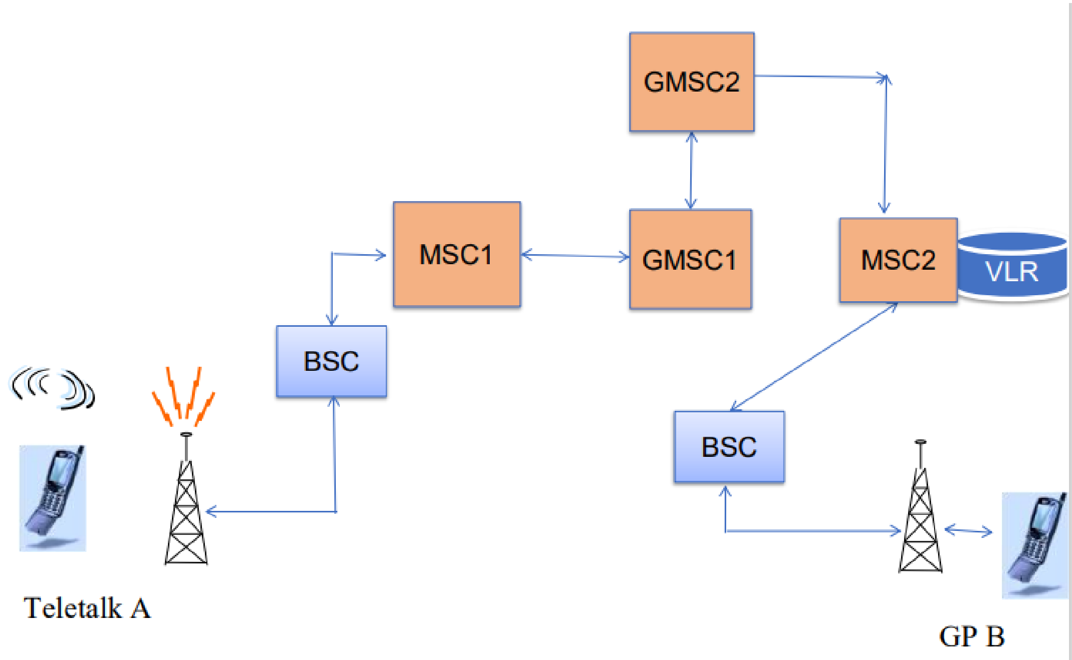

Figure 4.10: Call Setup in Different Operator

5 Transmission System

5.1 Microwave Transmission

The objective of microwave communication systems is to transmit information from one place to another without interruption, and clear reproduction at the receiver. Fig-5.11 indicates how this is achieved in its simplest form.

Above 100 MHz the waves travel in straight lines and can therefore be narrowly focused. Concentrating all the energy into a small beam using a parabolic antenna (like the satellite TV dish) gives a much higher signal-to-noise ratio, but the transmitting and receiving antennas must be accurately aligned with each other. Before the advent of fiber optics, these microwaves formed the heart of the long-distance telephone transmission system.

In its simplest form, the microwave link can be one hop, consisting of one pair of antennas spaced as little as one or two kilometers apart, or can be a backbone, including multiple hops, spanning several thousand kilometers. A single hop is typically 30 to 60 km in relatively flat regions for frequencies in the 2 to 8 GHz bands. When antennas are placed between mountain peaks, a very long hop length can be achieved. Hop distances in excess of 200 km are in existence. The "line-of-sight" nature of microwaves has some very attractive advantages over cable systems. Line of sight is a term that is only partially correct when describing microwave paths. Atmospheric conditions and certain effects modify the propagation of microwaves so that even if the designer can see from point A to point B (true line of sight), it may not be possible to place antennas at those two points and achieve a satisfactory communication performance.

In order to overcome the problems of line-of-sight and power amplification of weak signals, microwave systems use repeaters at intervals of about 25 to 30 km between the transmitting receiving stations. The first repeater is placed in line-of-sight of the transmitting station and the last repeater is placed in line-of-sight of the receiving station. Two consecutive repeaters are also placed in line-of-sight of each other. The data signals are received, amplified, and retransmitted by each of these stations.

5.1.1 Microwave Transmitter and Receiver

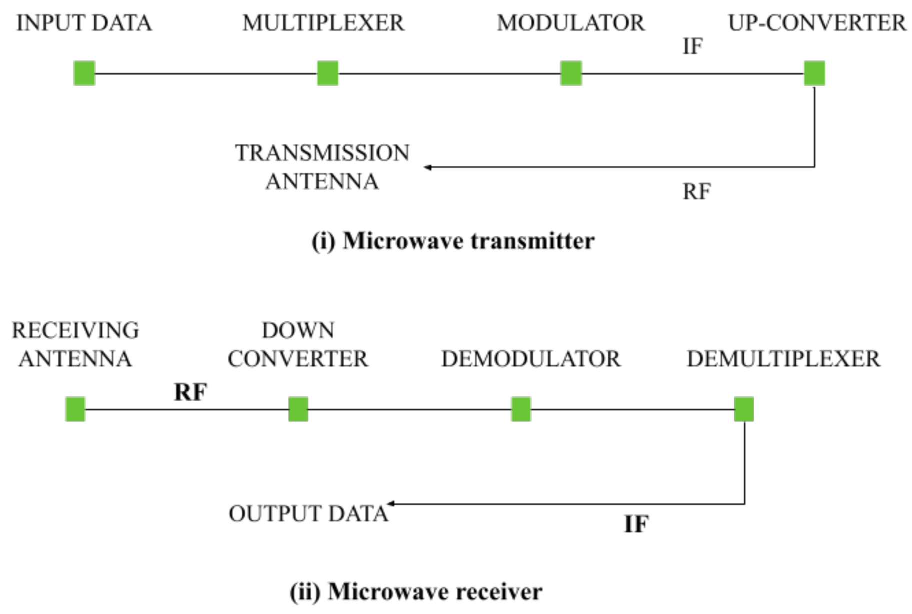

Figure 5.11: Microwave Transmitter and Receiver

The voice, video, or data channels are combined by a technique known as multiplexing to produce a baseband (BB) signal. This signal is frequency-modulated to an IF and then up-converted (heterodyned) to the RF for transmission through the atmosphere. The reverse process occurs at the receiver. The microwave transmission frequencies are within the approximate range of 2 to 24 GHz.

The frequency bands used for digital microwave radio are recommended by the CCIR. Each recommendation clearly defines the frequency range, the number of channels that can be used within that range, the channel spacing the bit rate, and the polarization possibilities.

5.2 Wired Transmission

The process of sending data or information using actual cables or wires is referred to as wired transmission. In contrast, data is sent wirelessly across the airways.

Consistent data rates, security, and dependability are hallmarks of wired transmission. It is often used in many different applications, including telephone lines for landline communication, coaxial or optical fibre cables for broadband internet, and Ethernet connections for local area networks (LANs). Although wireless technologies are more convenient and mobile, wired transmission is still necessary for important applications where reliable and secure data connections are essential.

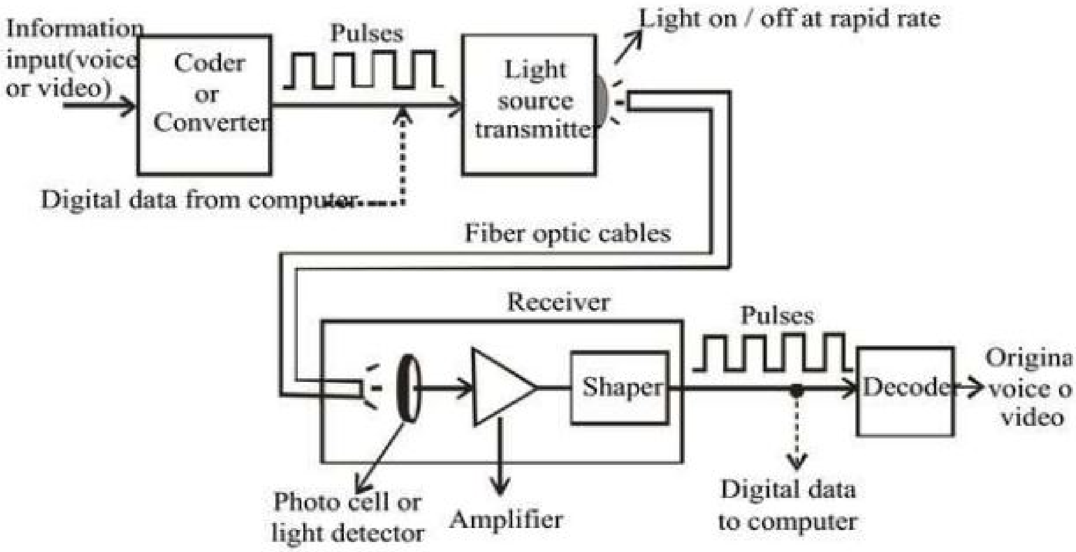

Figure 5.12: Wired Transmission using Optical Fiber

The foundation of contemporary data networks and telecommunications is optical fiber-based wired transmission. Light pulses are used by optical fibres, which are composed of tiny glass or plastic strands, to carry data. Their large bandwidth, fast data transfer rates, and low signal loss over extended distances are their main advantages. Because fibre optics are impervious to electromagnetic interference, data transmission via them is dependable and secure. Because of these characteristics, optical fibre is essential for telecommunication systems, internet connections, and backbone networks. The information highway of the digital era is powered by optical fibre, which is the preferred option for high-speed, long-distance data transmission due to its endurance, lightweight design, and potential for high data security.

5.2.1 Optical Fiber

Optical fibre is often composed of glass or plastic and is clear, flexible, and slim. It is intended to send light pulses that contain data. High-speed data transfer via phone networks, cable television, and the internet is made possible by this technology. Among the many benefits of optical fibres are their enormous bandwidth, fast data transfer rates, low signal loss over extended distances, and resistance to electromagnetic interference. Because of these characteristics, optical fibre is essential for telecommunication systems, high-speed internet, and backbone networks. Because of its strength, portability, and capacity for secure data transfer, optical fibre is a vital component of contemporary data transport, facilitating the quick exchange of information.

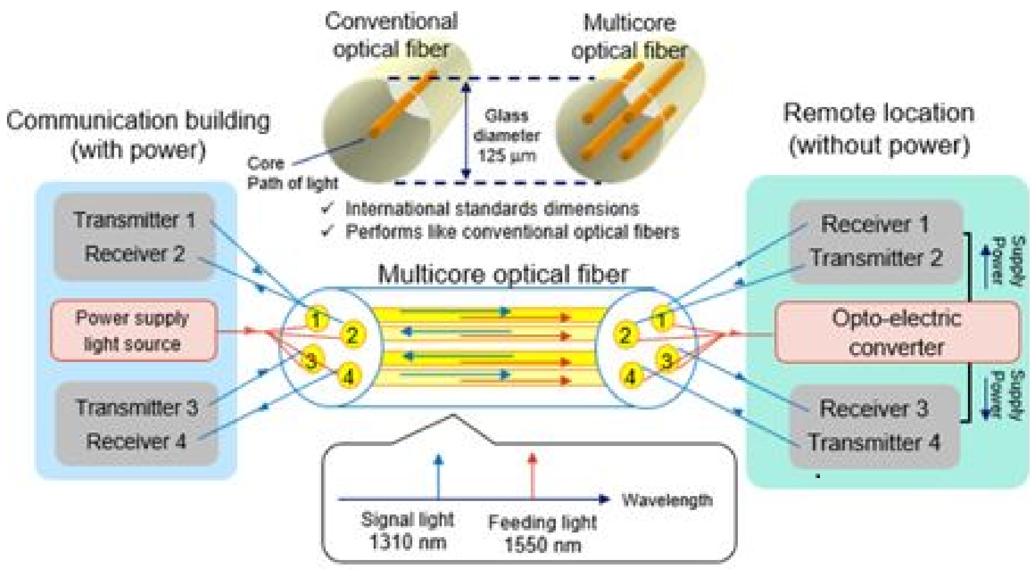

Figure 5.13: Physical Structure of Optical Fiber

Single-Mode Fibre (SMF) only permits one mode of light to propagate and has a tiny core. It is employed in data backbones and telecommunications for high-speed, long-distance transmission.

In optical fiber network three types of transmission equipment are used. All of them came from the vendor Huawei.

a. OptiX Metro 1000

b. OptiX OSN 2500 intelligent optical transmission

c. OptiX OSN 3500 intelligent optical transmission

6 Modulation of Digital Data

Digital Modulation provides more information capacity, high data security, quicker system availability with great quality communication. Hence, digital modulation techniques have a greater demand, for their capacity to convey larger amounts of data than analog modulation techniques.

Carrier Signal is a High-frequency signal used for digital-to-analog or analog-to-digital modulation.

Modulation is a Process of changing one of the characteristics of an analog signal based on information in the digital signal.

Figure 6.14: Digital to Analog Conversion

6.1 Basic Modulation Technique

6.1.1 Amplitude shift keying (ASK)

It is a type of digital modulation in which the amplitude of a carrier signal is varied to represent the digital data. ASK is the simplest digital modulation technique, and it is widely used in a variety of applications, including radio remote controls, key fobs, and garage door openers.

ASK works by varying the amplitude of a carrier signal in accordance with the digital data. For example, a binary "1" may be represented by a high amplitude carrier signal, while a binary "0" may be represented by a low amplitude carrier signal, or no carrier signal at all.

There are two main types of ASK:

On-off keying (OOK): In OOK, the carrier signal is either turned on or off to represent the digital data.

Linear ASK (LASK): In LASK, the amplitude of the carrier signal is varied linearly to represent the digital data. OOK is the simplest form of ASK, and it is the most commonly used type of ASK in low-cost applications. However, LASK offers better performance in terms of noise immunity and bandwidth utilization.

ASK is a relatively simple modulation technique to implement, and it is also relatively inexpensive. However, it is less efficient than other digital modulation techniques, such as frequency shift keying (FSK) and phase shift keying (PSK). This means that ASK requires more bandwidth to transmit the same amount of data.

ASK is also susceptible to noise and interference. This is because the amplitude of the carrier signal can be affected by a variety of factors, such as atmospheric conditions and other radio signals.

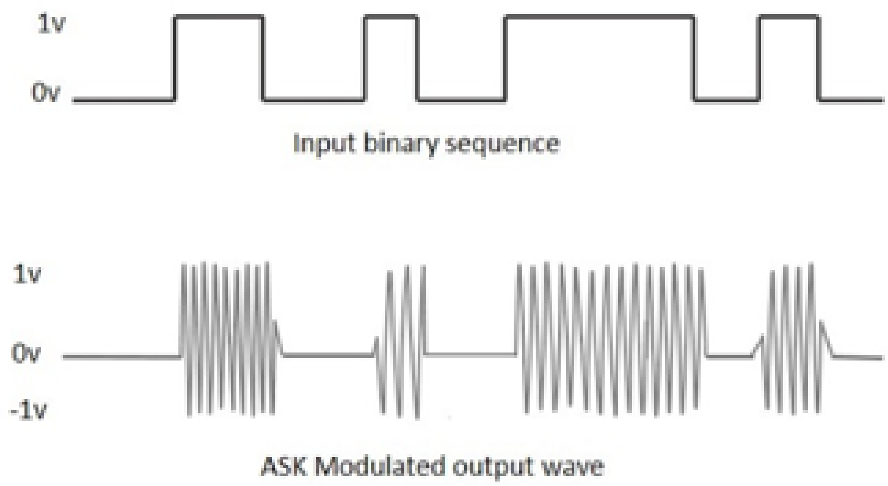

Figure 6.15: Ask Input and Output

6.1.2 Frequency Shift Keying (FSK)

It is a type of digital modulation in which the frequency of a carrier signal is varied to represent the digital data. FSK is more efficient than amplitude shift keying (ASK), and it is also more robust to noise and interference. As a result, FSK is widely used in a variety of applications, including radio modems, wireless sensors, and satellite communications.

FSK works by varying the frequency of a carrier signal in accordance with the digital data. For example, a binary "1" may be represented by a high frequency carrier signal, while a binary "0" may be represented by a low frequency carrier signal.

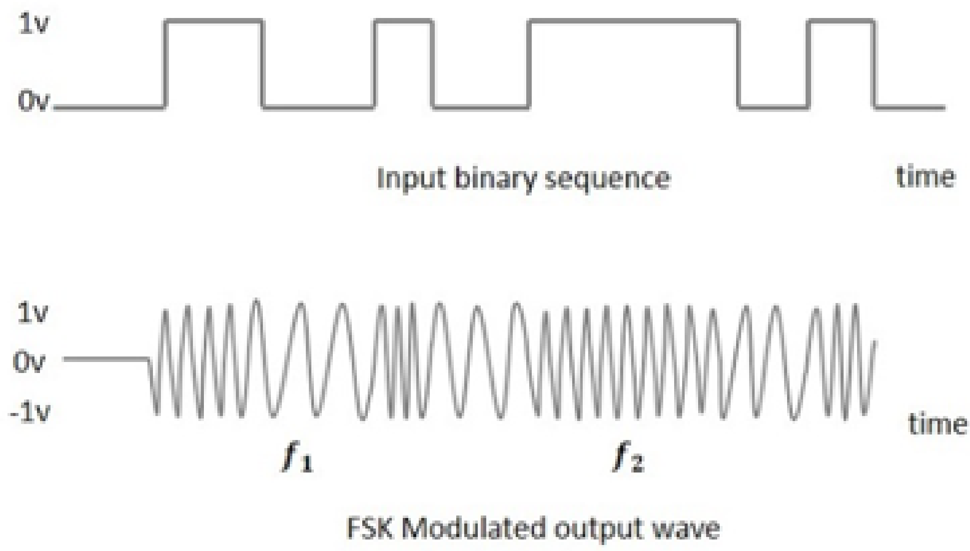

Figure 6.16: Fsk Input and Output

6.1.3 Phase Shift Keying (PSK)

Phase-shift keying (PSK) is a type of digital modulation in which the phase of a carrier signal is varied to represent the digital data. PSK is a relatively simple modulation technique to implement, and it is also relatively inexpensive. However, it is less efficient than other digital modulation techniques, such as quadrature amplitude modulation (QAM). This means that PSK requires more bandwidth to transmit the same amount of data.

Binary phase shift keying (BPSK):It is a type of digital modulation in which the phase of a carrier signal is varied to represent the digital data. BPSK is the simplest form of phase shift keying (PSK), and it is widely used in a variety of applications, including Wi-Fi, Bluetooth, and satellite communications.

BPSK works by varying the phase of a carrier signal in accordance with the digital data. For example, a binary "1" may be represented by a 0-degree phase shift, while a binary "0" may be represented by a 180-degree phase shift.

BPSK is a relatively simple modulation technique to implement, and it is also relatively inexpensive. However, it is less efficient than other digital modulation techniques, such as quadrature amplitude modulation (QAM). This means that BPSK requires more bandwidth to transmit the same amount of data.

BPSK is also susceptible to noise and interference. However, this can be mitigated by using appropriate filtering techniques and error correction coding schemes.

Quadrature phase shift keying (QPSK):It is a type of digital modulation in which the phase of a carrier signal is varied to represent two bits of digital data per symbol. QPSK is more efficient than binary phase shift keying (BPSK), and it is also more robust to noise and interference. As a result, QPSK is widely used in a variety of applications, including Wi-Fi, Bluetooth, and satellite communications.

QPSK works by varying the phase of a carrier signal in four different ways to represent the four possible combinations of two bits of digital data (00, 01, 10, and 11). For example, a 0-degree phase shift may represent the bit combination 00, a 90-degree phase shift may represent the bit combination 01, a 180-degree phase shift may represent the bit combination 10, and a 270-degree phase shift may represent the bit combination 11.

QPSK is a relatively simple modulation technique to implement, and it is also relatively inexpensive. However, it is less efficient than other digital modulation techniques, such as 16-quadrature amplitude modulation (16QAM). This means that QPSK requires more bandwidth to transmit the same amount of data.

6.2 Constellation Diagram

A constellation diagram is a graphical representation of a digital signal, where each point on the diagram represents a possible symbol. The symbols are spaced out in the diagram in such a way that they are as different from each other as possible, to minimize the chance of errors when demodulating the signal.

Constellation diagrams are used in a variety of digital communication systems, including: digital modulation systems, such as quadrature amplitude modulation (QAM) and phase shift keying (PSK).Digital signal processing systems, such as equalization and filtering error correction systems. Constellation diagrams can be used to:

Visualize the different symbols that are used to represent the digital data Diagnose problems with the digital signal, such as noise and interference Optimize the performance of the digital communication system

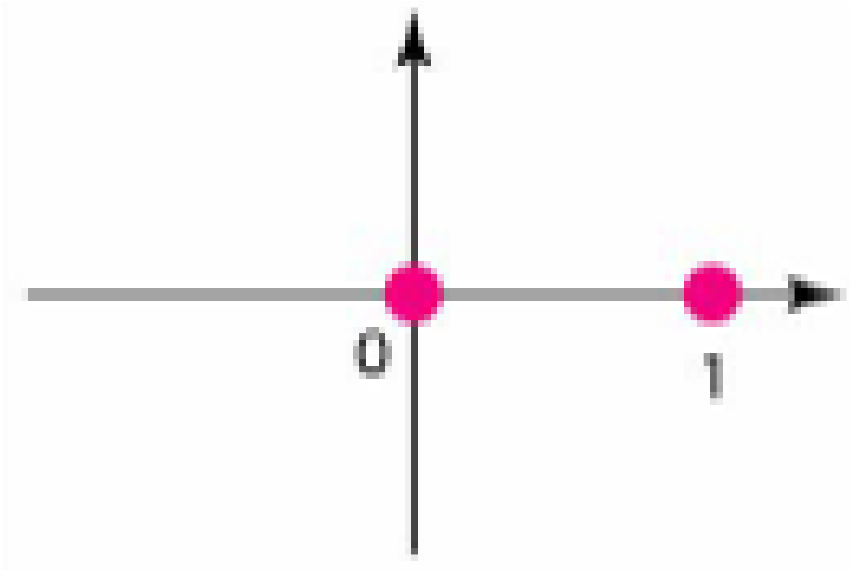

Figure 6.17: Constellation Diagram of Ask

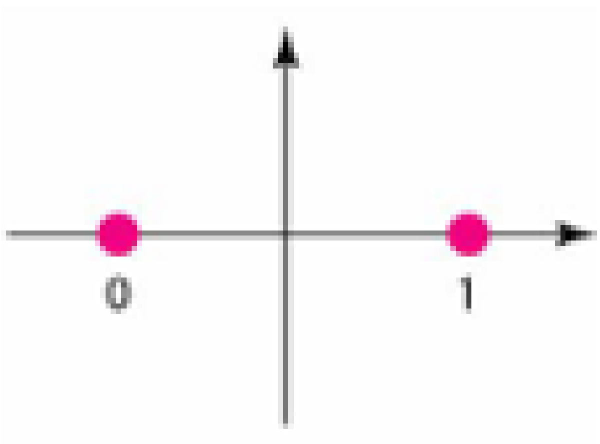

Figure 6.18: Constellation Diagram of Bpsk

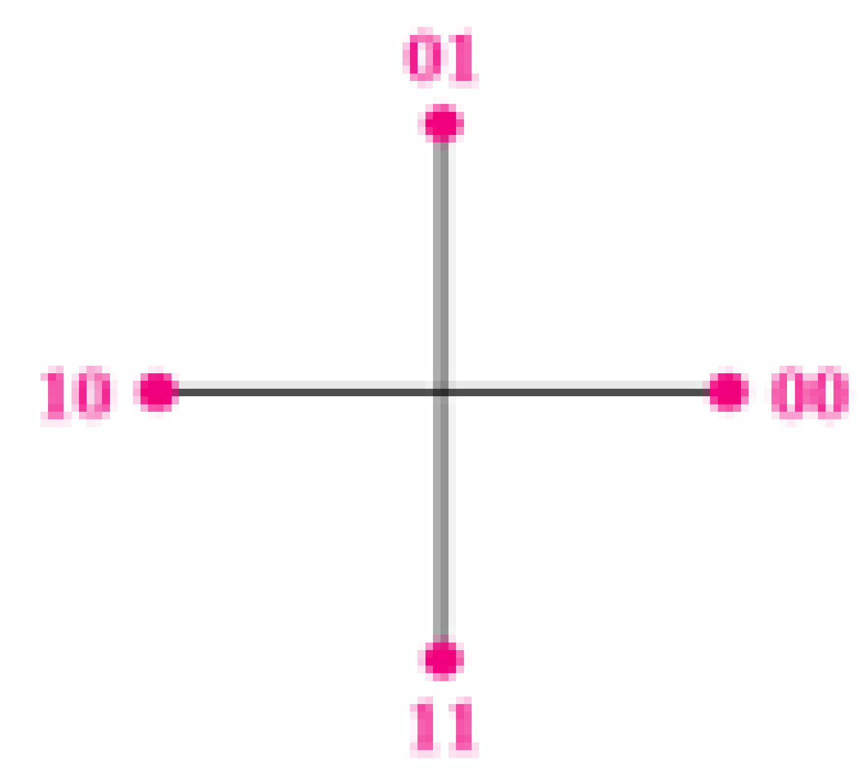

Figure 6.19: Constellation Diagram of Qpsk

6.3 Modulation Techniques Used in Different Generations of Networks

1G: The first generation of cellular networks used analog frequency modulation (FM) to transmit voice data. FM is a modulation technique that encodes the digital data onto the frequency of a carrier signal.

2G: The second generation of cellular networks introduced digital modulation methods such as time-division multiple access (TDMA) and code-division multiple access (CDMA). TDMA divides the time available on a channel into slots, and each user is assigned a specific time slot. CDMA assigns each user a unique code sequence, and the signals from different users are transmitted simultaneously.

3G: The third generation of cellular networks introduced WCDMA and orthogonal frequency division multiplexing (OFDM). WCDMA is a type of CDMA that uses a wider bandwidth and more complex coding schemes to achieve higher data rates. OFDM divides the available bandwidth into a large number of subcarriers, and the data is transmitted in parallel on all of the subcarriers.

4G: The fourth generation of cellular networks uses OFDM to transmit data. OFDM is a very efficient modulation technique that can achieve high data rates in a variety of channel conditions.
5G: The fifth generation of cellular networks uses OFDM with improved modulation techniques such as higher-order QAM to achieve even higher data rates and lower latency.

7 Site Visit

A site visit during an industrial attachment is an important aspect of gaining practical experience in your chosen field. Whether you're studying engineering, architecture, environmental science, or any other discipline that involves hands-on work, site visits provide you with the opportunity to observe and learn from real-world applications of your academic knowledge. Instructor had shown the whole power system and all other Base station controller equipments through visiting the area. The equipments which we had observed is breiefly described in later part.

7.1 Lithium Ion battery

Lithium-ion batteries play a crucial role in the field of telecommunications by providing reliable and efficient power solutions for various applications. Here are some ways in which lithium-ion batteries are used in the telecommunications industry:

- Backup Power Systems
- Fiber Optic Network Power
- Remote Communication Devices
- Telecommunications Vehicles

Lithium-ion batteries are preferred in the telecommunications industry due to their energy density, reliability, and performance characteristics. Their compact size and long cycle life make them well-suited for providing backup power and enabling remote communication in various telecommunications applications.

Figure 7.20: Lithium-ion Battery Rack

7.2 Rectifier Module

Rectifier modules are essential components in telecommunications infrastructure, particularly in scenarios where a stable and reliable DC power supply is required. These modules convert alternating current (AC) into direct current (DC), providing a steady source of power to critical telecommunication equipment. Here's a closer look at the role of rectifier modules in telecommunications:

- Power Supply Conversion
- Reliability and Backup

- Efficiency
- Remote Monitoring and Control

Rectifier modules are a critical component in the telecommunications infrastructure, ensuring that the network operates reliably and efficiently. They are an integral part of the power supply and backup systems that keep telecommunication services running, even in adverse conditions.

Figure 7.21: Rectifier Module

7.3 Rectifier Controller

A rectifier controller in telecommunications is a device or system that plays a vital role in controlling and managing the rectification process of converting alternating current (AC) power to direct current (DC) power. These controllers are integral to the operation of telecommunications power systems, ensuring that the power supply is stable, efficient, and reliable. Here are some key aspects of rectifier controllers in telecommunications:

- Voltage and Current Regulation
- Efficiency Optimization
- Battery Management
- Remote Monitoring and Control

In summary, rectifier controllers in telecommunications are essential for managing the rectification process, optimizing power efficiency, and ensuring the reliability and continuity of power supply to critical telecommunications equipment. They also offer features for remote monitoring, control, and maintenance to minimize downtime and maximize power system performance.

Figure 7.22: Rectifier Controller

7.4 DC Distribution Unit

A DC Distribution Unit is a critical component of a telecommunications infrastructure that is responsible for distributing and managing direct current (DC) power to various network elements and equipment. Its primary purpose is to ensure a stable and reliable power supply to critical telecommunications equipment.

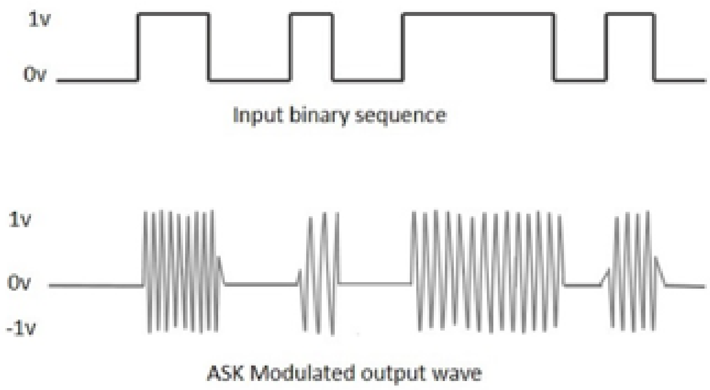

Figure 7.23: DC Distribution Unit

8 Software Simulation

Software simulation is a valuable tool often used in industrial settings during internships, attachments, or work placements. It allows you to model and analyze various aspects of industrial processes, systems, or operations without the need for physical prototypes.Here our instructor shows us a network model in their company using their own company software.some of the snapshot given below:

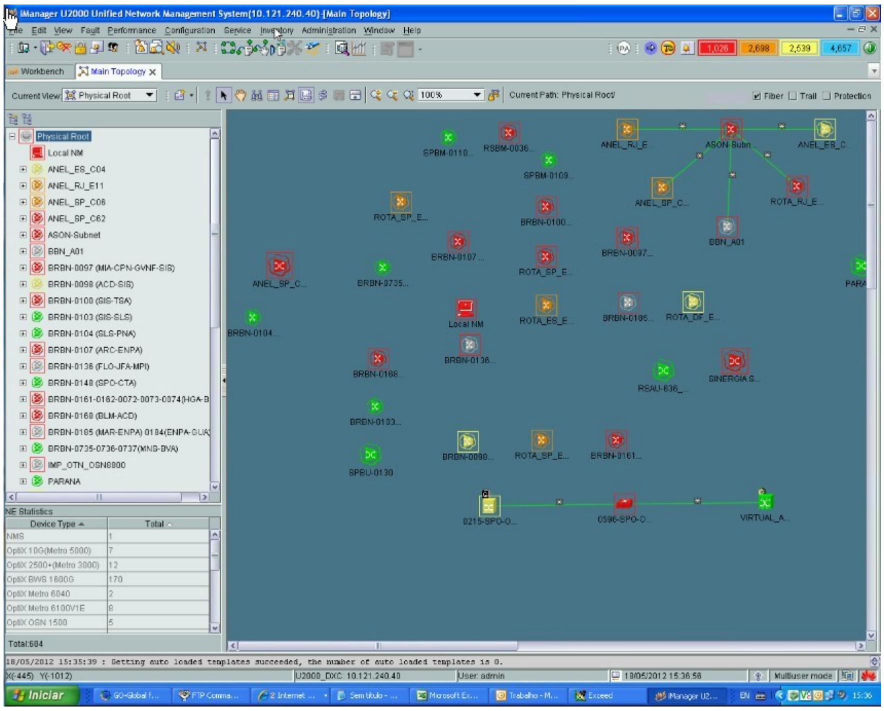

Figure 8.24: United Network Management System Software

9 Lackings in Teletalk

9.1 Low Spectrum Availability

Out of total available spectrum to be used, Teletalk has the lowest amount of spectrum available to them. Operators such as GP, Robi, BL has a spectrum of 107.4MHZ, 104MHZ, 80MHZ respectively. Meanwhile, Teletalk has only 55.2MHZ of spectrum available to them resulting slower data speed and reduced network capacity.

9.2 Lack of BTS

Teletalk has around 5500 BTS all over Bangladesh which is significantly lower than other operators of whom GP, Robi and Banglalink has around 18000, 13000 and 10000 BTSs respectively.

9.3 Lack of investment

Due to bureaucratic complications it is harder for teletalk to get the proper investment it needs and at the time it needs to compete with other operators.

10 Conclusion

This industrial attachment was an extraordinary experience for us. A telecommunication system in Bangladesh has developed over decades. Huge planning has been done in this sector to optimize the services of the network. Many mega planning and expensive instruments are used in telecommunication fields. As stated, before telecommunication is a huge sector, it is not possible for any to one to demolish all the knowledge related to this sector within 15 days. We have tried our best to be conversant with almost all the equipment and processes that we have seen

During the attachment of 15 days, we have seen the Core network, Access Network, Transmission System and BSS and NSS system. And at the last day of our attachment, we were fortunate to see the equipment that is used in the GSM system. Among the GSM Antennas, Microwave instruments, BTS cabinet, BSC equipment, Transcoder and MSC.

We have tried to put almost all the terms that we have learned in this attachment. It was really a fruitful industrial attachment which will help us to be better competent as a fresher in telecommunication field. Hope CSE, CUET will organize more such attachment for their students to develop the practical skills and knowledge of their students.