GOVERNMENT POLYTECHNIC

JALGAON

DEPARTMENT OF INFORMATION TECHNOLOGY

Course: - Wireless And Mobile Network

Project Name:- 4G & 4G LTE

Submitted by

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MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION

GOVERNMENT POLYTECHNIC, JALGAON

(0018)

Program Name and Code : Information Technology (IF5I)

Course Name and Code : Wireless And Mobile Network(22622)

Academic Year : 2024-25

Semester : Fifth

A MICRO PROJECT

On

4G & 4G LTE

Submitted by

Sr.No.	Roll No.	Name of student	Enrollment No.	Seat No.
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Certificate

This is to certify that **Sejas Attarde, Saksham Bari, Manas Chaudhari, Milind Chavan Roll No 06,08,15,18 of IF5I of Diploma In Information Technology**, **Government Polytechnic, Jalgaon** (Code:0018) completed the **Micro Project** satisfactorily in the course **Wireless And Mobile Network (22622)** for the Academic Year **2024-25** as prescribed in the curriculum.

Place: **Jalgaon** Enrollment No**: 2200180335, 2200180337, 2200180345, 2200180349**

Date: Exam Seat No**:**

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Seal of Institution

GOVERNMENT POLYTECHNIC

JALGAON

-SUBMISSION-

We **Sejas Attarde, Saksham Bari ,Manas Chaudhari, Milind Chavan Roll No. 06,08,15,18** as a students of **IF5I** of the Program **Information Technology** humbly submit that we have completed the Micro-Project work time to time as described in this report by our own skills and study in the academic year **2024 – 25** as per instructions and guidance of Mrs.Rekha.D.Kalambe. We have not copied the report or its any appreciable part from any other literature in contravention of the academic ethics.

Date:

Signature of Student

- 06
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Introduction

A **microproject** on 4G and 4G LTE would typically focus on exploring the fundamental concepts, technologies, and applications of 4G networks, with a specific emphasis on **Long-Term Evolution (LTE)**, the dominant 4G technology. The purpose of this microproject would be to provide a deeper understanding of how 4G and LTE revolutionized mobile communications, highlighting their key features, deployment strategies, and practical applications.

The goal of this microproject would be to provide a comprehensive understanding of **how 4G LTE works**, its evolution, its role in modern mobile telecommunications, and its impact on various industries. Participants would also gain hands-on experience through research, data analysis, and potentially practical tests that illustrate the benefits and challenges of 4G LTE deployment and its applications.

This microproject would be an excellent opportunity for students or researchers to dive into the technical aspects of 4G and LTE, making them better equipped to understand and contribute to the rapidly evolving field of telecommunications.

In short, **4G LTE** is the most common 4G technology deployed worldwide, enabling users to enjoy fast internet access, improved communication, and a host of new mobile applications.

History Of 4G & 4G LTE.

4G Concept: The concept of 4G began to take shape in the early 2000s, with the aim to **dramatically increase** mobile broadband speeds and deliver **higher capacity** for a growing number of users and data-intensive applications. The **International Telecommunication Union (ITU)** defined the goals for 4G in 2008, establishing the requirement for speeds up to **100 Mbps** for mobile users and **1 Gbps** for stationary users.

First Commercial 4G Network (2009): The **first commercial 4G network** was launched by **TeliaSonera** in Stockholm, Sweden, and Oslo, Norway, in **December 2009**. This network used **WiMAX**, a technology that was initially considered a potential candidate for 4G, but it was soon overshadowed by **LTE (Long-Term Evolution)** in most markets due to its greater efficiency and scalability.

Early Development of LTE: **LTE**, originally defined as a **3.9G technology**, was developed by the **3rd Generation Partnership Project (3GPP)**. It was designed to be a **long-term evolution** of 3G, offering **faster data rates** and a more efficient IP-based architecture. The goal was to provide a path towards 4G, and LTE provided higher speeds and lower latency compared to 3G technologies like **UMTS** and **CDMA2000**.

The Standardization of LTE: In **2008**, the first version of the LTE specification was finalized by the **3GPP**, and LTE was classified as the technology that could provide the performance necessary for **true 4G** in terms of speed and capacity.

First LTE Deployment: In **2010**, **Verizon Wireless** in the United States became one of the first to launch a commercial **LTE network** in **December 2010**, providing a **4G experience** to U.S. consumers. Shortly after, other carriers, like **AT&T** and **T-Mobile**, followed suit, rolling out their own LTE networks.

Worldwide LTE Expansion: By **2012**, **LTE** was becoming the global standard for **4G** networks, with large-scale deployments in countries such as Japan, South Korea, and several European nations. These networks offered download speeds of up to **100 Mbps** and were key in the evolution of mobile broadband.

What is 4G?

4G stands for **Fourth Generation** and refers to the fourth generation of mobile telecommunications technology. It is the successor to 3G (third generation) and offers significant improvements in terms of speed, capacity, and overall performance for mobile networks. 4G networks enable high-speed internet, better quality voice calls, and support for data-intensive applications like video streaming, gaming, and large file transfers.

Key Features of 4G:

Faster Speeds: 4G networks can deliver download speeds ranging from 100 Mbps to 1 Gbps, depending on whether the user is mobile or stationary. This is a significant leap compared to 3G's slower speeds (about 2 Mbps).

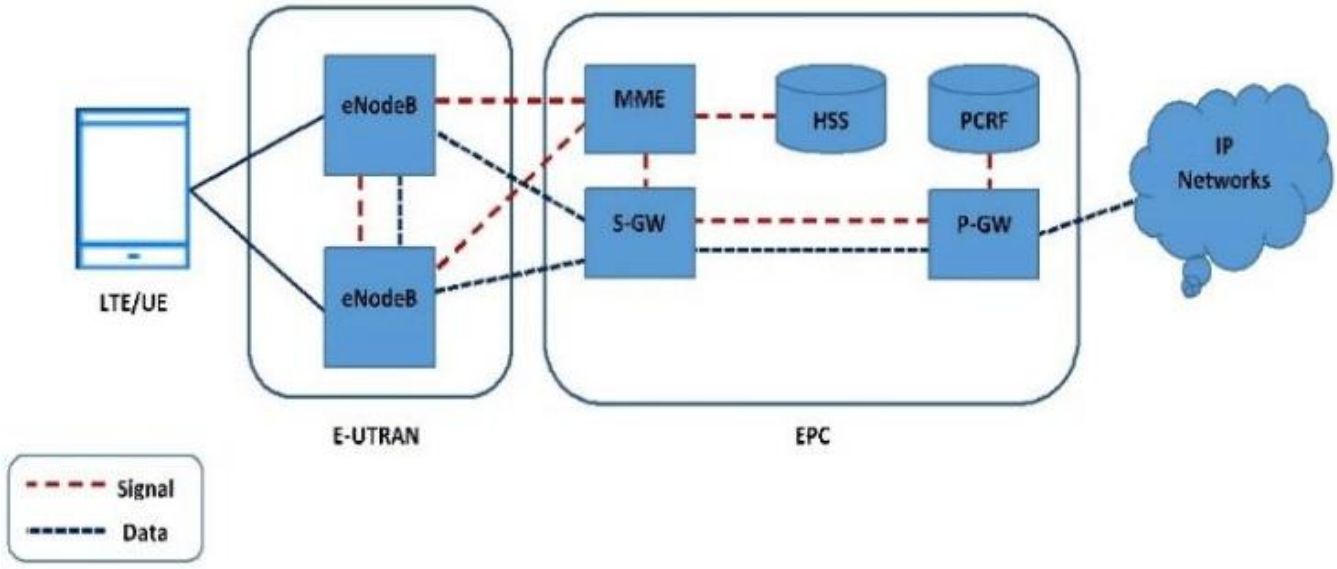
Low Latency: 4G networks have lower latency, meaning there's less delay between sending and receiving data. This is crucial for real-time applications like video conferencing, VoIP calls, and online gaming.

Better Network Efficiency: 4G networks can handle more users simultaneously, allowing for more efficient use of network resources and reducing congestion, especially in urban areas.

IP-Based Communication: 4G uses an all-IP (Internet Protocol) network, which means both data and voice services are carried over the same network. This allows for better integration with the internet and supports various multimedia services.

Supports High-Definition (HD) Video: With its increased bandwidth, 4G networks allow for HD video streaming and video conferencing without significant buffering or quality degradation.

Architecture Of 4G :-



The architecture of a 4G network is made up of the Radio Access Network (RAN), the Core Network, and the IP services part. 4G networks use IP mobility and high-speed wireless connections to provide services like video streaming, multimedia messaging, and VoIP.

Components of a 4G network

- **Radio Access Network (RAN):** Uses technologies like MIMO and OFDM to transmit data efficiently
- **Core Network:** Manages data routing, signaling, and network tasks
- **IP services part:** Deals with the internet, IMS, and cloud applications
- eNodeB: The 4G site that the user equipment (UE) connects to
- **Mobility Management Entity (MME):** Handles the initial attach of the UE to the network, authenticates the user, and tracks the UE location

4G network architecture goals

The 4G architecture aims to provide faster download and upload speeds, reduced latency, and improved spectral efficiency.

Technologies Behind 4G:

- **OFDM (Orthogonal Frequency Division Multiplexing)**: This technology allows for more efficient use of the available bandwidth by dividing it into smaller, parallel channels.
- **MIMO (Multiple Input, Multiple Output)**: MIMO improves signal quality by using multiple antennas at both the transmitter and receiver ends, allowing for higher speeds and more reliable connections.
- **All-IP Networks**: 4G relies on an all-IP network for both voice and data, making it more flexible and cost-effective.

Impact of 4G :

- **Mobile Broadband**: 4G has revolutionized mobile internet access, making high-speed internet available on the go. It has enabled a range of services like HD video streaming, mobile gaming, and video conferencing.
- **Smartphones and Mobile Apps**: The rise of 4G coincided with the explosive growth of smartphones and mobile apps. It allowed for more responsive, data-rich applications and services, transforming how people use mobile devices for entertainment, communication, and business.
- **Internet of Things (IoT)**: 4G networks have played a key role in the development of IoT, enabling devices like smart home products, wearables, and connected cars to communicate seamlessly.

Limitations of 4G:

- Limited Coverage in Rural and Remote Areas.
- Network Congestion.
- Latency Issues.
- High Deployment and Maintenance Costs.
- Security Vulnerabilities

Advantages Of 4G :

- Faster Internet Speeds
- Improved Network Coverage
- Better Call Quality (VoLTE)
- Lower Latency
- Supports High-Quality Video Streaming
- Enhanced Security
- Supports More Connected Devices

Applications of 4G :

- Mobile Communication & Internet
- Business & Remote Work
- Entertainment & Media
- Smart Cities & IoT (Internet of Things)
- Healthcare & Telemedicine
- Transportation & Navigation
- Education & E-Learning
- E-Commerce & Digital Payments
- Industrial & Agricultural Applications
- Public Safety & Emergency Services

What is 4G LTE?

4G LTE (Long-Term Evolution) is a **standard for mobile telecommunications** and is the technology that powers most modern **4G mobile networks**. It provides high-speed internet access on mobile devices and is a significant improvement over previous technologies like 3G. LTE was specifically designed to meet the requirements for **high-speed data** and **low latency** while offering better coverage and network efficiency.

Key Features of 4G LTE:

High-Speed Data: LTE offers **significantly faster speeds** than 3G networks, with typical download speeds ranging from **5 to 100 Mbps**, and upload speeds from **2 to 50 Mbps** depending on network conditions and infrastructure. This is ideal for data-heavy applications like streaming HD video, online gaming, and browsing.

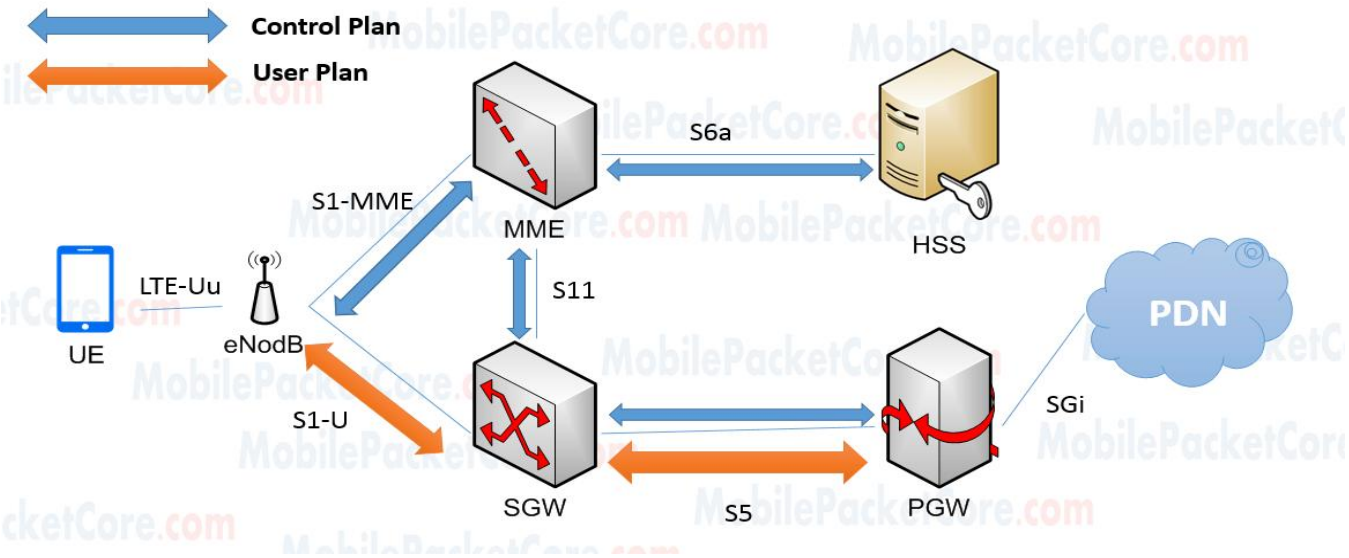
Low Latency: One of the main advantages of LTE over 3G is its lower latency, which refers to the delay between sending and receiving data. LTE typically offers **latencies around 30-50 milliseconds**, making it suitable for real-time applications such as **video conferencing**, **voice calls**, and **gaming**.

All-IP (Internet Protocol) Network: LTE is an **IP-based** technology, meaning that it uses **Internet Protocol** for both data and voice services, replacing older technologies that required separate circuits for voice and data. This reduces costs, simplifies network management, and allows for the integration of different types of services.

Efficient Spectrum Use: LTE uses **OFDM (Orthogonal Frequency Division Multiplexing)** to divide the available bandwidth into multiple smaller channels, increasing the efficiency and reliability of data transmission. It also supports **MIMO (Multiple Input, Multiple Output)**, which uses multiple antennas to improve signal quality and network capacity.

Carrier Aggregation: LTE supports **carrier aggregation**, which allows operators to combine multiple frequency bands to increase the effective bandwidth and deliver faster data speeds. This is particularly useful in high-demand areas.

Architecture Of 4G LTE :-



1. User Equipment (UE)

- Devices such as smartphones, tablets, and modems.
- Communicates with the network via the LTE air interface.
- Contains a **Universal Subscriber Identity Module (USIM)** for authentication.

2. Evolved UMTS Terrestrial Radio Access Network (E-UTRAN)

- Comprises the **eNodeB (eNB)**, which handles radio communications with the UE.
- Responsibilities of eNodeB:
    - Radio resource management.
    - Mobility management (handover between cells).
    - Encryption and security.

3. Evolved Packet Core (EPC)

This is the backbone of LTE, responsible for handling data and connectivity. It consists of:

a) Mobility Management Entity (MME)

- Manages UE registration, authentication, and handovers.
- Handles security key management.

b) Serving Gateway (S-GW)

- Routes and forwards user data packets.
- Manages mobility between eNodeBs.

c) Packet Data Network Gateway (P-GW)

- Connects the LTE network to external networks (Internet, IMS, etc.).
- Handles policy enforcement, deep packet inspection, and charging.

d) Home Subscriber Server (HSS)

- Stores subscriber information and authentication data.
- Works with MME for user authentication.

e) Policy and Charging Rules Function (PCRF)

- Manages quality of service (QoS) and billing policies.

Technologies Behind 4G :

- **Orthogonal Frequency Division Multiplexing (OFDM) :** OFDM is a key technology used in 4G networks to improve bandwidth efficiency and reduce interference.
- **Multiple Input Multiple Output (MIMO) :** MIMO is a technology that uses multiple antennas at both the transmitter and receiver ends to increase data transfer speeds and improve signal quality.
- **Long-Term Evolution (LTE) :** LTE is the core technology that defines 4G networks. It is an all-IP (Internet Protocol) technology, meaning that all data (including voice) is transmitted as data packets over the same network.

Impact Of 4G LTE :

- **Enhanced Mobile Internet Experience :** 4G LTE significantly improved download and upload speeds compared to its predecessors (3G and 2G). The enhanced speed made it possible to stream high-definition (HD) video, download large files, and browse the web much faster.
- **Transformation of Mobile Applications :** With 4G LTE, mobile apps such as **video calling**, **video conferencing**, **live streaming**, and **gaming** became more popular due to the reduced latency and increased data speeds. Apps like **Zoom**, **Skype**, **Netflix**, **Twitch**, and **Facebook Live** thrive on 4G networks.
- **Economic Growth :** 4G LTE spurred innovation in many industries by enabling new mobile business models and improving business operations.

Limitations of 4G LTE :

- Limited Coverage in Rural and Remote Areas.
- Speed and Bandwidth Limitations.
- Latency Issues.
- Infrastructure Constraints.
- Battery Drain on Mobile Devices.

Advantages of 4G LTE :

- Faster Data Speeds
- Lower Latency
- Improved Network Coverage & Connectivity
- Enhanced Voice Quality (VoLTE)
- Supports Multitasking & IoT
- Improved Battery Efficiency
- Better Security & Reliability

Application Of 4G :

- Mobile Communication & Internet
- Streaming & Entertainment
- Business & Remote Work
- Healthcare & Telemedicine
- Transportation & Navigation
- Smart Cities & IoT (Internet of Things)
- Education & E-Learning
- E-Commerce & Mobile Payments
- Industrial & Agricultural Applications
- Public Safety & Emergency Services

Conclusion

4G and 4G LTE have revolutionized wireless communication by providing high-speed, low-latency, and efficient data transmission. Unlike previous generations, LTE is a fully IP-based network designed to support high-speed internet, HD voice (VoLTE), and seamless multimedia services.While LTE is a major leap forward, 5G is now taking over, offering even lower latency, higher speeds, and enhanced IoT connectivity. However, 4G LTE will continue to be widely used for many years due to its broad coverage and reliable performance.4G and LTE (Long-Term Evolution) represent a significant advancement in mobile network technology, offering faster speeds, improved efficiency, and enhanced network capacity compared to previous generations like 3G. The LTE architecture, designed for an all-IP network, eliminates the limitations of circuit-switched technologies, providing seamless broadband connectivity.

4G LTE has transformed mobile communication by providing a high-speed, efficient, and reliable wireless network infrastructure. The all-IP nature of LTE ensures seamless integration with modern internet applications, while its scalability and efficiency have laid the foundation for future technologies like 5G and beyond.As mobile networks continue to evolve, 4G LTE will remain a crucial part of the global connectivity ecosystem—serving as a fallback network for 5G and continuing to support billions of devices worldwide.

Reference

1] www.tutorialpoint.com

2] www.geeksforgeeks.com

3] www.niralibooks.com