Project-Based Learning Report

on

"Study of the mobile networks**"**

Submitted in the partial fulfillment of the requirements.

For the Project-based learning in **Cellular Technology & 4G**

in
Electronics & Communication Engineering

By

Aashish Kumar	**2014111065**
Vishal Dubey	**2014111041**
Kishan Patil	**2014111035**

Under the guidance of Course In-charge
S.V. Dhole

Bharati Vidyapeeth
(Deemed to be University)
College of Engineering,
Pune – 411043

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CERTIFICATE

This is to be Certified that the Project Based Learning report entitled, "**S**tudy of the mobile networks**"** work is done by

Aashish Kumar	**2014111065**
Vishal Dubey	**2014111041**
Kishan Patil	**2014111035**

In partial fulfillment of the requirements for the award of credits for Project Based Learning (PBL) in **Cellular Technology & 4G** Bachelor of Technology Semester V1, Electronics and Communication Engineering.

Date:

S.V. Dhole
Course In-charge

Dr. Arundhati A. Shinde
Professor & Head(ECE)

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Problem Statement

Study of the mobile networks

Solution

The study of mobile networks is a broad and interdisciplinary field that encompasses various aspects of wireless communication systems, including radio frequency (RF) propagation, signal processing, network architecture, protocols, and applications.

Mobile networks allow users to communicate wireless using mobile devices such as smart-phones, tablets, and laptops, and they rely on a complex infrastructure of base stations, antennas, routers, switches, and servers to provide connectivity, data transmission, and other services.

The study of mobile networks involves understanding the technical details of how these systems work, including the different types of wireless communication technologies (such as 2G, 3G, 4G, and 5G), the characteristics of the radio frequency spectrum, the modulation schemes used for data transmission, and the protocols and algorithms used to manage the network and ensure data integrity and security.

Additionally, the study of mobile networks may also involve understanding the social and economic impacts of these systems, such as their effects on user behavior, privacy, access to information, and the digital divide.

Overall, the study of mobile networks is a multidisciplinary field that requires expertise in various areas of engineering, computer science, mathematics, and social sciences. It is essential for advancing the development and deployment of mobile networks, improving their performance and efficiency, and addressing the challenges and opportunities that they present.

Introduction of mobile networks

Mobile Communication is the use of technology that allows us to communicate with others in different locations without the use of any physical connection (wires or cables). Mobile communication makes our life easier, and it saves time and effort.

A mobile phone (also called mobile cellular network, cell phone or hand phone) is an example of mobile communication (wireless communication). It is an electric device used for full duplex two way radio telecommunication over a cellular network of base stations known as cell site.

Mobile networks are wireless communication systems that enable users to exchange information and access services using mobile devices such as smartphones, tablets, and laptops. They provide a convenient and flexible way of staying connected, allowing users to access the internet, make voice and video calls, send text messages, and access various applications and services.

Mobile networks rely on a complex infrastructure of base stations, antennas, routers, switches, and servers to provide connectivity, data transmission, and other services. The infrastructure is typically managed by network operators, who are responsible for deploying and maintaining the network, managing network resources, and ensuring the quality of service.

The first generation of mobile networks, known as 1G, was introduced in the 1980s and provided analog voice communication using frequency modulation (FM) technology. 2G networks, introduced in the 1990s, used digital signal processing (DSP) and provided voice and text messaging services, as well as basic data transmission capabilities.

3G networks, introduced in the early 2000s, marked a significant improvement in data transmission speeds and capacity, enabling more advanced services such as mobile internet and video calling. 4G networks, introduced in the late 2000s, further improved data speeds and capacity, allowing for the development of new applications such as virtual reality and autonomous vehicles.

The latest generation of mobile networks, known as 5G, was introduced in the 2010s and promises even faster data transmission speeds, lower latency, and higher capacity than 4G networks. 5G networks also introduce new technologies such as network slicing, which enables the creation of customized networks for specific use cases such as smart cities, industrial automation, and healthcare.

Overall, mobile networks have revolutionized the way we communicate and access information, and they continue to evolve and improve to meet the growing demands of users and applications.

Working of mobile communication

Mobile technology refers to the wireless communication systems and devices that enable users to exchange information and access services using mobile devices such as smartphones, tablets, and laptops. The working of mobile technology involves multiple layers of hardware and software components that work together to provide connectivity, data transmission, and other services.

The basic working of mobile technology involves the following steps:

- Radio Frequency (RF) Signal Transmission: Mobile devices use radio waves to transmit and receive signals. The device converts digital information into analog signals that are transmitted over the airwaves to the nearest base station.
- Base Station Transmission: The base station receives the analog signal from the mobile device and converts it back to digital information. The signal is then sent to the mobile switching center (MSC) over a wired network.
- Network Routing: The MSC routes the signal to the appropriate destination, which may be another mobile device, a landline telephone, or the internet.
- Data Transmission: The signal is converted into data packets that are transmitted over the network to the destination device. The data packets are reassembled at the destination device to form the original signal.
- Feedback and Error Correction: The network provides feedback to ensure that the signal is received correctly. If errors are detected, the network uses error correction techniques to retransmit the data.

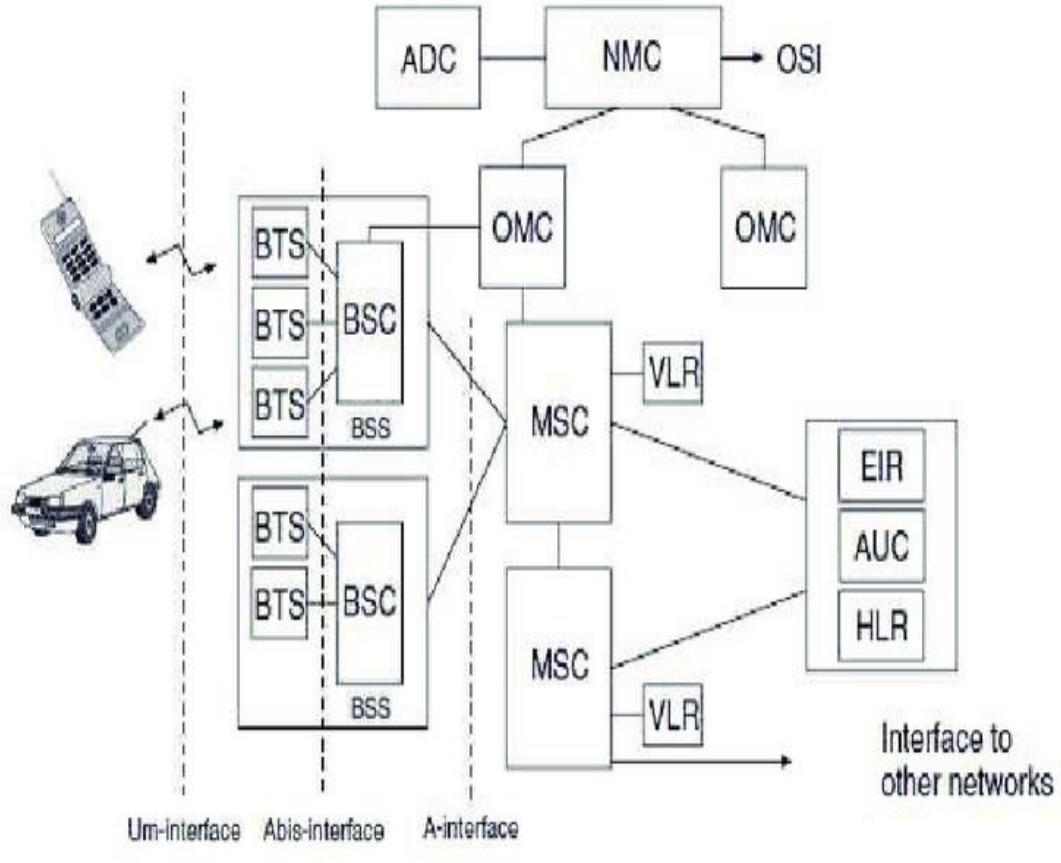
Mobile technology uses various hardware and software components to enable this communication, including antennas, base stations, routers, switches, servers, and mobile operating systems. The mobile operating system provides a user interface and manages the device's hardware and software resources, enabling users to access various applications and services.

Overall, the working of mobile technology is a complex process that involves multiple layers of hardware and software components working together to provide seamless connectivity and communication.

The mobile communication process involves multiple stations or components that work together to enable communication between two or more mobile devices or between a mobile device and a wired network. The main stations involved in the communication process are:

- Mobile Device: A mobile device is a portable electronic device, such as a smartphone or tablet, that can send and receive information wirelessly. It has an antenna that sends and receives radio waves to communicate with other devices.
- Base Station: A base station is a fixed station that connects mobile devices to a wired network. It receives signals from mobile devices in its coverage area and relays them to the wired network through a mobile switching center (MSC).

- Mobile Switching Center (MSC): A mobile switching center is a central control hub that connects base stations to the wired network. It routes calls and messages between different mobile devices and the wired network.



- Home Location Register (HLR): The home location register is a database that stores subscriber information, including phone numbers, services, and billing information. The HLR communicates with the MSC to authenticate subscribers and provide routing information.
- Visitor Location Register (VLR): The visitor location register is a database that stores temporary information about mobile devices in a particular area. It communicates with the MSC to authenticate mobile devices and provide location information.
- Public Switched Telephone Network (PSTN): The PSTN is a wired network that connects landline telephones and mobile devices. It uses traditional circuit-switched technology to route calls and messages between different devices.
- Internet: The internet is a global network of computers that enables communication between different devices and services. Mobile devices can access the internet through a wireless network or by connecting to a wired network via a router.

The working of mobile communication involves multiple steps, including voice and data transmission, radio frequency signal transmission, base station transmission, network routing, data transmission, feedback, and error correction. The mobile device sends and receives signals through the antenna, which are converted into digital information by the base station.

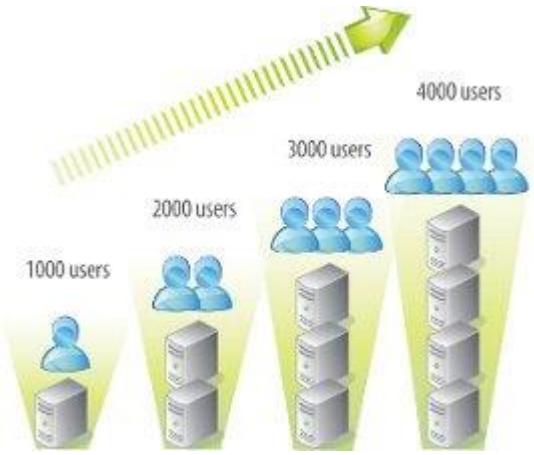
The MSC routes the information to the appropriate destination, which may be another mobile device, landline telephone, or internet service. The HLR and VLR authenticate subscribers and mobile devices and provide routing and location information. The PSTN and internet provide wired connections to other devices and services

Features of mobile communication

The following are the features of mobile communication:

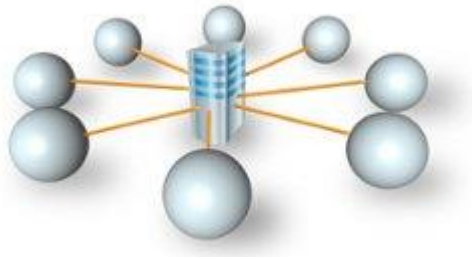
- **High capacity load balancing:** Each wired or wireless infrastructure must incorporate high capacity load balancing.
  High capacity load balancing means, when one access point is overloaded, the system will actively shift users from one access point to another depending on the capacity which is available.

- **Scalability:** The growth in popularity of new wireless devices continuously increasing day by day. The wireless networks have the ability to start small if necessary, but expand in terms of coverage and capacity as needed - without having to overhaul or build an entirely new network.



- **Network management system:** Now a day, wireless networks are much more complex and may consist of hundreds or even thousands of access points, firewalls, switches, managed

power and various other components.
The wireless networks have a smarter way of managing the entire network from a centralized point.



- **Role based access control:** Role based access control (RBAC) allows you to assign roles based on what, who, where, when and how a user or device is trying to access your network.
Once the end user or role of the devices is defined, access control policies or rules can be enforced.

- **Indoor as well as outdoor coverage options:** It is important that your wireless system has the capability of adding indoor coverage as well as outdoor coverage.

- **Network access control:** Network access control can also be called as mobile device registration. It is essential to have a secure registration.
Network access control (NAC) controls the role of the user and enforces policies. NAC can allow your users to register themselves to the network. It is a helpful feature that enhances the user experience.

- **Mobile device management:** Suppose, many mobile devices are accessing your wireless network; now think about the thousands of applications are running on those mobile devices.
How do you plan on managing all of these devices and their applications, especially as devices come and go from your business?
Mobile device management can provide control of how you will manage access to programs and applications. Even you can remotely wipe the device if it is lost or stolen.

- **Roaming:** You don't need to worry about dropped connections, slower speeds or any disruption in service as you move throughout your office or even from building to building

wireless needs to be mobile first.
Roaming allows your end-users to successfully move from one access point to another without ever noticing a dip in a performance.
For example, allowing a student to check their mail as they walk from one class to the next.

- **Redundancy:** The level or amount of redundancy your wireless system requires depends on your specific environment and needs.
- **For example:** A hospital environment will need a higher level of redundancy than a coffee shop. However, at the end of the day, they both need to have a backup plan in place.
- **Proper Security means using the right firewall:** The backbone of the system is your network firewall. With the right firewall in place you will be able to:
    - See and control both your applications and end users.
    - Create the right balance between security and performance.
    - Reduce the complexity with:
        - Antivirus protection.
        - Deep Packet Inspection (DPI)
        - Application filtering
    - Protect your network and end users against known and unknown threads including:
        - Zero- day.
        - Encrypted malware.
        - Ransomware.
        - Malicious botnets.
- **Switching:** Basically, a network switch is the traffic cop of your wireless network which making sure that everyone and every device gets to where they need to go.
  Switching is an essential part of every fast, secure wireless network for several reasons:
    - It helps the traffic on your network flow more efficiently.
    - It minimizes unnecessary traffic.
    - It creates a better user experience by ensuring your traffic is going to the right places.

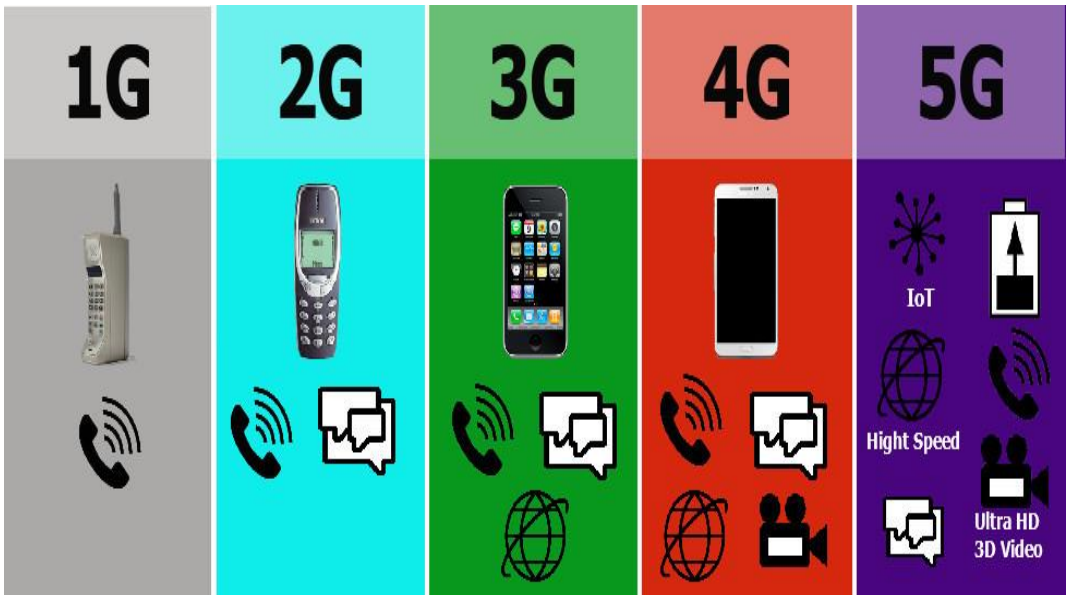
Advantages of Mobile Communication

There are following advantages of mobile communication:

- **Flexibility:** Wireless communication enables the people to communicate with each other regardless of location. There is no need to be in an office or some telephone booth in order to pass and receive messages.
- **Cost effectiveness:** In wireless communication, there is no need of any physical infrastructure (Wires or cables) or maintenance practice. Hence, the cost is reduced.
- **Speed:** Improvements can also be seen in speed. The network connectivity or the accessibility was much improved in accuracy and speed.
- **Accessibility:** With the help of wireless technology easy accessibility to the remote areas is possible. For example, in rural areas, online education is now possible. Educators or students no longer need to travel to far-flung areas to teach their lessons.

- **Constant connectivity:** Constant connectivity ensures that people can respond to emergencies relatively quickly. For example, a wireless device like mobile can ensure you a constant connectivity though you move from place to place or while you travel, whereas a wired landline can't.

1G,2G,3G,4G and 5G



1G, 2G, 3G, 4G, and 5G refer to different generations of mobile networks. Each generation of mobile networks has brought significant advancements in wireless communication technology and has improved the speed, reliability, and capabilities of mobile devices. Here's a brief overview of each generation:

1G: The first generation of mobile networks, introduced in the 1980s, allowed for analog voice communication using first-generation mobile phones. These networks were limited in capacity, range, and security and could not handle digital data or internet connectivity.

2G: The second generation of mobile networks, introduced in the 1990s, allowed for digital voice communication and introduced the concept of short message service (SMS) messaging. These networks offered better voice quality, higher capacity, and improved security.

3G: The third generation of mobile networks, introduced in the early 2000s, allowed for data transmission, internet connectivity, and multimedia communication, such as video calls and streaming. These networks provided faster data transfer rates and higher capacity, enabling users to access the internet and use various applications on their mobile devices.

4G: The fourth generation of mobile networks, introduced in the late 2000s, offered faster download and upload speeds, lower latency, and higher capacity than 3G networks. These networks enabled users to stream high-quality video and audio and use advanced applications, such as augmented reality and virtual reality.

5G: The fifth generation of mobile networks, introduced in the 2010s, offers even faster download and upload speeds, lower latency, and higher capacity than 4G networks. These networks are designed to support emerging technologies, such as the Internet of Things (IoT), autonomous vehicles, and smart cities, and are expected to revolutionize the way people communicate and access information.

Difference between the Generations

Technologies / Features	*1G*	*2G/2.5G*	*3G*	*4G*	*5G*
Evolution	1970	1980	1990	2000	2010
Deployment	1984	1999	2002	2010	2015
Data Rate	2 kbps	14.4-64 kbps	2 Mbps	200 Mbps to 1 Gbps for low mobility	10 Gbps to 100 Gbps
Famous Standards	AMPS	2G: GSM,C]DMA 2.5G: GPRS, EDGE, 1xRTT	WCDMA, CDMA-2000	LTA, WiMAX	Not yet defined
Technology behind	Analog cellular technology	Digital cellular technology	Broad bandwidth CDMA, IP technology	Undefined IP and seamless combination of broadband. LAN/WAN/PAN/ WLAN	Undefined IP and seamless combination of broadband. LAN/WAN/ PAN/WLAN
Service	Voice	2G: Digital Voice, SMS 2.5G: Voice+Data	Integrated high quality audio, video and data	Dynamic information access, wearable devices	Dynamic information access, wearable devices with AI capabilities
Multiplexing	FDMA	TDMA,CDMA	CDMA	CDMA	CDMA
Type of Switching	Circuit	2G: Circuit 2.5G: Circuit and packet	Packet	Packet	Packet
Handoff	Horizontal	Horizontal	Horizontal	Horizontal and Vertical	Horizontal and Vertical
Core Network	PSTN	PSTN	Packet network	Internet	Internet

Uses and Applications

1G: The first generation of mobile networks was primarily used for voice communication. This technology allowed for wireless mobile phones to make calls with good audio quality, but it didn't support any data connectivity.

2G: The second generation of mobile networks introduced digital communication and enabled data transmission through SMS messaging. It also provided basic internet connectivity for mobile devices, but it was limited to simple web browsing and email. 2G was primarily used for voice communication and text messaging.

3G: The third generation of mobile networks provided faster data transmission rates, which made it possible to use mobile devices for more complex applications. This technology allowed for internet connectivity with improved download and upload speeds, as well as multimedia communication such as video calling and streaming.

4G: The fourth generation of mobile networks brought significant improvements in data transmission speeds, latency, and capacity. This technology enabled the widespread use of mobile devices for high-speed internet connectivity, video streaming, and advanced applications such as augmented reality and virtual reality. 4G networks also laid the foundation for the development of the Internet of Things (IoT) technology.

5G: The fifth generation of mobile networks is designed to provide faster data transmission rates, lower latency, and higher capacity than previous generations. It is expected to support a wide range of emerging technologies such as autonomous vehicles, smart cities, and IoT applications. With 5G networks, users will be able to download and stream large files almost instantaneously, experience virtual and augmented reality in real-time, and connect with devices in a more efficient and effective way.

In summary, each generation of mobile networks has enabled different use cases and applications, from basic voice communication to high-speed internet connectivity and advanced technologies. The advancements in mobile communication technology have transformed the way people communicate and access information, and 5G networks are poised to drive further innovation in the years to come.

COURSE OUTCOME AND CONCLUSION

Project Outcome

Through this following project we learnt about the mobile networks, how the mobile stations communicate with each other and the types of mobile networks

CO1 :

Understand the basics of mobile communication systems.

Conclusion

In conclusion, mobile networks are a vital component of modern communication technology. They enable wireless communication between different mobile devices and wired networks, providing seamless connectivity and access to various applications and services. The working of mobile communication involves multiple layers of hardware and software components, including antennas, base stations, routers, switches, servers, and mobile operating systems. The mobile communication process involves voice and data transmission, radio frequency signal transmission, base station transmission, network routing, data transmission, feedback, and error correction. Understanding the working of mobile networks is essential for designing, developing, and maintaining efficient and reliable communication systems.

In conclusion, mobile networks are a critical part of modern communication technology that has revolutionized the way people communicate and access information. There are several types of mobile networks, including 2G, 3G, 4G, and 5G, each offering different speeds and capabilities. These networks utilize different stations and components, including mobile devices, base stations, mobile switching centers, home and visitor location registers, the public switched telephone network, and the internet. The working of mobile communication involves multiple layers of hardware and software components that work together seamlessly to provide reliable wireless connectivity and access to various applications and services. Understanding the different types of mobile networks and the stations involved is essential for designing, developing, and maintaining efficient and effective communication systems that meet the ever-evolving demands of the modern digital age.