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Research Article

A COMPARATIVE STUDY OF VARIOUS MOBILE GENERATION TECHNIQUES

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ABSTRACT

As mobile communication comes the exchange of information or data across the people is very is and very fast. Day by day the demand of greater speed and more services are expected by mobile users to make their activities smoother. The latest mobile generation techniques 5g comes with the same aspects of speed, efficiency, application effectives and quality of service. Mobile technology 1G for only analog voice communication, 2G for digital voice and data communication, 3G for high data transmission at lower cost, improved security, better performance and broadband communication, 4G for better speed, wide coverage, 5G for data rate in Gbps, higher connection density, much lower latency for business and consumers demand. This paper discusses the earlier, present and future mobile technologies with various features.

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INTRODUCTION

Day by day the use of mobile devices is exponential increase and it becomes the necessity of everyone. In mobile communicator the exchanges of information either it is voice or data without any physical connection. To make the business operation faster and efficiently the mobile communication is very useful. A cellular network or mobile network the geographical area is divided into a many cells, each cell having a fixed-location base station, which perform the transmission and receiving the data from the mobile devices. The base station is responsible for transmission for voice, data and other types of content. Each neighbouring cells use the different frequencies for communication to remove the interference of each other signal. Each cell provides the good strength of signal to cover its area [1]. The mobile network is also connected with public switched telephone network (PSTN) and public Internet [2]. Low frequencies 450 MHz mostly used for countryside coverage. GSM 900 MHz is a mostly used for urban area coverage. GSM 1.8 GHz is to be limited by structural walls. UMTS 2.1 GHz is also used to coverage for urban area. Mobile communication generations are shown in below figure. It started with 1G in 1990. 2G comes with GSM (Global System for Mobile Communications), GPRS (General Packet Radio Service) and EDGE (Enhanced Data GSM Environment). 3G comes with WCDMA (Wide Band Code Division Multiple Access), HSPA (High Speed Packet Access),

4G with LTE (Long Term Evolution) and 5G with different frequency bands like 3.5 GHz, 28GHz and 39GHz.

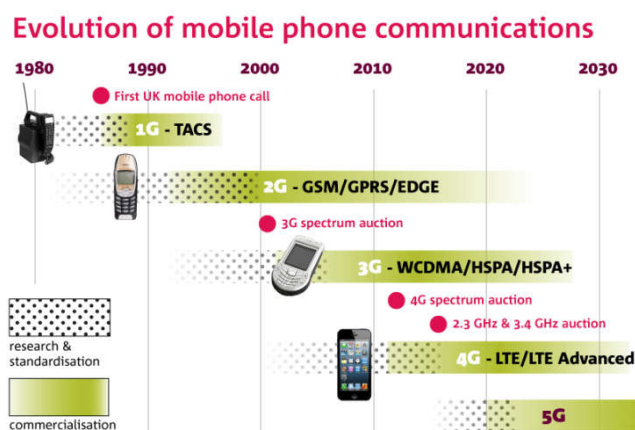


Fig 1 Evaluation of mobile phone Generation [3]

Various Mobile Generation

According to your connection with the service provider your mobile device shows that either your internet connection is 2G, 3G or 4G. Here "G" stands for "Generation" of mobile technology. Each Generation have a different telephone network standards. As the technologies are changes from one generation to another, it makes improvement in the features of mobile communications. The speed of mobile generation is increase due to the changes in the technology used is also

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changed. First generation supports 2.4 kbps, Second generation supports 64 Kbps with GSM, Third generation supports 144 kbps-2 mbps with WCDMA, Fourth generation supports 100 Mbps - 1 Gbps with LTE technology. Each of the Generations has standards that must be met to officially use the G terminology.

1G – First Generation

1G is an analog technology and the phones generally had poor battery life and voice quality was large without security, and ratio of calls dropped is high. The maximum speed of 1G is 2.4 Kbps.

AMPS (Advanced Mobile Phone System)

- Use FDM (Frequency Division Multiplexing) to separate the channels.
- 832 full-duplex channels
 - ✓ Pair of simplex channels.
 - ✓ Each channel is 30 KHz wide.
 - ✓ (Mobile to Base station Transmission)
 - ✓ 824 – 849 MHz
 - ✓ (Base station to Mobile Transmission)
 - ✓ 894 MHz
 - ✓ 832 Channels are divided into four categories.

Control Channel: To Manage the system

Paging Channel: To Alert the mobile users

Access Channel: Call setup and Channel assignment.

Data Channel: Carries voice or data

2G - Second Generation

The main difference between the First generation and Second generation mobile systems is that the radio signals used by First generation network are analog, while Second generation networks are digital. The main aim is to provide more reliable communication and security. It implemented the concept of GSM (Global System for Mobile Communications) and CDMA (Code Division Multiple Access). It provided services like sms (Short Message Service) and mms (Multimedia Message Service). 2G networks were commercially launched on the GSM standard in Finland by

Radiolinja in 1991. It allows data of multiple users on same channels. It also used for data as well as voice signal. The maximum speed of 2G with General Packet Radio Service (GPRS) is 50 Kbps or 1 Mbps with Enhanced Data Rates for GSM Evolution (EDGE).

GSM (Global System for Mobile Communications)

In GSM frequency division multiplexing (FDM) is used. In such system mobile transmitting on one frequency and receiving on other frequency. Again with the help of time division multiplexing (TDM), a single frequency pair is divided into small time slots and multiple users use the particular timeslot to transmit or receive the data. In GSM 890-915 MHz is used for upward direction and 935-960 MHz is used for downward direction. A GSM has 124 pairs of simplex channels and each channel is 200 KHz wide to support eight different connections on it. Also for each connection the transmitting and receiving time slots are different. Each TDM slot has a specific structure that consists of slot boundaries, 57 bit information field, and synchronizes data.

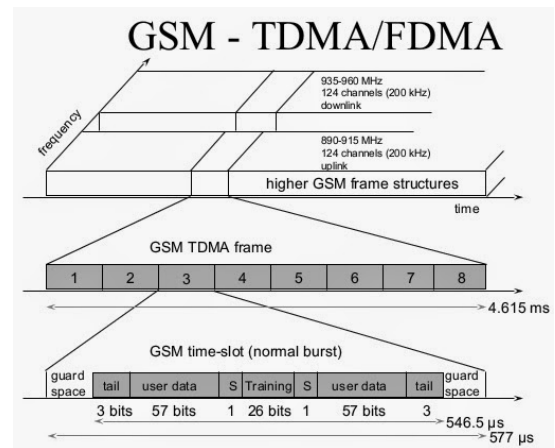


Fig 2 GSM Structure [4]

3G - Third Generation

As the widespread use of 2G devices in the world and people started to use the mobile devices in their daily lives, it is necessary that the demand for data service was increasing rapidly. 3G is the third generation of mobile communication. The main difference that distinguishes 3G technology from 2G technology is the use of packet switching rather than circuit switching for data transmission. It is used with mobile devices to connect with the internet in order to surf on search engines, to make voice and video calls, to download and upload information. The main aims of third generation mobile communication were to facilitate increase data transmission at a lower cost, greater voice and data capacity and support a wider range of applications. The theoretical max speed for HSPA+ is 21.6 Mbps. The 3G standard utilises Universal Mobile Telecommunications System (UMTS) as its core network architecture. Based on a set of standards used for mobile devices and mobile telecommunications use services and networks that comply with the International Mobile Telecommunications-2000 (IMT-2000) specifications by the International Telecommunication Union. In 3G, portability and universal access across different devices are made possible. During the call time the audio signals are compressed to achieve good efficiency of frequency spectrum. Due to this multiple calls can be possible at the same time on the same frequency. In 3G technology stationary speeds upto 2Mbps and mobility speeds upto 384kbps. 3G implemented High-Speed Downlink Packet Access (HSDPA). It is an enhanced 3G mobile telephony communications protocol in the High-Speed Packet Access (HSPA) family. Current HSDPA deployments support down-link speeds of 1.8, 3.6, 7.2 and 14.0 Mbit/s. Further speed increases up to 42 Mbit/s downlink and 84 Mbit/s with Release 9 of the 3GPP standards available with HSPA+. The theoretical max speed for HSPA+ is 21.6 Mbps. A 3G phone cannot communicate through a 4G network, but newer generations of phones are practically always designed to be backward compatible, so a 4G phone can communicate through a 3G or even 2G network.

3G/UMTS Architecture

The Constituent parts of 3G UMTS network are

Mobile Station: It can be a mobile phones, tabs or computers that could be used as an end user.

RAN (Radio Access Network): It consists of base stations and radio access controller. It connects mobile stations with core network. It also controls and manages the air interface for the network.

CN (Core Network): It provides the main processing and management of subsystems.

The core network is classified into two categories, Circuit Switched Domain and Packet-switched domain. Circuit Switched Domain: In this domain the dedicated channel is provided for a particular time period to set of users. Circuit Switched Domain having two blocks MSC – Mobile Switching Centre that manages circuit switched calls and GMSC – Gateway MSC that acts as an intermediary between external and internal networks. Packet-switched domain: To transmit and receive the data among the multiple users the IP (Internet Protocol) is used. The main two blocks in Packet Switched Domain are: SGSN (Serving GPRS Support Node): It provides session management, mobility management, communication with other areas of the network. The Gateway GPRS Support Node (GGSN) is a main part of the GPRS network. Its main responsibility is to interworking between the GPRS network and external packet switched networks. For example to interworking between the Internet network and X.25 networks. GGSN hides the GPRS infrastructure from the external network. When the GGSN receives data for a specific user, it first checks if the user is active. If user is active the GGSN forwards the data to the SGSN serving the mobile user. If the user is inactive, the data are discarded. It means that the GGSN is routed the packets in proper networks for the packets. It having the record of active mobile users and it is responsible for the billing.

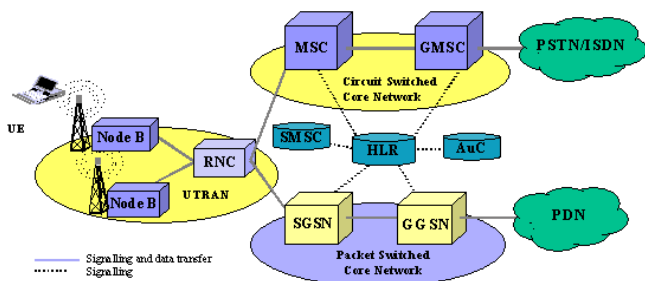


Fig 3 UMTS Architecture [5]

4g - Fourth Generation

Its main purpose is to increase the speed of communication, strengthen the quality of voice and data, and increase the capacity of number of users connected simultaneously. Also 4G helps to reduce the cost of Voice package and data package to attract more customers. Its main applications are IP telephony, cloud computing, 3D television, gaming services, high-definition mobile TV, and video conferencing. MIMO (Multiple Input Multiple Output) and OFDM (Orthogonal Frequency Division Multiplexing) are the main technologies used in 4G. The important 4G standards are WiMAX (Worldwide Interoperability for Microwave Access) and LTE (Long Term Evolution). In 4G network, when the device is moving the speed is 100 Mbps and when the device is stationary the speed is 1 Gbps. 4G allows to download the audio or video data without buffering. The new phones are designed in such a way that it should be work with the previous

technology for communication. The Internet Service Provider (ISP) has to changes the implementation of infrastructure and re-engineers their voice call network. In OFDM (Orthogonal Frequency Division Multiplexing) technique a signal is dividing into many narrowband channels at different frequencies to allow more users to communicate without interference to each other.

5G - Fifth Generation

5G promises higher connection density, significantly faster data rates, much lower latency. In 5G the speed of data transmission and receive is many times faster than 4G. Massive MIMO, Millimeter Wave Mobile Communications, Li-Fi etc. are used as main key technologies in 5G. It gives upto 10Gb/s speed and allows connections for billions of devices at the same time. It should be possible that 5G should be very useful to meet business and consumer acceptations.

In 2013, Huawei , Samsung, and Ericsson started prototype development. In 2013, Japan and Korea started to work on 5G requirement. In 2014, NTT Docomo did first 5G experimental trials. In 2018, South Korean SK Telecom plans to demo 5G at the Pyeongchang winter Olympics. Japan target is to launch 5G for the 2020 Tokyo summer Olympics.

Today in 4G networks to perform the mutual authentication between the users and connected devices and the network USIM application is used. The entity hosting the USIM application can be a removable SIM card or an embedded UICC chip. 5G is provide the connectivity between any devices with other devices without interrupt. The need for security, privacy and trust will be as strong as for 4G if not stronger with the increased impact of IoT services. Local SEs in devices can not only secure network access but also support secure services such as emergency call management and virtual networks for IoT. [6]. The below figure shows the requirements specification for 5G technology.

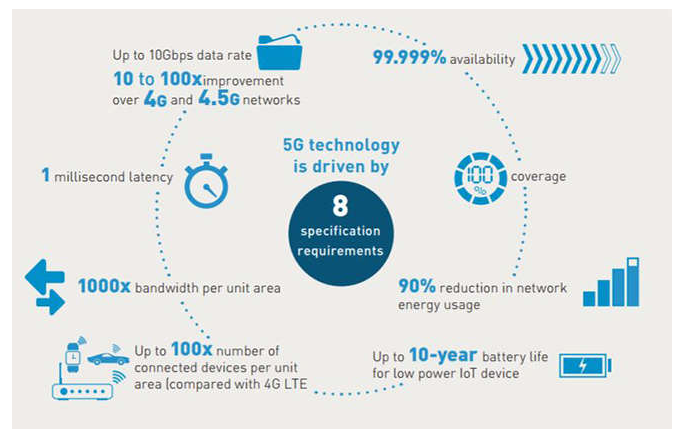


Fig 4 5G Technology [6]

Comparison of 1g, 2g, 3g, 4g and 5g Networks

This table shows the comparative study of all the mobile generation. From 1G to 5G various features are improved by implementation of various technologies [7-11].

Table 1 Comparison of Mobile Generations

Features	1G	2G	3G	4G	5G
Time-Period	1970-1990	1990-2004	2004-2010	2011-2019	2020 Onwards
Speed	2.4Kbps	64 Kbps	3Mbps	100 Mbps	Higher than 1Gbps
Technology	AMPS	GSM,CDMA	WCDM,IMT2000	LTE , Wi-Max	WWW
Internet Services	No Internet	Narrowband	Broadband	UltraBroadband	mmWavae
Carrier Frequency	30KHz	200KHz	5MHz	15MHz	60GHz
Handoff	Horizontal	Horizontal	Horizontal	Horizontal & Vertical	Horizontal & Vertical
Services	Voice	Voice & Data	High quality in audio, video and data	Higher data rate & dynamic information access	Very high data rate, wearable devices with AI
Multiplexing	FDM(Frequency Division Multiplexing)	FDM (Frequency Division Multiplexing) & TDM (Time Division Multiplexing)	CDMA (Code Division Multiple Access)	CDMA (Code Division Multiple Access)	CDMA (Code Division Multiple Access)
Core Network	PSTN(Public Switched Telephone Network)	PSTN(Public Switched Telephone Network)	Packet-Network	Internet	Internet

CONCLUSION

As mobile technology development is growing very fast and day to day the features are improved with the help of new technology. 5G comes with WWW (Wireless World Wide Web) and in that all the device in the world connected to each other without any cables. 5G will change the field of communication domain and bringing wireless experience to a completely new level.

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