

# Evaluation of Mobile Communication Technology from Scratch

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**ABSTRACT:** *With the evaluation of mankind, mobile communication technology has also evaluated parallelly with it. Over the last decades the mobile communication technology has grown tremendously, this evaluation of the mobile generation includes a number of enhancements in the previous generation technologies. It was all started with the development of the first generation i.e., 1G and the enhancement is still ongoing. The Journey from 1G to 5G (under development) looks short but one should not relate to it by counting the numerical numbers only. The first generation (1G) was the boon to the telecommunication industry, as it was the first analog device technology to communicate through a voice call with the other people wirelessly from one place to another, after which came second generation (2g) which brings digital transmission, then came third generation(3g) which was a big revolution in the mobile technology as it provides the high speed transmission and video calling etc., and it was followed by the fourth generation(4G) introduced the high speed transmission and the evaluation of LTE and last but not least fifth generation (5G) associated with the internet of things. In this paper a detailed review of all the generations is discussed and analyzed.*

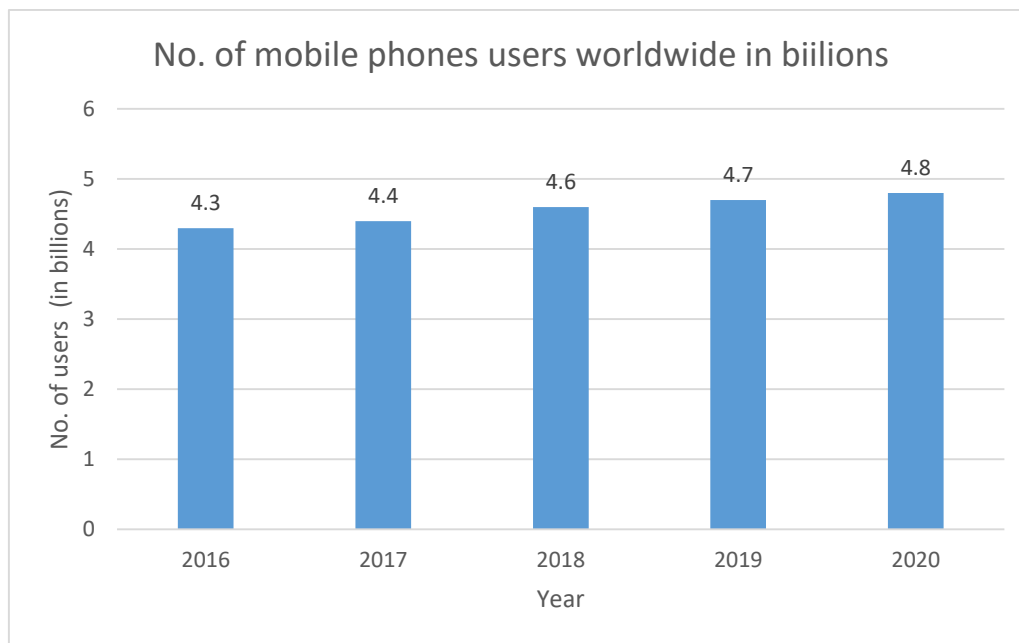
**KEYWORDS:** 1G, 2G, 3G, 4G, 5G, Wireless Communication, Mobile Broadband Technology.

## INTRODUCTION

Mobile communication technology was designed to overcome the drawbacks of the wired telecommunication services which only have a fixed bandwidth with reach to very few people, mobile generation technology enables wireless communication by reusing the allotted frequency, the mobile base stations and the towers. It allows us to communicate with people from one place to another through the voice, video or data transmission and receiving. Mobile generation technology has come a long way from 1G to 5G where G represents Generation and numerical numbers represent the number of the generation, it utilizes the base station and mobile towers to provide the full duplex communication to the user. At first mobile communication technology was only designed for voice call communication however, as the generation went up with enhancements the mobile communication technology is now capable of sending text messages, GPRS, video communication etc., with very high data speed transmission.

From 4.3 billion mobile phone users which includes both feature and smartphones in 2016 to 4.8 billion mobile phone users in 2020, the mobile communication industry has evolved a lot and have gained a large number of subscribers, around 61.20% of people in world uses the mobile phones [1] and it is predicted that in the upcoming years all the system based users will be shifted to the wireless or mobile communication devices. In today's era a mobile phone device is capable of establishing a wireless communication around each and every corner of the world with the help of satellite communication, mobile phones are capable of doing almost everything from making a phone call to establishing a video communication and transmitting data through high speed internet.

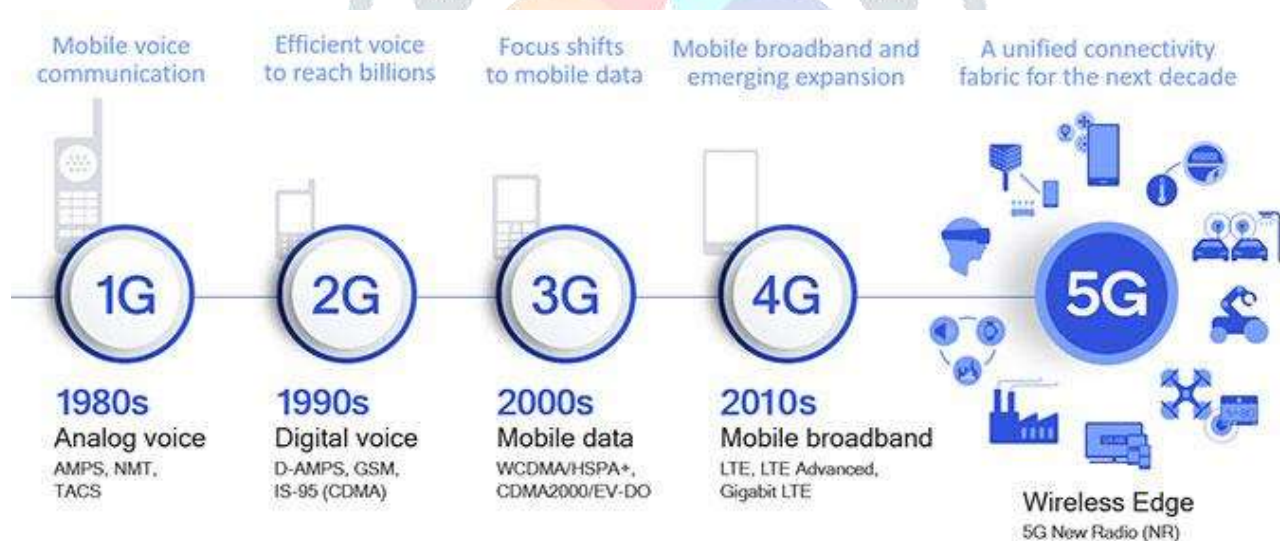
Growth in the number of mobile phone users from 2016 to 2020 is shown in Figure 1. Around 500 million mobile phone users are added in these 4 years.



**Figure 1: Mobile phone users worldwide in billions (2016-2020) [1]**

### 1. Evaluation of the Mobile Technology

The mobile communication **technology** has evolved a lot from analog to wireless, by analyzing the Figure 2. One can say that in every 10 years the technology gets an advancement and if it stays like this there is not much time left for the announcement of 6G.



**Figure 2: Evaluation of mobile communication [2]**

#### 1.1 First Generation (1G)

As the name suggests it was the first wireless mobile communication technology which was designed and introduced first in 1979 by Nippon Telegraph and Telephone (NTT) in Tokyo. Till 1984 it came into fame in many countries such as the US, Finland, UK and Europe. However, in 1982-83, the US rolled out the first 1G technology, AMPS (Advanced Mobile Phone System) channel was allocated 40-MHz bandwidth (BW) within the 820-900 MHz frequency range by the Federal Communications

Commission (FCC). It uses the FDMA (Frequency Division Multiple Access). Other countries also invented their own 1G networks after a few years. The two most popular used 1G technology systems were NMT (Nordic Mobile Telephone) and TACS (Total Access Communications System) which were used in countries such as Europe, Russia, United Kingdom. Motorola's DynaTAC became one of the first commercially available mobile phones because of its pocket friendly shape and size. However, 1G technology was only capable of establishing a voice call and that is too with very poor connection and voice quality.

Characteristics of first generation (1G):

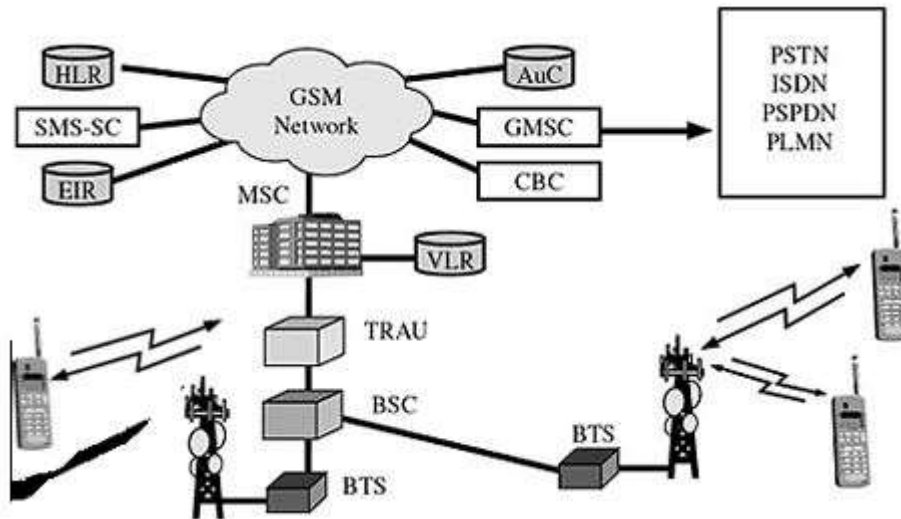
- Data Speed-2kbps
- voice call communication
- Wireless cellphones
- Analog cellular technology
- Bad voice quality
- Poor battery
- Big cellphones

### 1.2 Second Generation (2G)

Second generation (2G) technology was introduced in the late 1980s in Finland which was based on the concept of GSM (Global System for Mobile Communication). GSM architecture is shown in Figure 3 [3]. The main feature which separates it from the first generation was its digital signal transmission technology for establishing the voice calls. It introduced the concept of using the two digital multiple access technologies which were CDMA (code division multiple access) and TDMA (time division multiple access). 2G was capable of providing the digital and secured or encrypted voice calls with good voice quality. It was designed to not only establish the voice calls but also to send and receive SMS (text messages), MMS (multimedia message), roaming, emails, basic internet services etc. However, the data transmission rate of the 2G was very low, it was around 9.6 kbps. The telecommunication industry started to grow at a very fast rate due to the services provided by the 2G. It played a very important role in the evaluation of both the mobile communication technology and the industry, because of this many operators noticed an opportunity to invest millions of money in this sector.

Characteristics of Second generation (2G):

- Data speed was up to 64kbps
- digital cellular technology
- Better voice quality than 1G
- SMS and MMS



**Figure 3: GSM architecture [3]**

Due to the low data transmission speed there were continuous attempts to provide a better speed and an enhancement in the services provided by the 2G. Mainly two technologies with some enhancements in 2G came into existence i.e., 2.5G and 2.75G.

### 1.2.1 2.5G (GPRS)

2.5G also known as GPRS (General Packet Radio Service) was introduced in 1995. It uses both circuit and packet switching and is capable of providing the data speed up to 115 kbps. This opened up the new gates to the internet technology, it provided the web browsing service to the users on the mobile phone. And most importantly it was then possible to send and receive pictures and videos via WAP (wireless application protocol).

Characteristics of 2.5G (GPRS):

- Data speed up to 115 kbps
- 2G communication technology with GPRS
- E-mails, web browsing
- Camera Phones

### 1.2.2 2.75G (EDGE)

2.75G also known as EDGE (Enhanced Data Rates for GSM Evolution) was designed and introduced by Cingular AT&T in United States. EDGE was the evolution of GPRS technology which works only on the GSM networks. It provided a high speed data rate of up to 384 kbps.

Characteristics of 2.5G (GPRS):

- Data rate up to 384 kbps
- Higher-order PSK/8 key phase shift keying

### 1.3 Third Generation (3G)

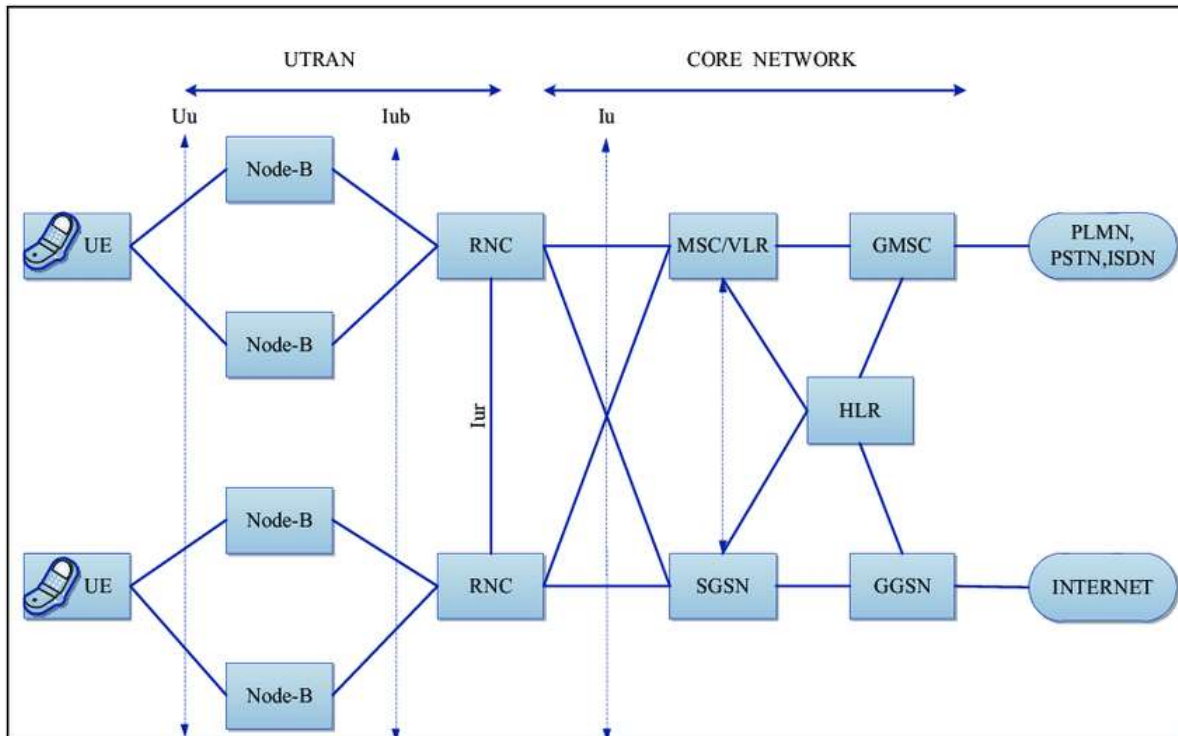
Third generation (3G)

Third generation (3G) technology brought the revolution in the mobile communication industry, it was launched by NTT DoCoMo in 2001. It was based on the concept of UTMS (Universal Mobile Terrestrial / Telecommunication Systems), this technology was the enhancement of the GSM technology and

provides very high speed data transmission rate up to 2 mbps using packet switching. Frequency range of the 3G communication is 1.6 -2 GHz.

Characteristics of 3G:

- Data speed up to 2 mbps
- First smartphone.
- Video calls
- UTMS technology



**Figure 4: UMTS Architecture [4]**

Figure 4 describe the architecture of the UMTS. It is basically divided into two interfaces, first one is UTRAN (UMTS Terrestrial Radio Access Network) and second is CORE NETWORK. Core network consists of HLR (Home Location Register), AuC (Authentication Center), EIR (Equipment Identity Register), MSC/VLR (Mobile switching center / Visitor location register), GMSC (Gateway MSC), SGSN (Serving GPRS Support Node), GGSN (Gateway GPRS Support Node).

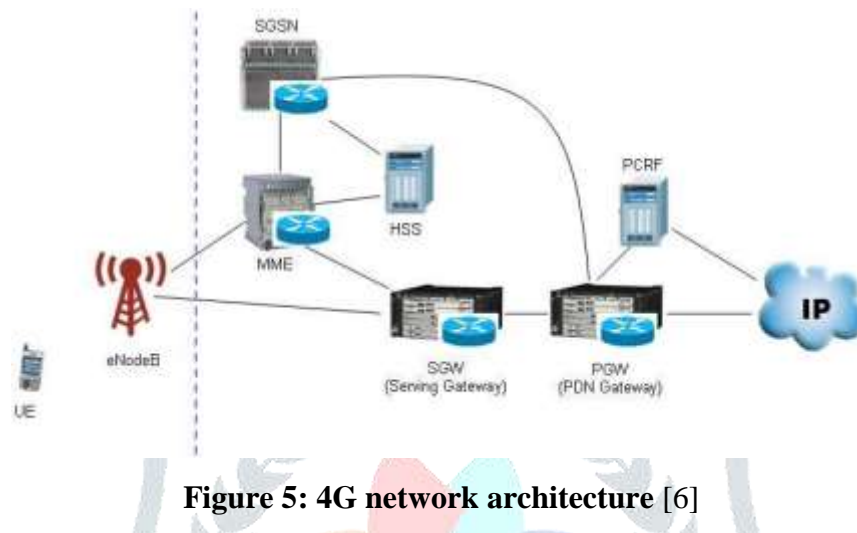
UTRAN consists of Node B which is a used for radio transmission and reception with cells. RNC (Radio controller network) The RNC monitor and controls the radio resources in its target area. It acts as a medium between Node B and the CN [4].

#### 1.4 Fourth Generation (4G)

Fourth generation (4G) was introduced in Stockholm, Sweden, Oslo, Norway in 2009 [5]. Two most important standards in 4g technology is LTE (Long-term Evolution) and WiMAX (Worldwide Interoperability for Microwave Access). 4G has anytime, anywhere connection, it is also referred to as MAGIC: Mobile Multimedia, Anytime anywhere, Global mobility support, Integrated wireless solution, Customized personal service [5]. Architecture of the 4G network is shown in Figure 5.

Characteristics of 4G:

- Data rate -100mbps to 1 gbps
- LTE, WiMAX technology
- Better QOS (quality of service)
- More Battery Consumption
- Bandwidth: 100MHz
- High Security



**Figure 5: 4G network architecture [6]**

### 1.5 Fifth Generation (5G)

Fifth generation (5G) also called future generation was developed in the late 2010's and was first launched in Chicago and Minneapolis On April 3, 2019. The prime target of this technology is to provide a World-Wireless World Wide Web (WWWW). After 3G one can say that 5G will be the biggest revolution in mobile communication technology. Some operators have started rolling out the 5G in some metropolitan cities, however there is still time in wide scale establishment of the 5g communication technology. Some operators have started rolling out the 5G in some metropolitan cities, however there is still time in wide scale establishment of the 5g communication technology. It is associated with the Internet of things era 5G technology will provide a very high speed data transmission with higher security.

Characteristics of 5G:

- High speed data speed up to 10gbps or higher
- Support World-Wireless World Wide Web (WWWW)
- Support to Iot (internet of things)
- Uses both circuit and packet switching
- CDMA multiplexing

## 2. Comparison Table of mobile communication technologies(1G,2G,3G,4G,5G)

GENERATIONS	1G	2G	3G	4G	5G
FEATURES					
Period	1970-1980	1990-2001	2001-2010	2011-2020	2019 onwards
Data Rate up to	2 Kbps	64 Kbps	2 Mbps	1 Gbps	1 Gbps and higher
Frequency	30 Khz	1.8 Ghz	1.6 - 2.5 Ghz	2 - 8 Ghz	> 6 Ghz
Core Network	PSTN	PSTN	Packet network	Internet	Internet
Architecture	Analog	GSM, GPRS, EDGE	UTMS	LTE, WiMAX	WWWW
Multiplexing	FDMA	TDMA,CDMA	CDMA	CDMA	CDMA
Switching	Circuit	Circuit, Packet	Packet	All packet	All packet

### CONSLUSION

The mobile communication technology has evolved tremendously over the last decades, around 61.20 % of people in the world own a cellphone today. Increasing numbers of mobile phone users have challenged the mobile communication industry to enhance its technology continuously. With the evolution from 1g to 5g the quality of mobile communication and services provided by the operators to the mobile phone users has also boosted a lot. 1G provided us with voice communication, 2G provided us with SMS and MMS services. Revolution was brought by 3G technology, it was the first smartphone device which enables the users to browse through the internet and video calls. Followed by this 4G provided high speed internet with the maximum security. In the coming years it is quite evident that mobile communication technology will be deploying 5G over a wide scale. 5g technology is based on the internet of things and wireless world wide web (WWWW) which makes it more intelligent and provides connectivity without any interruption.

### REFERENCES

1. World, W.L.-I.T. and 2006, undefined, "Defining china's fourth generation mobile communications."
2. Ese David, O., "Roadmap and Challenges to the Deployment of 4g Lte Network: The Nigerian Experience," *Am. J. Networks Commun.* 6(5):74, 2017, doi:10.11648/j.ajnc.20170605.11.