



Transformation of Mobile Communication Network from 1G to 4G and 5G

Mohammad Javed and Ahmad Talha Siddiqui

Department of computer science and technology

Maulana Azad National Urdu University

Hyderabad, Telangana, India

Abstract: Nowadays users are searching for proper bundle including the whole highlights because all of them are getting to be distinctly mindful of the mobile phone technology change. This causes the fundamental expectation of cellular phone companies to scan for the new technology to outshine their competition. The clients can utilize these applications on their whim through portable correspondence. The aim of this paper is to address the evolution of versatile interchanges from its origin, 1G to 2G, 2G to 3G, 3G to 4G and the newest 4G to 5G.

Keywords: 1G, 2G, 3G, 4G, 5G, GSM, CDMA, LTE

1. INTRODUCTION

We have seen incredible growth in the field of mobile phone communication in the past 2 decades. In order to get together the client necessities, users media transmission organizations are attempting to carry new advancements into reality with better components. Because of the cellphone innovation our lives have changed; in early days there were wired phones called land lines telephones and there was no

option to communicate with the world without static line telephones. Portable remote correspondence has replaced the conventional one and now we can talk to anybody, anyplace, at any time; it gives another arrangement of administrations which concentrates on voice correspondence as well as tries to give the client access to worldwide correspondence reality [1].

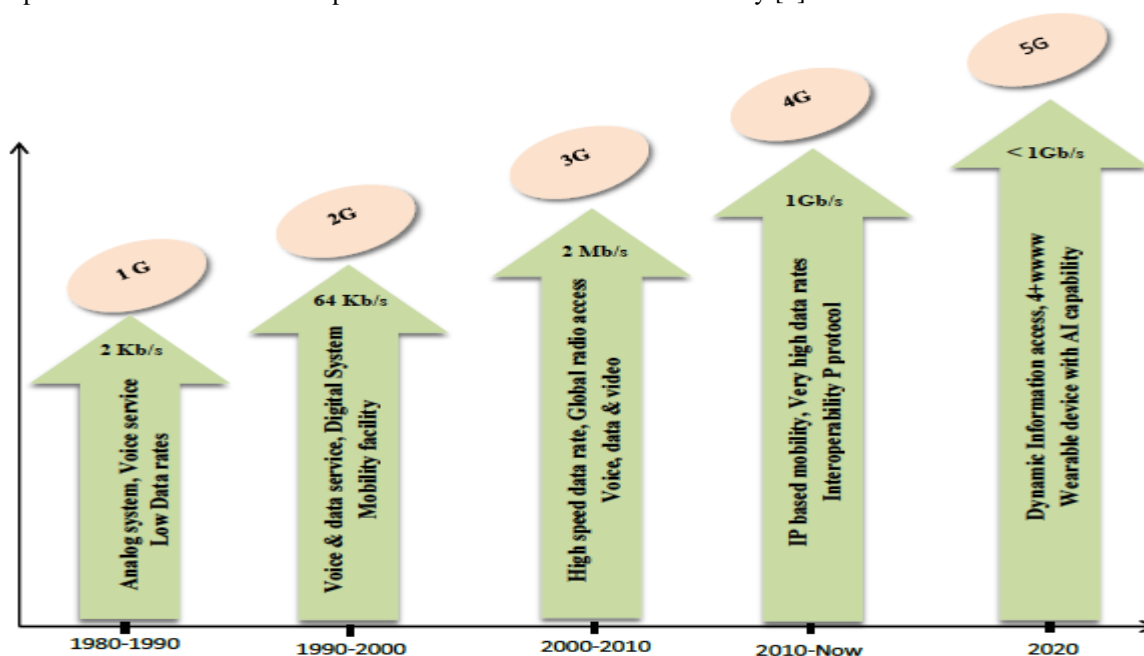


Fig.1. Evolution of wireless networks

The first era of remote versatile correspondence system came into existence in mid-eighties and second era's frameworks in the late 1980s. They were fundamentally expected for voice transmission only. The underlying frameworks were using simple recurrence balance whereas the second consequent portable frameworks employed advanced correspondence methods with time division multiplexing (TDM), recurrence division multiplexing (FDM) or the code division different get to (CDMA). The third era remote frameworks which are simply getting presented on the markets offer impressively higher

information rates, and permit far more noteworthy changes over the 2G frameworks. 3G was proposed to give voice and paging administrations to give instinctual sight and sound including remotely coordinating and web get to and assortment of different administrations.[10] Contrasted with old cell phones a 3G handset gives lots of new elements, for example, TV streaming, media, videoconferencing, Web serving, email, paging and navigational maps. Following 3G comes 4G/LTE (Fourth Generation/Long Term Evolution), it is more versatile in terms of system advancement.

The 4G improvement promises us to convey the remote experience to a great extent with numerous great client applications, for instances, refined graphical user interface, gaming, top quality video and elite imaging. [1]

5G Technology is going to be another portable transformation in versatile market. Overall PDAs and this innovation additionally hit the China portable market and a client being skilled to get access to German cell phone as the neighborhood cell phones and 5G innovation has additional customary information capacities and has capacity to twist together unlimited calls and limitless information communicate inside most recent versatile working framework. 5G innovation has a splendid future since it can deal with most incredible advancements and offer valuable handset to their clients. 5G has an amazing capacity to assist Software and Consultancy [2].

2. DEVELOPMENT OF MOBILE COMMUNICATION NETWORK

We have divided the mobile communication advancements into eras, a diagram of these eras has been given below: In this section we shall talk about the history and advancement of versatile administration from the 1G (First era) to fourth era.

2.1. First generation (1G)

1G was introduced in 1980s and was based on the analog system [1]. They are popularly known as cell phones. It offers mobile technologies for example Mobile Telephone System (MTS), Advanced Mobile Telephone System (AMTS), Improved Mobile Telephone Service (IMTS), and Push to Talk (PTT) [8]. It makes use of analog radio signal which have frequency 150 MHz. In this voice call modulation is finished by a technique called frequency division multiple access (FDMA) [5]. Analog systems were based on circuit switching technology and offer only voice communication and no data communication [1].

Key features and facilities of 1G

- ❖ Based on analog system.
- ❖ It gives data speed of up to 2kbps.
- ❖ Cordless phone.

Basic disadvantages of 1G

- ❖ Only voice, no data communication.
- ❖ Low capacity.
- ❖ Negative handoff.
- ❖ Less secure.
- ❖ Poor voice link.

2.2. Second generation (2G)

In 1980s Second-generation (2G) mobile systems were introduced and then it got terminated in the late 1990s, it was mainly for voice transmission by digital signal and speeds up to 64kbps. It is generally related with global system for mobile (GSM) services, it had a bandwidth of 30-200 KHz. [4] the 2G mobile communication system is a digital cellular system. This system is still popular in different areas of the world. This generation was particularly used for voice & data transmission and also offered some more services such as a short message services (SMS), picture message services and Multi Media Message services (MMS), GPRS & E-mail. In this generation, two digital modulation plans are utilized; one is time division multiple access (TDMA) and the 2nd is code division multiple access (CDMA) [5]. Next to 2G, 2.5G system uses packet switched and circuit switched domain and provide data rate up to 144 kbps. E.g. GPRS, CDMA and EDGE [8]

Key features and facilities of 2G

- ❖ Enhanced Spectrum proficiency.
- ❖ Provides data rate of 64kbps.
- ❖ Improved framework limit, and network coverage.
- ❖ Roaming benefits.
- ❖ Voice and data service.
- ❖ Enhanced security.

Basic disadvantages of 2G

- ❖ It doesn't bolster high information rates.
- ❖ Weaker computerized signal.
- ❖ Unable to deal with complex information.

Table I: Comparison between 1G & 2G

1G	2G
It existed in 1980s.	It came in 1990.
It works on analog signals.	It works on digital signals.
1G cell phones are used for voice calls.	It is essentially utilized for mobile Communication.
Band width per frequency channel of 1G is up to 30Khz.	Band width per frequency channel of 2G is up to 200Khz

2.3. Third generation (3G)

3G was presented in the year 2000. It is the services which combine high speed mobile access with Internet Protocol (IP)-based services [3]. 3G is built on the Universal Mobile Telecommunication Systems (UMTS). UMTS is an element under a set of standards IMT-2000 issued by ITU [11]. The IMT-2000 family consists of five systems: (1) Wideband Code Division Multiple Access (WCDMA) including TDD and FDD modes, (2) CDMA 2000 1X, (3) Time Division – Synchronous Code Division Multiple Access (TD-SCDMA) (4) EDGE (additionally called UWC-136) and (5) Digital Enhanced Cordless Telecommunications (DECT). Toward the finish of the selection phase for IMT-2000, two major families of systems have arisen, leading to the

creation of two groups of standardization (which include operators and manufacturers), namely: (1) 3rd Generation Partnership Project (3GPP), which built up the W-CDMA standard also known as Universal Mobile Telecommunication System (UMTS) in FDD and TDD modes, and (2) 3GPP2, which built up the CDMA 2000 standards as an evolution of the IS-95 standards. The terrestrial radio interface of UMTS, called Universal Terrestrial Radio Access Network (UTRAN) has been produced through a sequence of releases, downlink data rate of 14.4 Mb/s – High Speed Downlink Packet Access (HSDPA). The ITU did set guidelines for “3G systems” in the IMT-2000 framework to support data rate 144 kb/s for high mobility and 2 Mb/s in a fixed location [12].

Key features and facilities of 3G

- ❖ Faster data rates.
- ❖ Supports multimedia applications such as video and photography.
- ❖ Value added services like mobile television, GPS (global positioning system), video call and video conferencing.

- ❖ Fast mobile internet access.
- ❖ Increased capacity.

Basic disadvantages of 3G

- ❖ Needs 3G compatible handsets.
- ❖ The cost of upgrading to 3G devices is high.
- ❖ Power utilization is high.
- ❖ 3G requires closer base stations which is costly.

Table II: Comparison between 2G &3G

2G	3G
It came in 1990	It came in 2000
It is successor to 1G	3G is successor to 2G
It depends on digital signals	It depends on high capacity broadband data
Band width per frequency channel of 2G is up to 200Khz	Band width per frequency channel is up to 20Mhz

2.4. Fourth generation (4G)

4G focuses on, not one defined technology or standard, but on a collection (an integration) of technologies and protocols expected to provide a complete and secure all-IP based packet-switched networks, optimized for data [13].

The International Telecommunications Union (ITU) defined the International Mobile Telecommunications-Advanced (IMT-Advanced) standard as the global standard for 4G wireless communications. As told by the International Telecommunication Union's Recommendation (ITU-R), 4G provides very high speed connections such as 100Mbps for outdoor environments and 1Gbps for indoor environments. Also, it is recommended that a 4G heterogeneous network should have high capacity, low cost, low latency, desirable excellent of provider, and good coverage. There are many competitors, for example as LTE Advanced and Wireless MAN Advanced which are trying to acquire these requirements, especially high speed, while,

other candidates are trying to build a 4G heterogeneous network as a convergence between wireless and wired [14].It is developed around 2010 – 2015. 4G ought to have the capacity to give exceptionally smooth worldwide meandering universally with lower cost [2].

Key features and facilities of 4G

- ❖ High spectral efficiency.
- ❖ High voice quality.
- ❖ Easily get to web, streaming media, video conferencing.
- ❖ Very low inactivity.
- ❖ Simple protocol architecture.
- ❖ Efficient multicast/communicate

Basic disadvantages of 4G

- ❖ Higher data costs for users.
- ❖ It is very costly and difficult to execute.
- ❖ Complex hardware.
- ❖ Power consumption more.

Table III: Comparison between 3G &4G

3G	4G
It came in 2000	It came in 2010-2015
It is known as tri band 3G	4G is the fourth generation mobile communication
The maximum data transfer speed is up to 3.1 mbps	Speeds for 4G are further increased to keep up with data access demand used by different services
It provides digital navigation and access to video	4G provide high definition streaming and some additional qualities such as multimedia Newspaper and ultra-broadband internet access which were not absent in 3G.

2.5. Fifth generation (5G)

5G is expected to be launched in 2020 approximately. This generation technology will offer significant high bandwidth that client never experienced before. 5G wireless cellular multimedia internet networks can be absolutely wireless communication without difficulty, which makes ideal wireless real world – World Wide Wireless Web (WWW). 5G is primarily based on 4G technologies. The fifth wireless cellular internet networks are real wireless world It will be supported by using LASCDA (Large Area Synchronized Code-Division Multiple Access), OFDM (Orthogonal frequency-division multiplexing), MCCDMA (Multi-Carrier Code Division Multiple Access), UWB(Ultra-wideband), Network-LMDS(Local Multipoint Distribution Service), and IPv6. 5G will offer high data capabilities and unrestricted calls and countless data broadcast together inside latest cellular operating system.^{5th}

generation would make an important difference and add more services and advantages to the world over 4G. 5G would be greater sensible technology that interconnects the whole global without limits. [6]

Key features and facilities of 5G

The primary features of technology might have are given below:-

- ❖ Fast, high power and minimal cost per bit. It Support intuitive interactive media, voice, streaming video, Web, and other broadband administrations, greater compelling and more alluring, Bidirectional, exact measurements [2].
- ❖ Presentation of another radio framework is conceivable in which diverse radio innovations will circulate the same range. This should be possible by finding unused range and afterward adjusting to

the innovation of the radio innovation with which the range is being shared [2].

- ❖ It is giving large broadcasting capacity up to Gigabit which supporting very nearly 65,000 connections at a time. [6]
- ❖ 5G technology gives Global access and service portability [6].

- ❖ Each portable in a 5G system will have an IP address (IPv6) as indicated by the area and system being utilized.
- ❖ The innovation is probably going to bolster virtual private systems and propelled charging interfaces.
- ❖ The movement insights by 5G innovation makes it more precise and it likewise bolsters virtual private system.

Table IV: Comparison between 4G & 5G

4G	5G
It came in 2010-2015	5G will come completely in 2020
4G is the fourth generation of mobile communication technology.	5G is the revolution in 4G Cell phone communication technology
Speeds for 4G are further increased to keep up with data access demand used by various services	5G will provide very high speed as well as good use of available band width to the client
4G provide high definition streaming and some more features such as multimedia Newspaper and ultra-broadband internet access which were not present in 3G.	5G includes huge phone memory, dialing speed, and many more and also we can connect our 5G cell phones with laptop to get broadband internet access

Challenges of 5G

The three basic necessities for building 5G wireless systems are

- ❖ Abilities for supporting huge limit and enormous network.
- ❖ Bolster for an undeniably differing set of services, application and clients all with extremely different necessities for work and life.
- ❖ Adaptable and effective utilization of all accessible non-adjacent range for fiercely extraordinary system sending situations Versatile systems will

progressively turn into the essential method for system access for individual to-individual and individual to-machine connectivity.

These systems should coordinate advances in settled systems administration as far as conveyed nature of administration, unwavering quality and security. To do as such, 5G advances should be equipped to do conveying fiber-like 10 Gb/s rates to make conceivable ultra-top quality visual interchanges and immersive media associations. These innovations will rely on broad data transmission with sub millisecond latency.

Table V: Comparative Study of Communication Network

Technology & Feature	FIRST GENERATION (1G)	SECOND GENERATION (2G)	THIRD GENERATION (3G)	FOURTH GENERATION (4G)	FIFTH GENERATION (5G)
Start/Deployment	1980 – 1990	1990-2000	2000-2010	Now	Probably Soon(2020)
Data Rate	2kb/s	64kb/s	2 Mb/s	1Gb/s	< 1Gb/s
Technology	Analog Cellular Technology	Digital Cellular Technology	Broad bandwidth CDMA IP Technology	WiMax LTE, Wi-Fi	4G+WWWW
Service	Analog voice service No data service	Digital voice, SMS,MMS, Higher capacity packetized 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
Standards	MTS,AMTS,IMTS	GSM,GPRS,EDE	IMT-2000 HSDPA, HSUPA	Single unified Standard WiMax, LTE	Single unified Standard
Switching	Circuit	Circuit, Packet	Packet	All Packet	All Packet
Core Network	PSTN	PSTN	Packet N/W	Internet	Internet

3. FUTURE WORK

The future changes of Nano-center will be staggering as it connects with artificial intelligent (AI). One can be ready to control one's clever Robot utilizing one's cell phone. Your cell phone can naturally sort the message what your mind considers. We may get a situation where we don't want any range for Correspondence. There are many issues in regards to the dangers and vulnerabilities that ought to be explored broadly to discover elective arrangements that finish all the security prerequisites proposed on 3GPP details.

Our examination is centered on the assessment of all the AKA choices given by research bunches utilizing Casper/FDR, a testing device to assess security conventions demonstrated by useful programming. Distinguishing proof of further shortcomings is basic to configure better security situations for the 4G

Besides, an upgraded arrangement will be proposed to adapt to all the distinguished dangers and limit the verification activity amid the AKA stage, considering a completely in reverse similarity without perpetrating further threats into the framework. The arrangement will be checked and reenacted in OPNET, a device to dissect and configuration simulated networks, gadgets.

4. CONCLUSION

The wireless organization is busy with standardization of the 4G cellular network. This paper concentrates on innovation of word wide wireless web (www) 5G.

5G technology is going to be another development in mobile market. 5G technology has a great future as it can deal with best innovation and offer pries handset to their client. As information activity has great development potential, under 4G existing voice driven telecom pecking orders will be moving flat IP design where, base stations will be specifically associated with media portals. 5G will forward the idea of Super Core, where all the system networks will be associated with one single center and have one single infrastructure, paying little attention to their get to advancements. 5G will bring assessment of dynamic infra sharing and overseen administration, and in the long run all current system administrators will be MVNOs (Mobile virtual network operators).

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