

# A Review of Different Generations of Mobile Technology

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**Abstract—** Wireless mobile technology has revolutionized the way people communicate with each other the hindrance that was caused to the communicating parties due to distance has become obsolete a mobile phone has become an integral part of our day to day work the present day mobile phones that we use have come a long way since the inception of mobile telephone service introduced in USA in 1940s the evolutionary process of wireless mobile technology is broadly classified into generations (0G, 2G, 3G, 4G) where G stands for generation with 0G being the initial phase and 4G which is in use currently 0G refers to pre cell phone telephone technology the concept of “cell” was introduced in 1G present day mobile phones are capable of text, voice and video data transfer work is underway on development of 5G mobile technology it will have features of World Wide Wireless Web(WWWW), Dynamic Adhoc wireless network(DAWN) it will have much higher speed, better connectivity, high capacity and high error tolerance right now the term 5G is not officially used.

**Index Terms—** mobile technology, 1G,2G,3G,4G,5G, WWW, wireless technology, generations

## I INTRODUCTION

In 1895, Italian inventor and electrical engineer Guglielmo Marconi paved the way for modern wireless communications by transmitting the three-dot Morse code for the letter ‘S’ over a distance of three kilometers using electromagnetic waves since then the wireless transmission has come a long way technology is evolving at a rapid pace and it is true in case of mobile technology also mobile or cellular phones have become a vital element in our day to day work and routine socializing there has been a transition from fixed telephone line systems to mobile phones in the past decade there are many factors for this transition one of most pronounced one being the portability factor. The first brush we had with mobile wireless technology was after World War II in the form of radio telephones which some cars in USA used to have in those formative days a mobile operator used to set up calls and only few channels were available, mobile network is also called cellular network as the network is

distributed over

land areas called cells each cell has its own cell site or base station the frequencies used by neighboring cells are different to avoid interference.

## II Zero Generation (0G-0.5G)

The work to design a portable telephone system started immediately after World War II the phase which is categorized under 0G started from 1946 when Motorola and Bell systems began operating first mobile telephone system (MTS) this phase is also known as mobile radio telephone system phase and pre cellular phase in this generation the telephone systems were quite different from what are in use now the mobile telephone systems were mounted on vehicles like cars, trucks etc. the telephone system had a transceiver which performed the function of a transmitter and receiver and was placed somewhere in the vehicle’s trunk and was connected with a wire to the head which consisted of dialing mechanism and display the head was placed near the driver’s seat its working principle was, the telephone device would connect to local telephone network only when it is in a range of 20 km a central antenna tower was installed in each city having 25 channels number of people who were able to avail the services of this system was very less as only 25 channels were available these telephone systems had only voice transmission facility, used analog signals, were very bulky, had half duplex mode of communication Technologies used in 0G systems included PTT (Push to Talk), MTS (Mobile Telephone System), IMTS (Improved Mobile Telephone Service), AMTS (Advanced Mobile Telephone System), OLT and MTD

**0.5G** was the successor of 0G technology it had some noticeable new features the size was reduced and the telephone systems became portable ARP (autoradiopuhelin) was launched in 1971 which was the first commercial public mobile network it operated on 8 channels with frequency of 147.9-154.87 MHz like 0G these systems had also half duplex mode of communication one path breaking feature of 0.5 G was the concept of “cell” a cell is an area of some city divided into small sectors also called cells(hence the term cellular phone) cell size being 30 Km these systems didn’t had handover facility, technologies used in this generation were High Capacity Mobile Telephone System(HCMTS),

Public Automated Land mobile(PALM)



. Fig 1 mobile telephone systems of 0G

## II First Generation (1G)

This technology was introduced in early 1980's from this phase mobile cellular era began this technology used analog signals and had only voice transmission facility the global mobile phone market grew after 1G technology was introduced these phones had low capacity, unreliable handoff, poor voice links, no security from eavesdropping these telephones worked on circuit switching, operated at 150 MHz frequency and speed of 2.4kb/s the voice quality was poor, suffered interference due to use of analog signals ,had limited capacity of users, these phones were large in size and had poor battery life due to their size there was one more issue concerning secure communication as anyone was able to hear the transmission after tuning to the same frequency, semiconductors and microprocessors were used in the design of phones of this generation some noticeable models of 1G were Advanced Mobile Phone System (AMPS) launched in USA in 1982, Radiocom 2000 launched in France ,Total Access Communication system(TACS), BTMI launched in Italy and Nordic Mobile Telephony(NMT) used in Denmark, Iceland, Finland and Sweden. The first generation of analogue mobile systems was launched in Japan by NTT in 1979 and covered Tokyo's 20m people with 23 base stations and by 1984 covered the whole of the country, in USA Motorola pioneered in creating first mobile network in Washington DC



Fig 2 mobile system of first generation

## III Second Generation

This technology was introduced in 1991 based on technique known as Global System for Mobile Communication(GSM) in this era the signals were digital so this generation systems had a clear edge over their predecessors it had the facility of text messages, picture messages and video messages the messages were digitally encrypted due to the use of digital signals voice quality became better than previous generations, spectrum is also utilized more efficiently and less amount of bandwidth is needed for voice and video transmission 2G also introduced the ability to download media content on mobile phones the size was considerably reduced from the first generation phones data speed achieved by 2G phones was up to 100 kbps. The downside of 2G was that it was dependent on proximity and location to towers 2G systems can be classified by their multiple access techniques as either TDMA or FDMA

**TDMA (2G):** 2G Mobiles uses TDMA (Time Division Multiple Access) technology in some of its models. It actually divides the band into three time-periods TDMA contains technologies GSM (Global Service Mobile Communication), which is the most common technology, uses widely across the world use of SIM is a prominent feature of GSM. It needs only a SIM to start communication at a particular region.

**CDMA (2G):** CDMA works using the entire band with the help of code. CDMA is based on a wide spectrum as many calls laid over each other identifying on the basis of unique code

Further variants of 2G are 2.5G-GPRS and 2.75-EDGE



Fig 3 mobile systems of 2G

2.5 G--GPRS (general Packet Radio service): it has higher data capacity than 2G GPRS adds packet switched capabilities and TDMA networking it sends text and graphics rich data at a high speed this technology provides data rates up to 115kbps has features like WAP, e-mail, MMS and Internet.

2.75—EDGE (Enhanced Data Rates For GSM Evolution):it an extended version 2.5 G it provides fast transmission without glitches it can transmit packet switched and circuit switched data.

#### **IV Third Generation**

It is based on the International Telecommunication Union (ITU) family of standards under the International Mobile Telecommunications programme it was implemented in year 2000, IMT-2000 this technology redefined the definition of a mobile phone which till now was primarily a communication device but from 3G era internet, email and other web features became associated with mobile phones this technology supports data transfer rates up to 2Mbps, supports multimedia applications like full motion video, video conferencing location based services like GPS, IPTV, wider bandwidth, its voice quality surpasses all the previous generations and better spectral efficiency 3G makes use of CDMA and TDMA technologies 3G functions in the range of 2100 Hz and bandwidth 15-20 MHz and works on packet switching the concept of global roaming also came in this generation. The first pre-commercial 3G network was launched by NTT DoCoMo in Japan in 1998, branded as FOMA it was first available in May 2001 as a pre-release (test) of W-CDMA technology the first commercial launch of 3G was also by NTT DoCoMo in Japan on 1 October 2001, although it was initially somewhat limited in scope on the downside 3G is very costly as compared to 2G technologies due to high bandwidth transmission of 3G technologies, power consumption greatly increases which results in reduced device battery life.



Fig 4 mobile system of 3G (Motorola's first 3G model)

Further variants of 3G are:

3.5G – HSDPA (High-Speed Downlink Packet Access): it is a mobile telephony protocol it provides packet based service it provides a packet based service it improves the speed and quality of downlink data transmission on networks based on UMTS HSDPA consist of Multiple-Input Multiple-Output (MIMO), Hybrid Automatic Request (HARQ), Adaptive Modulation and Coding (AMC), advanced receiver design and fast cell search provides the speed ranging from 8-10 Mbps downlink which is much more than 3G it has less latency as compared to 3G and is cheap because it only has to be upgraded from 3G.

3.75G – HSUPA (High-Speed Uplink Packet Access): it is also known as 3.75G this protocol strives for providing higher uplink speeds up to 5.8Mbps it enhances the uplink speed by increasing throughput, capacity and decreasing delays. HSUPA works on request grant principle in which user will seek permission from scheduler to transmit data (data is send in packets), scheduler then decides at what time the user can send data and number of users who will be permitted to send data.

#### **V Fourth generation**

This generation is an extension of 3G it was implemented around 2010 right now the definition of 4G is a bit vague as what to include in it one of the main objective of 4G is to allow all sorts of devices on “the” network and to bring about seamless integration between different devices this technology offers best voice quality surpassing all the previous generations, higher bandwidth, more user services, high quality audio/video streaming facility , ultra broadband Internet access, cloud computing, IP Telephony, high definition(HD) mobile TV it provides a transmission speed up to 20mbps and increased interaction between corroborating devices it makes use of Orthogonal Frequency Division Multiplexing (OFMD) in the downlink or single-carrier frequency-domain-equalization (SC-FDE) in the uplink and other frequency domain equalization schemes(FDE), Turbo principle error-correcting codes To minimize the required SNR at the reception side, 4G system does not support traditional circuit-switched telephony service, but all-Internet Protocol (IP) based communication in fourth generation technology the high date speed networks connects simultaneously which offers the faultless handoffs around all over the geographical regions other features include Fully Converged Services, Ubiquitous Mobile Access, Software Dependency, Diverse User Devices , Autonomous Networks, integration of Wireless LANs into the total mobile network, 4G will support ad hoc networking via a more evolved version of a currently existing standard called Bluetooth. Though 4G became available in the US in 2009, no specific technologies were officially designated as 4G until 2010 the commercially deployed 4G systems are the mobile WiMAX (first used in South Korea in 2007) standards and Long Term evolution (LTE) (in Oslo, Norway and Stockholm, Sweden since 2009) other technologies

under 4G are standard based on GSM/EDGE and UMTS/HSPA, 3 Gen partner project (3GPP) etc.



Fig 5 a 4G mobile system

### VI Fifth generation

Fifth generation or 5G technology is deemed to be the next phase of mobile communication till now this nomenclature is limited to research projects and articles it denotes the future of mobile technology beyond the 4G era right now this term 5G is not officially used for any specification this technology aims at meeting the requirements for mobile communications beyond 2020 some analysts and observers believe that by early 2020's 5G technology systems would be in the market. Fifth generation 5G is a complete [5] wireless communication with almost no limitation , Additional features such as Multimedia Newspapers, also to watch T.V programs with the clarity as to that of an HD T.V, we can send Data much faster than that of the previous generations,5G will bring almost perfect real world wireless or called "WWW: World Wide Wireless Web Real wireless world with no more limitation to access and zone issue ,wearable devices with AI capabilities other prominent [5] features include

1. 5G technology offers high resolution for crazy cell phone user and bi- directional large bandwidth shaping.
2. The advanced billing interfaces of 5G technology make it more attractive and effective.
3. 5G technology also provides subscriber supervision tools for fast action.
4. The high quality services of 5G technology based on Policy to avoid error.
5. 5G technology is provides large broadcasting of data in Gigabit which supporting almost 65,000 connections.
6. 5G technology offers a transporter class gateway with unparalleled consistency.
7. The traffic statistics by 5G technology makes it more accurate.

8. Through remote management offered by 5G technology a user can get a better and faster solution.

9. The remote diagnostics also a great feature of 5G technology.

10. The 5G technology is providing up to 25 Mbps connectivity speed and support for virtual private network

Application Layer	Application (services)
Presentation layer	
Session layer	Open transport protocol (OTP)
Transport layer	
Network Layer	Upper network layer Lower network Layer
Data link Layer	Open wireless Architecture (OWA)
Physical layer	

Fig 6 protocol stack for 5G



Fig 7 5G mobile phone layout

### VII Conclusion

Mobile technology has revolutionized the way we communicate and it occupies an important place in our lives the technology has gone through various phases from the bulky 0G systems to the present day smart phones the definition of a mobile phone is also ever changing which was at once a device for communication now it plays streaming videos ,high speed Internet etc. each generation offered users different services and the successor ones overcame the shortcomings of the previous ones two key developments the switch from analog signals to digital ones in 2G and then availability of Internet and multimedia in the 3G proved seminal for future research right now mobiles have Internet, email, different messaging facility, text, video messaging

,GPS facility and the proposed 5G technology would offer phones with AI features ,unmatched speed and many other new features.

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