# Evolution of Mobile Technology

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**Abstract –In this paper we throw a light on the various generations of mobile wireless technologies (1G to 5G) and also presents an overview of 5G technology trends in the wireless technology market.The First Generation were referred to as cellular, which was later shortened to "cell", Cell phone signals were based on analog system transmissions.The wireless industry is busy with the standardization of the 4th generation (4G) cellular networks.The word wide revolution in mobile is changing our lives in term of the way we work, learn and interact. Mobile devices are fast becoming the most pervasive and ubiquitous technology ever invented. We have an overview of the mobile technologies.**

***Keywords****-1G, 2G, 3G, 4G, 5G, Mobile Communication, Wireless Communication, VOIP.*

## I. Introduction

While currently it is necessary to connect to the wireless networks from one's mobile devices, technological innovation is looking towards an "always on" phenomenon. The greater the focus towards data-centric networks, the greater will be the shift from the circuit-switched services towards packet-switched networks. In other words, consumers will not have to shell out money for the airtime they use, but for the data they exchange over the wireless medium. The data rates for users in the air links of these systems are limited to a few Kbps.

International Mobile Telecommunications 2000 (IMT-2000), the third-generation cellular systems, aim to provide 2 Mbps (indoor) and 144 kbps (outdoor) of data rates over wireless communication channels. However, demands for higher access speeds for multimedia communications will be unlimited. In the years to come, users and businesses will be free of space and time restrictions.

Advanced personal communication devices will lead people to be truly a global entity. The technologies are taking their own logical evolutionary process [1].

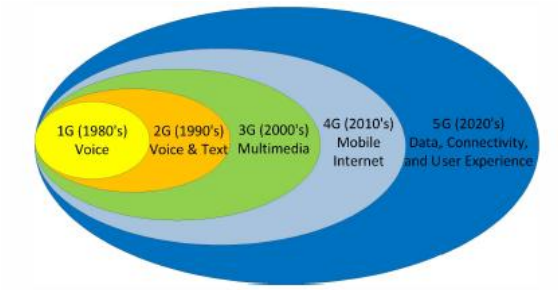


Fig: Evolution of Mobile technology.

## II. 1G Technology

First Generation Mobile Networks Mobility to users on phones came about in the late 70s and early 80s when mobile phones came into the market. The technology was voice-centric and catered to putting the telephones on the move (hence the term mobile phones). Various analog techniques came into the market.


Fig: Nokia 650 1G Mobile phone.



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Evolution of Mobile Network Systems ß AMPS (Advanced Mobile Phone Service) in Asia and North America ß NMT (Nordic Mobile Telephone) in Sweden, Norway, Finland ß ETACS (Extended Total Access Communication System) in the UK ß NTT (Nippon Telegraph and Telephone) in Japan These mobile phones worked and still work on the concept of cells, where the geographical spread was divided into small sectors, each called a cell, hence the term cell phones, to optimize and reuse frequencies in order to have a wider subscription base.

A region is divided into different hexagonal regions with the same frequency being allocated to non-adjacent cells, thus reusing the frequency bands available. Low power transmitters in the cell phones prevent interference across cells. All these networks, based on analog modulation technologies, had their inherent limitations in terms of limitations of the number of channels, proliferation of incompatible standards in different countries and regions, etc. This restricted the expansion plans of these technologies and thus, was costly to implement.

Hence, most of the users of the first generation mobile phones were restricted to big corporate and business users only.

## III. 2G Technology

Second Generation Mobile Networks the First Generation Networks gave rise to the idea of investing in developing digital networks that can accommodate a larger number of subscribers in the same bandwidth, as well as provide for better voice quality. Different algorithms were used to divide available time slots amongst subscribers, thus increasing the potential capacity of the networks.: First digital cellular system developed for compatibility throughout Europe. Operates at 900MHz range. Data rates vary according to switching type.

Fig: 2G Mobile phones

These technologies are still voice-centric. Digitization of signals was aimed at improving channel capacity and voice clarity rather than transmittal of data. However, the very fact that digitized information could be transmitted on these channels gave rise to the idea of exchanging information on top of voice over the same networks.

This gave rise to the concept of Personal Communication Systems (PCS) that could shift the focus to data communications as well, although the prime focus remains voice. PCS operates in the Evolution of Mobile Network Systems frequency band of 1850–1900 MHz and thus can accommodate a higher number of channels.

This led to the evaluation of networks such as JS-008 (CDMA network at 1900 MHz in USA), E-NetZ (German network at 1900 MHz and GSM 1900 (Europe). More bandwidth was madeavailable, hence a higher subscriber base could be achieved.

Also, the focus slowly started shifting towards data communications over wireless, leading to protocols such as SMS, WAP, i-Mode, Wi-Fi, and Bluetooth, among others.

It can provide higher data rates of more than 64 Kbps due to its concept of frequency reuse and soft handoffs. Additionally, the cell planning is simpler. It is being promotedin a big way as a step towards 3G high bandwidth networks.


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Cellular Digital Packet Data (CDPD):

There was aneed to have a technology that could be put as an overlay over these existing networksand at the same time provide some digital services to their customers.

CDPD is thesolution most popular in North America. It is a packet data overlay that works on idle time inbetween calls to transmit and receive information.

3G Wireless Networks:

Now that the importance of data over wireless networks is well understood, researchinstitutions and organizations have progressively started investing in developing highspeed data networks that can enhance the capacity, quality and rates at which data is currently available. These emerging technologies constitute what is known commonly as Third Generation Wireless networks, or simply 3G.

These systems aim to provide anenhanced experience to the users in terms of receiving or sending voice, text or binarydata.

With the advent of 3G networks, the wireless and the internet worlds are being brought together along with more realtime video and multimedia graphics also made available over the wireless medium. This is to be achieved while enhancing the voice services as well, to match landline quality.

True global roaming will be made possible, theunderlying network technology, notwithstanding.

## IV. Migration Path towards 3G Wireless Systems

Soon, a greater demand to remove the distinction between fixed and mobile networks will become apparent. Access to the Internet and Intranets, Teleworking, and theadvent of the Virtual Office, are concepts which will become more commonplace in the near future.

For the third generation communications system, the challenge will be the globalization and convergence of office and home applications and services with thehelp of new communications tools.
However, the situation is not that simple. The variety of communication systems in the market today, as discussed above, across different geographical locations, with theirown economic, political, regulatory and social issues, make it difficult to bring all theplayerstogether to one single convergence point. There are large investments involved already and it is extremely difficult if not impossible

Fig: 3G Mobile Phones

IMT2000 is a standardizing initiative where each of the regional third generationsystems, which fulfills a defined basic set of requirements, can become an IMT2000family member. The International Telecommunication Union (ITU) is responsible fordevelopingthe framework standardization that will ensure interworking between all the IMT2000 family members. It will also include seamless co-existence with wire line networks, with the goal of fixedmobile convergence in the future. The family ofstandards concept, the support of broadband services, together with wireless Intelligent Networks (IN)-based services will be major components for the development of a set of third generation requirements.

COMPONENTS OF IMT2000:
The IMT2000 system is expected to be more thanjustan improved cellular system. The vision is to provide a universal communications system by converging all types of networks, including satellite systems, macrocell–Microcellpicocell terrestrial cellular systems, unlicensed cordless systems and wireless accesssystems. The timescale for developing individual subsystems and strategies will not be the same for every region or even for every country within that region –each will haveits own evolution strategy.

A couple of these initiatives are mentioned below

1. Universal Mobile telecommunications System (UMTS)

UMTS builds ontoday's significant investments in second generation mobile systems. It has the


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supportof several hundred network operators, manufacturers and equipment vendorsworldwide. It is one of the major new third generation mobilecommunications systemsbeing developed within the framework which has been defined by the ITU and is knownas IMT2000.

UMTS aims at enabling tomorrow's wireless Information Society, delivering high-valuebroadband information, commerce andentertainment services to mobile users via fixed,wireless and satellite networks.

UMTS have deliver low-cost, high-capacity mobilecommunications offering data rates up to 2Mbps with global roaming and otheradvanced capabilities.

## V. 4G-Cellular Systems

4G refers to the fourth generation of cellular wireless standards. It is a successor to 3G and 2G families of standards. The nomenclature of the generations generally refers to a change in the fundamental nature of the service, non-backwards compatible transmission technology, and new frequency bands.


Fig: 4 G Technology Mobile phone

4G-cellular systems will not only be high-speed but also of high-capacity, with low bitcost and the ability to support the services of the next decade. In order to achieve highcapacity. By constructing networks based on IP technology, the seamless connection between 4G, 3G, wireless LANs(WLANs), and fixed networks will be implemented.

## VI. 5 G Technology&its Need

5G aims at providing myriad of services to the end users at high speed. The applications developed to avail these services are highly user friendly minimizing the interaction between the application and the user. For example, integration of speech recognition technology in the user interfaces would ease the use of the applications for every layman.
Main advantage is Interoperability, Multiple standards of 4G restrict the user's mobility and interoperation across different networks. 5G targets at providing a unified global standard which will facilitate global mobility and service portability. In other words, end user can subscribe to different services from different service providers using the same mobile device[2]-[8].

5G technology offer high resolution for cell phone users and bi-directional large bandwidth. The advanced billing interfaces of 5G technology makes it more attractive and effective. 5G technology is providing large broadcasting of data in Gigabit which will support almost 65,000 connections.

- As technical requirements over currently existing technologies (4G) lists the following:

- 1000 times higher mobile data volume per area,
- 10 to 100 times higher typical user data rate,
- 10 to 100 times higher number of connected devices,
- 10 times longer battery life for low power devices,
- 5 times reduced end-to-end latency.

- Main Development Challenges:

- Cognitive Radio (CR)-New ways of Using Spectrum
- Software Defined Radio (SDR)-Reconfigurability enabler
- Reconfigurable-Interoperability between several types of wireless access Network
- Adaptive Coupling-Reconfigurable Integration
- Network Energy Efficiency


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| **Generation** | 1 G | 2 G | 2.5 G | 3 G | 4G | 5 G |
|---|---|---|---|---|---|---|
| **Design Began** | 1970 | 1980 | 1985 | 1990 | 2000 | 2012-13 |
| **Implementation** | 1984 | 1991 | 1999 | 2002 | 2010 | Expected 2020 |
| **Service** | Analog voice , Synchronizes Data to 9.6KBPS | Digital voice, Short Messages | Higher capacity, packetized Data | Higher Capacity, Broadband data upto 2MBPS | Higher Capacity, Completely Ip-Oriented, data to hunders of megabytes | Mobile 3D imaging, artificial intelligence, high-definition resolution capabilities, and holographic technologies |
| **Standard** | AMPS.TACS, NTM , Etc. | TDMA, CDMA, GSM, PDC | GPRS, EDGE, 1xRTT | WCDMA, CDMA2000 | Single Standard | Single Standard |
| **Data Bandwidth** | 19 KBPS | 14.6KBPS | 384KBPS | 2MBPS | 200MBPS | Expected : Data rates 10 GBPS And Cell Rates 100 MBPS |
| **Multiplexing** | FDMA | TDMA CDMA | TDMA CDMA | CDMA | CDMA | MIMO |
| **Core Network** | PSTN | PSTN | PSTN Packet network | Packet network | internet | fixed (fiber) networks |

Table 1: Comparative Study of Mobile Technologies.


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## VII. Conclusions

Mobile communications are clearly going to show major enhancements in terms ofcapabilities of mobilenetworks. The next generation of wireless services, besidesimproving the overall capacity, will create its own unique demands in terms oflocalization, personalization, etc., which will in turn, drive the development andcontinuous evolution of services and infrastructure. While development of 3G networkswill continue and pick up pace in the near future, the 2nd generation networks will keepevolving in terms of continuous enhancements and towards convergence of existing 2Gstandards. The limitations of 3G gave rise to 4 G networks. They are yet to be fully implemented inA lot willdepend on the commercial proposition of each of the technologies and on how good anorganization's business models are to recover investments.Thesetechnologies, indeed, have a long way to go. And exciting and amazing products arebound to emerge in the years to come [9].

Intensive research toward 5th generation wireless communication networks is progressing in many fronts. 5G technology is expected to be in use around 2020 [10].

There is no unique definition (yet) for 5G However, a general consensus is building around the idea that 5G is merely integration of several techniques, scenarios and use cases rather than the invention of a new single radio access technology [11].

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