

# A Quick Survey on 1G to 5G Technologies

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*Abstract*— Mobile wireless industry had started its technology creation, revolution and evolution since early 1970's. In this paper, there is a comparison of 1G to 5G wireless network technologies along with the proposed Architecture of 5G cellular network. The paper also draws the attention towards the harmful radiation effects incorporated with these technologies. These advancements made in the field of wireless technology leads to a charismatic blend of recent research with the customized use of these wireless gadgets resulting in increased bandwidth and performance which make it more effective and attractive.

**Key words:** Wireless Technologies, 1G to 5G, Cellular Architecture, Mobile Radiation

## I. INTRODUCTION

Wireless means “having no wires”. In networking terminology, wireless is the term used to describe any computer network where there is no physical wired connection between sender and receiver, but rather the network is connected by radio waves and or microwaves to maintain communications. Our ultimate goal is to communicate with any type of information with anyone, at any time, from anywhere. This is possible with the aid of Wireless Technology. The ultimate goal in future is a networked society with access to information and sharing of data without any bounds and barriers which is accessible everywhere and anytime and for everything. To fulfil this visualization, new technology components need to be examined for the evolution of existing wireless based technologies [1]. Moreover, the radiation effects along with the advanced use of cellular networks cannot be denied and hence measurable steps are to be taken in order to minimize it to make more effective use of such advancements.

## II. COMPARISON BETWEEN WIRELESS TECHNOLOGIES

1G - 1G is the 1st generation of wireless telephone technology, mobile telecommunications launched in between 1980 to 1990. It's speed upto 2.4kbps with a restricted bandwidth which permits the calls within a country. It uses Analog Signal. AMPS which are 1G mobile system launched firstly in USA. Its limitations are poor voice quality, large phone size, no security, limited capacity, poor battery life, poor handoff reliability.



Fig. 1: 1G Wireless System

2G - 2G technology is the 2nd generation of wireless telephone technology which is GSM operated. Finland was the first country to launch it in 1991. It makes use of digital signals only with a data speed of 64kbps. It enables services such as text messages, picture messages and MMS (Multimedia message) with a better picture quality and a good message storage capability. Its limitations are it requires strong digital signals as a result of no network coverage and its inability to tackle complex data such as Videos.



Fig. 2: 2G Wireless Systems

2.5G – 2.5 G is a technology between 2nd and 3rd generation of mobile telephony. It is sometimes described as 2G Cellular Technology combined with GPRS. It includes phone calls, send/receive E-mail messages, web browsing, camera phones, Its speed is 64- 144kbps and takes a time of 6-9 minutes to download a 3 minutes Mp3 song.



Fig. 3: 2.5G Wireless Systems

3G - 3G technology is the 3rd generation of wireless telephone technology which was introduced in 2000 with data transmission speed up to 2Mbps. Collaboration of Typically called Smart Phones and features increased its bandwidth and data transfer rates to accommodate web-based applications and audio and video files. It provides faster communication, send /receive large email messages, high speed web/ more security, video conferencing/3D gaming, TV streaming/ mobile TV/Phone calls, large capacities and Broadband Capacities, 11second-1.5minute time to download a 3 min Mp3song. The drawbacks of 3G are expensive fees for 3G Licenses services and was challenge to build the infrastructure for 3G, high bandwidth requirement, expensive 3G phones, large cell phones.



Fig. 4: 3G Wireless Systems

4G - 4G technology refers to the 4th generation of wireless telephone technology. 4G is the short term for fourth-generation wireless. It is still a research lab standard, the stage of broadband mobile communications that will supersede the third generation (3G). It is expected that end-to-end IP and high-quality streaming video will be among 4G's distinguishing features. A 4G system will be able to provide a comprehensive IP solution where voice, data and streamed multimedia can be given to the users on “ Anytime Anywhere ” basis and higher data rates than the previous generations. It will be a fully IP based integrated system capable of providing between 100 Mbps to 1 Gbps in both indoor and outdoor with premium quality and high security.



Fig. 5: 4G Wireless Systems

5G -5G technology would offer high resolution for wireless gadget users and bi-directional large bandwidth shaping. The advanced billing interfaces of 5G technology makes it more attractive and effective. The high quality services of 5G technology is based on Policy to avoid error.

### III. 5G CELLULAR NETWORK ARCHITECTURE

The 5G cellular network architecture is explained in [2] and [3]. The Paper focuses on the proposed architecture of 5G cellular Network. It explains the interconnectivity with various demanding technologies like massive MIMO network, Cognitive Radio network, mobile and static small-cell networks. The proposed architecture also clarifies the importance of network function virtualization (NFV) cloud in the 5G cellular network architecture. The idea of Device to Device (D2D) communication, small cell access points and Internet of things (IoT) has also been integrated in this proposed 5G cellular network architecture.

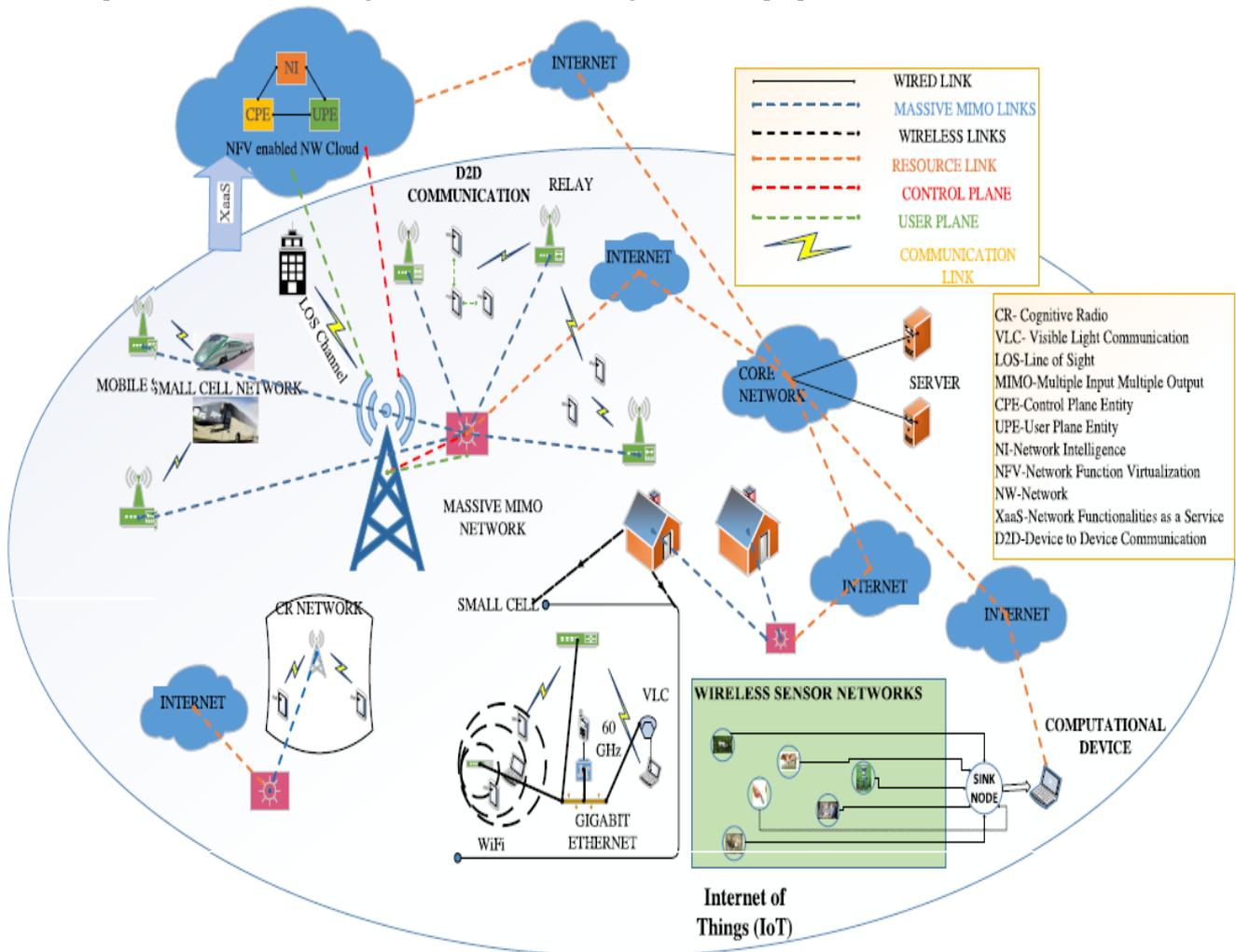


Fig. 6: A General 5G Cellular Network Architecture [4]

Technology	1G	2G/2.5G	3G	4G	5G
Deployment	1970/1984	1980/1999	1990/2002	2000/2010	2014/2015
Bandwidth	2kbps	14-64kbps	2mbps	200mbps	>1gbps
Technology	Analog cellular	Digital Cellular	Broadbandwidth/ CDMA/IP Technology	Unified ip &seamless combo of LAN/WAN/WLAN/PAN	4G+WWWW
Service	Mobile Telephony	Digital Voice, Short Messaging	Integrated High Quality Audio, Video & Data	Dynamic Information Access, Variable Devices	Dynamic information access, variable devices with AI capabilities
Multiplexing	FDMA	TDMA/CDMA	Wideband CDMA	Multi-carrier - CDMA or OFDM (TDMA)	CDMA
Switching	Circuit	Circuit/circuit for access network& air interface	Packet except for air interface	All packet	All packet
Core network	PSTN	PSTN	Packet network	Internet	Internet
Handoff	Horizontal	Horizontal	Horizontal	Horizontal &Vertical	Horizontal &Vertical

Table 1: Comparison of 1G to 5G technologies

#### IV. RADIATION PROBLEM DUE TO THE CELLULAR TECHNOLOGY

##### A. Increase in Cancer Risk:

International Agency for Research on Cancer (IARC), a part of WHO designates cell phones as “Possible Human Carcinogen” Apart from brain tumors there are many other type of cancers incorporated with the continuous exposure to mobile phone radiations like, salivary gland tumors, uveal melanoma, lymphoma, facial nerve tumors, skin, blood, testicular and breast cancer.

##### B. DNA Damage:

High Cellular operating frequencies cause damage to DNA structure due to breakage of its single and double helical strands. When the rate of DNA damage exceeds the rate of its repair mechanism certain gene mutations are more likely to occur which may lead to Cancer or Neurodegenerative diseases.

##### C. Biological Effects:

Microwave absorption is more likely to occur in the body parts which contain more fluid like brain, abdomen, heart, eyes etc., thus resulting in the drying of fluids in the affected area.

##### D. Risk to Children and Pregnant Woman:

Recent studies show that Children using cell phones for several hours a day are at a higher risk of brain tumor. Women who use mobile phones for prolonged period during pregnancy are more prone to spontaneous abortion, congenital malformations and behavioural problems in their children because of frequent RF exposure.

Here are certain precautions to take care of in order to minimize these health hazards associated with the use of mobile phones.

- Limit your use.
- Talk for short durations
- If possible, use SMS
- Use cell phone with lower SWR value.
- Use the speakerphone or wired hands free or Bluetooth, but keep the cell phone at 12 inches from your body.
- Use the land-line, when available,
- Do not keep cell phones in your hand/pocket for long.
- At home/office, keep the phone away from you.

#### V. CONCLUSION

In this paper, we reviewed from 1st Generation to 5th Generation Mobile Technologies, their advancements and the drawbacks they suffer, proposing in future the 6G Technology with increased bandwidth, low SAR Value, high mobile top speeds and data download rate. In general, this proposed 5G cellular network architecture will prove to be a major advancement factor for 5G standardization network. Still there are several issues like increased cost due to equipment set up and spectrum license fee and Limited spectrum bandwidth.

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