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HARMFUL EFFECTS OF 5G ON LIFE WITH POSSIBLE SOLUTION

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Keywords

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ABSTRACT

Wireless mobile networks evolve and take a stand in an attempt and interact and function widely with the fifth-generation (5G) evolution. Both the wireless infrastructure of today and the modern era of 5G are seen as an asset in the intelligent system. Growing dependency upon wireless technology has led to a technological revolution in communications, with access to the public to distribute data through different devices and networks at wider and higher frequencies of the electromagnetic spectrum. But the introduction of broadband with shorter wavelength radiation illustrates the question over the potential health and safety issues of a massive 5G integrated telecommunications network. The latest 2G, 3G, and 4G wireless technologies appear to be at risk. 5G applications for medical or environmental consequences are often less researched. It was suggested that by adding this additional high-frequency 5G radiation to an increasingly complicated combination of lower frequencies, both the physical and the mental health results would be detrimental. This paper presents the evolution of 5G and its architecture. Furthermore, the adverse effects of 5G radiations on various verticals such as safety, environmental problems, privacy, and thermal factors are discussed in this article.

I. INTRODUCTION

Over recent decades, innovations classified as information and networking technologies, which include wireless connectivity for mobile telephony (MT), such as Wi-Fi using electromagnetic field (EMF), have evolved unprecedentedly [1]. Wi-Fi and other methods of wireless data sharing are now available worldwide [2]. Today, the new 5G wave of Mobile networks are being launched [3]. Importantly, 5G is not a new product; it is the refinement of 4G systems currently in existence [4]. Work on 5G that supports IPv6 is currently in development. There have been significant increases between 1G, 2G, 3G, and 4G to 5G [5]. Figure 1 displays the iterations of 1G and 5G cellular systems.

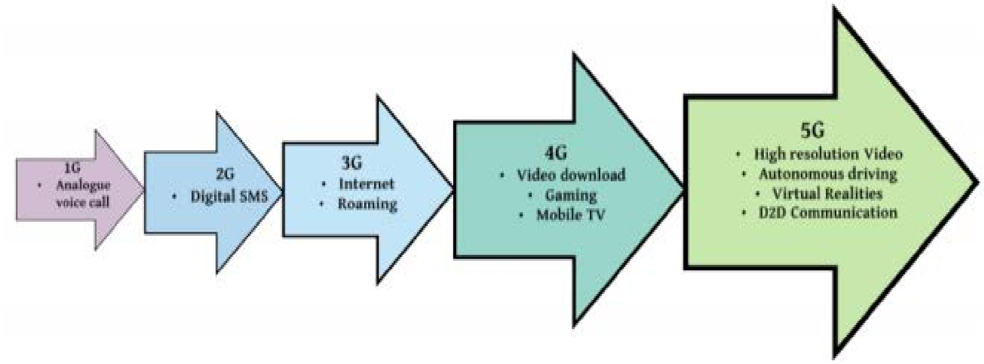

Figure 1 Generation of Wireless Network

Significantly faster internet connectivity and more universal use of mobile data will be assured with the upcoming introduction of 5G mobile networks [6]. The uses of higher Frequency bands make this possible. 5G is known as the Internet of Things (IoT) platform infrastructure, where machine to machine communication possible [7]. A change in people's response to the electromagnetic field (EMF) and the environment is expected around the same time [8]. With rapid developments in technology and communications in the EMF, children and younger ages are gradually exposed to radiations as shown in Figure 2 [9].

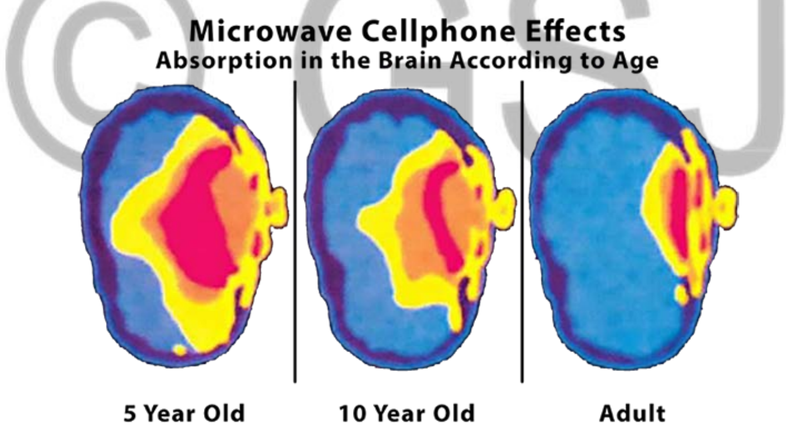

Figure 2 Radiation Effects

Under different frequency bands, the 5G networks would operate with the lower frequencies shown in Table 1. Many of these frequencies have previously been used by earlier forms of cell communications under 1 GHz with Ultra-high frequencies (UHF) [10]. In comparison, even higher radio frequencies (RF) can still be seen in the later stages of technical improvements [11]. The new bands have a higher frequency than UHF, with ranges of 3 to 26 GHz in centimeter/millimeter ranges [12]. The latter bands were usually used for radars and microwave connections [13].

Table 1: 5G Frequency Sub-division

Freq. Range	Use	Comments
<1 GHz	IoT	Longer range coverage, less costly infrastructure
1–6 GHz	IoT, Capacity for transfer data	More bandwidth, shorter range, and decreased efficiency compared with higher frequencies
>6 GHz	extremely high Capacity for data transfer	Short-range, extremely high-speed data transfer and short latency

II. 5G EVOLUTION

Owing to the rapid change in the field of mobile technology from 1 G to 5 G, wireless networking evolved in recent years, as shown in Figure 3. The result of this change is the need for transmission technology compatible with service and a significant increase among telecommunication customers [14]. Generation mainly refers to emerging transmission technology and new frequency bands which correspond to operational nature [15]. First launched in 1980 is the universal telephone network, and since then major developments have occurred in universal connectivity.

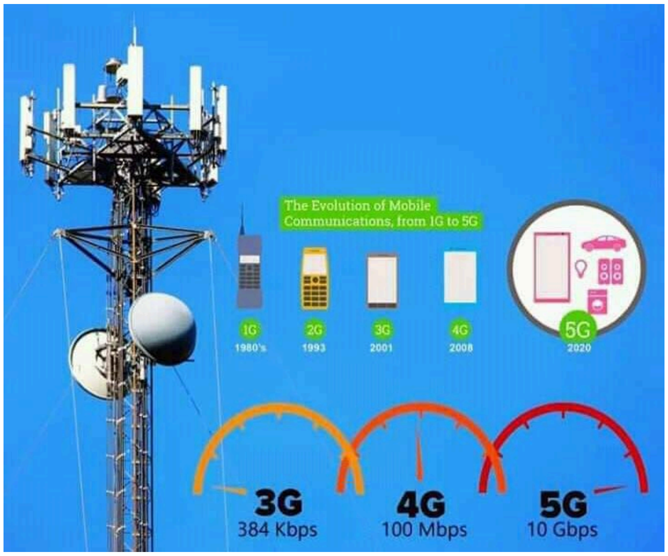

Figure 3 Evolution from 1G to 5G

a. 1G

In 1970, 1G was introduced as an analog telecommunications standard and ended at a data rate of up to 2.4 kbps in 1980. It uses Frequency Division Multiple Access (FDMA) and frequency-modulated (FM) with 30 kHz and 824-894 MHz frequency bands. The key issues with 1G are weak battery strength poor voice quality, limited capacity, poor coverage, limited protection, and low spectrum efficiency. The biggest downside to 1G is that it uses analog signals instead of digital signals and this ensures the delivery to information is less efficient because signals cannot reach too far remote areas and slower [15].

b. 2G

2G introduced in the 1980s as a standard electronic loop switching. It uses digital signal processing for speech processing. This used bandwidth from 30 to 200 kHz. Systems like the Code Division Multiple Access (CDMA), Global System for Mobile Communications (GSM) and Time Division Multiple Access (TDMA) were working. It can only be transmitted 64-144 kbps of digital audio but not email content. One of the major flaws in 2G technology is the weaker digital signal [16].

c. 3G

3G relies on GSM, which began in 2000. The multiple access (CDMA) Software Distribution has been used by 3G Mobile Networks. This also introduced high-speed Internet service up to 2 Mbps and expanded to 14 Mbps. This has been using systems such as Wideband Code Division Multiple Access (W-CDMA) and High-Speed Packet Access (HSPA). 3G operates on 2100 MHz and has a video chat with a frequency from 15-20 MHz used for high-speed internet access. It offers Internet connectivity in real-time as well as in non-real time. 3G's development was largely driven by Internet network access demand. 3G licenses and fees must be negotiated by the mobile provider, the issue of handset coverage, and prices in certain areas. 3G network's key downside is the requirement of different hardware and high electricity consumption [17].

d. 4G

4G introduced in 2015. To illustrate 4G technologies, a word MAGIC is used. stand for M (Mobile Multimedia), A (Anywhere Anytime), G (Global MobilitySupport), I (Integrated Wireless Solution), and C (Customized Personal Service). 4G works the same as the 3G basis, with more fast broadband access, greater speed, and reduced delay and can be considered a 3G extension. 4G gives a maximum downloading limit of 100 Mbps and a speed between 10 Mbps-1Gbps. 4G network technologies, including Long-Term Evolution (LTE) and Worldwide Interoperability for Microwave Access (WiMAX), is promising to be nearly five times quicker than 3G systems. It used technology such as Coded Orthogonal Frequency Division Multiplexing (COFDM) and Multiple Input Multi-Output (MIMO) [18]. 4G's challenges, such as bandwidth shortages and excessive energy consumption cannot solve. Consumers are obliged to purchase new 4G network equipment; new ranges mean that more devices are required at the mobile tower, higher customer service costs [16]. 4G needs a costly network infrastructure; it is ideal for data speeds, but not exactly the right option for voice calls, which are being discharged (delegated) to the Wi-Fi handset or 3G / GSM wireless networks.

e. 5G

5G systems are deployed by 2020. This offers users the wonderful feature at a lower or higher 1Gbps data limit. Fifth-generation tech uses either Code Division Multiple Access (CDMA) or Beam Division Multiple Access (BDMA) [19]. Figure 4 shows the Beam-division multiple-access framework. Fifth-generation networks are based on an encoding model known as orthogonal frequency division multiplexing (OFDM). The 5G promises to have high-speed communication and unrestricted connectivity everywhere and data rate up to greater than 1Gbps [3]. It is a complete wireless communication that is unrestricted. 5G main focus including World Wide Web Wireless (WWWW) is extremely appropriate, high speed and performance offer huge data transfer, digital newspapers, standard watch TV shows, and faster distribution than ever [20].

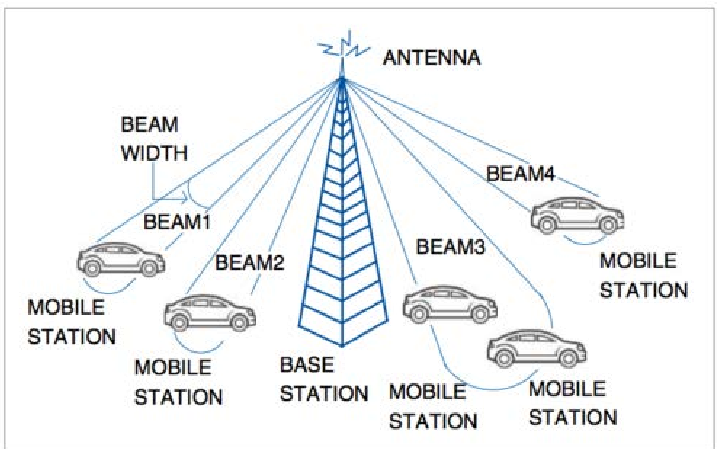

Figure 4 Beam-division multiple-access Framework

5G's key characteristics are high throughput, improved efficiency of the spectrum, minimize latency, support mobility, and high-density connection [10]. It provides digital audio, speech, picture, web, and other broadband services shown in Figure 5[21]. The MIMO would be used by 5G to greatly increase network efficiency [11]. Companies like Intel, Qualcomm, Nokia, Ericsson, and Samsung are developing the new wireless standard. Table 2 correlates the mobile network with 5G.

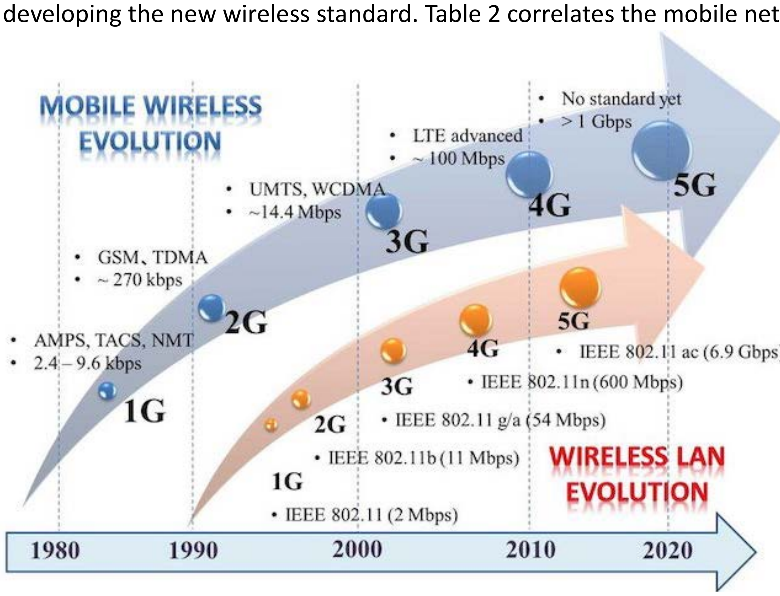

Figure 5: Evolution of 1G to 5G[21]

III. 5G NETWORK ARCHITECTURE

5G architecture is a completely IP-based mobile or internet communication. The numerous elements of the architecture make it simple, safe, and normal. Figure 6 displays 5G architecture vision [22].

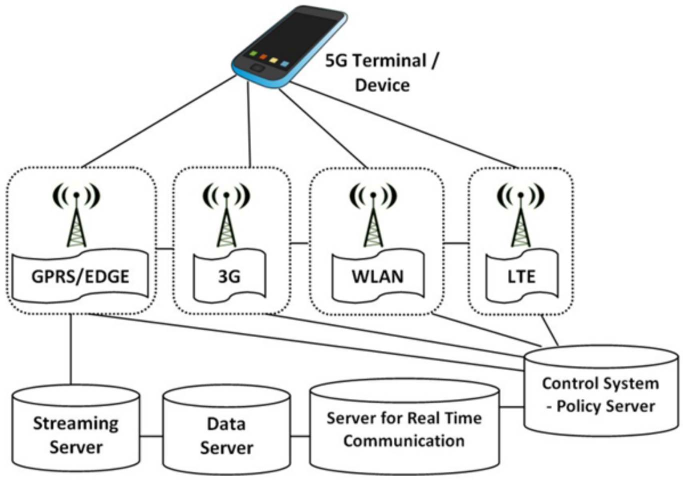

Figure 6 Architectural view

The following functional features can be found in 5G [23]:

i. It is committed, distributed, and programmable web-based.
ii. High data rates, More accessible, Low power consumption
iii. Delay a minimum 1-millisecond round trip.
iv. Provide multi connections 1-10 Gbps endpoints.
v. The larger number of support equipment

Table 2: Mobile network correlation: from 1G to 5G

Technology	1G	2G	3G	4G	5G
Start	1970-80	1980	2000	2015	2020 ownward
Bandwidth	2 Kbps	64 Kbps	2Mbps	1Gbps	>1 Gbps
Core Network	PSTN	PSTN	Packet N/W	Internet	Internet
Technology	Analog	Digital	CDMA 2000, UMTS, EDGE	Wi-Max, Wi-Fi, LTE	WWWW
Multiplexing	FDMA	TDMA/CDMA	CDMA	CDMA	CDMA/ BDMA
Key differentiator	Mobility	Secure, Mass Adoption	Better Internet Experience	Faster broad-band internet, Lower Latency	Better coverage and no dropped calls, much lower latency, Better Performance
Switching	Circuit	Circuit, Packet	Packet	All Packet	All Packet
Services	Analog	Digital phone calls & messaging	Messaging & calls	All IP service	High capacity, Speed and large broadcasting of data

IV. CHARACTERISTICS OF 5G

5G Wireless technology gives a large number of customers the highest priority. Fifth-generation wireless technology offers a variety of apps, rendering wireless suitable for the actual globe [24]. Some of the apps below are [25]:

a) It offers improved bandwidth and high data speeds.
b) Support a greater number of devices.
c) It provides high-quality policy-based services to avoid mistakes.
d) Provide a highly developed, more effective, and enticing billing system.

e) Uses a high resolution, high bandwidth shaping bi-directional.
f) It provides a single global standard that enables regional connectivity and portability of resources.
g) Provides links between 1 and 10Gbps to endpoints.
h) Runs on low energy usage, Higher infrastructure development rates.
i) It provides a massive distribution capacity with a very high 25 Mbps bandwidth.
j) Expected to provide up to 1Gbps of download speed in the LAN.

V. REAL-LIFE APPLICATIONS

The 5G software has the following uses in various fields [26]:

i. To render training in the education system even simpler.
ii. Smart surgery and medical examination.
iii. It is possible to detect natural disasters; it allows to predict weather and imagine the cosmos, planets, and galaxies.
iv. A wearable device is capable of AI, Global pervasive networks.
v. Virtual reality / increased reality / tactile Web / Autonomous driving / connected vehicles / Free distribution of news.
vi. Remote cloud-based office / multi-person video conferencing, VoIP (Voice over IP) enabled device.
vii. Control of radio infrastructure.
viii. Phone protection higher Stratospheric Platform Station (HSPS)

Some other applications of 5G wireless technologies include [27]:

a) The unified global standard for all
b) Blockchain, 3D and Ultra HD videos, Smart gird
c) 5G allows you to pay all bills with your mobile in one payment and vote from your mobile phone.

VI. ADVANTAGES

5G technology's advantages are as follows [28]:

1. 5G, latency (time between cause and effect) should be through.
2. Offers international connectivity and portability for products.
3. It has a very high rate of upload and installs.
4. This provides high definition and broad throughput bi-directional to mobile users.
5. Provide subscribers with quicker and more secure communications than 4G / LTE.
6. It has a strong cell-edge data rate and a good network coverage area.
7. The battery usage is small.
8. The government needs to promote democracy and allow people to connect to the Internet at any time.

VII. HEALTH & ENVIRONMENTAL ISSUES REGARDING 5G

The exponential demand increase for cell data would permit an unparalleled transmission power usage of the 5th generation (5G) broadband network in the millimeter-wave (mm-Wave) bands [29]. Dr. Pall's work on the biological effects of radiation from the EMF offers useful knowledge about how radiation from the EMF affects our bodies shown in Figure 7[9]. In the 1-2 Millimeter corneal and surface layers, millimeter waves are primarily absorbed in human skin. Figure 8 shows the thermographic image of the head with or without using the cell phone. Red and yellow area indicates the negative health effect while using cell phone some radiations absorbed by our skin. The main objectives of radiation are skin tissues. As the skin includes capillaries and nerve endings, mm-Wave bioeffects can be transferred by the skin or by the nervous system using the molecular pathways [30] as shown in Figure 9.

Short-Term Health Effects	Long-Term Health Effects	Electrical Sensitivity
• Aches and pains	• Cancers	• Sleeping problems
• Headaches	• Brain tumors	• Cognitive impairment
• Decreases sperm motility	• Fragmented DNA	• Concentration or memory loss
• Tingling or burning sensations	• Mutated cells	• Brain Fog
• Anxiety, stress, irratability	• Neurological	• Anxiety and Mood

Figure 7 EMF effect on health

Figure 8 Radiation Absorbed through cell phone

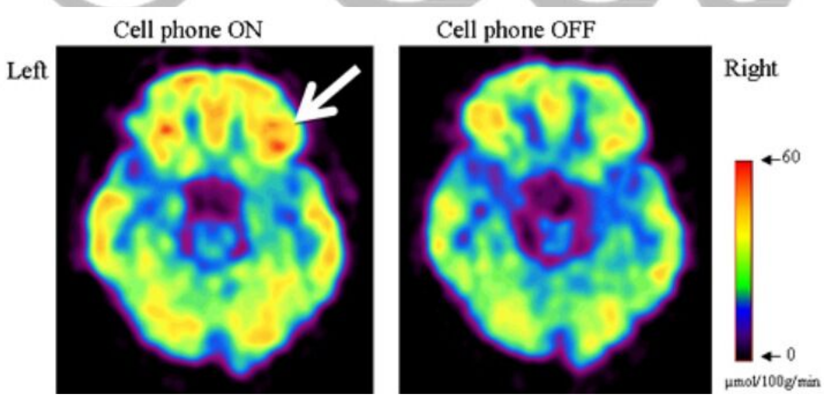

Figure 9Effect on Nervous system

Birds and other species vanish from regions polluted with "non-ionizing" 4G radiations. Our machines destroy innocent living beings with their hideous manmade frequencies. The second becomes the human race. No life form can tolerate 5G radiation in any quantity of time. Its existence in this universe is a barbaric genocidal assault on life [31].

1. Effect On Skin

Figure 10 shows that the 5G large range of bandwidth may lead to cell mutations and cause tumors that could become cancer later on [32]. Several studies have shown that MMW low-intensity surface effects can be important and causing a variety of biological changes, including cell membrane effects, also at non-thermal temperatures. It seems that the 95 GHz MMW frequency impacts the skin without heating and thermal disruption as a dangerous stimulus [33]. Evidence has demonstrated that the sweat ducts of human skin are helical tubes lined with a leading aquatic solution. The sweat canals in the skin can act as antennas and thus respond to millimeter waves [34].

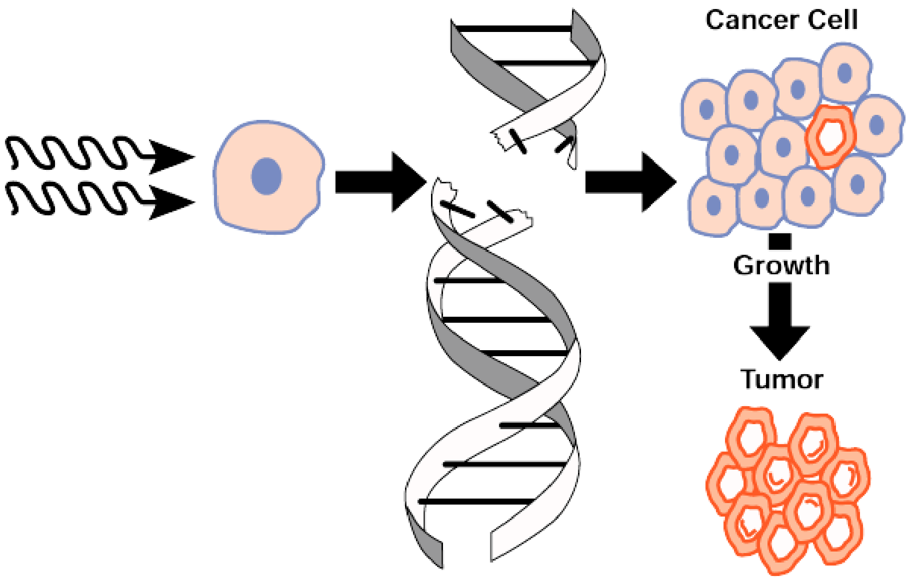

Figure 10 Cancer form due to radiation

2. Effects On Eyes

A big reason for blindness has remained Cataract. Radiation from the microwave is also a frequent cause of cataracts. Figure 11 shows the formation of cataracts. The eyes may also obtain valuable radiation, especially in nearby field exposures as 5G applications are specifically concerned. Age, obesity, asthma, and type B ultraviolet radiation are well-known risk factors for the formation of cataracts. 5G spectrum may cause electromagnetic sensitivity that has the following symptoms headache, sleeplessness, dizziness, fatigue, loss of focus, palpitations in the heart, and exhaustion [35].

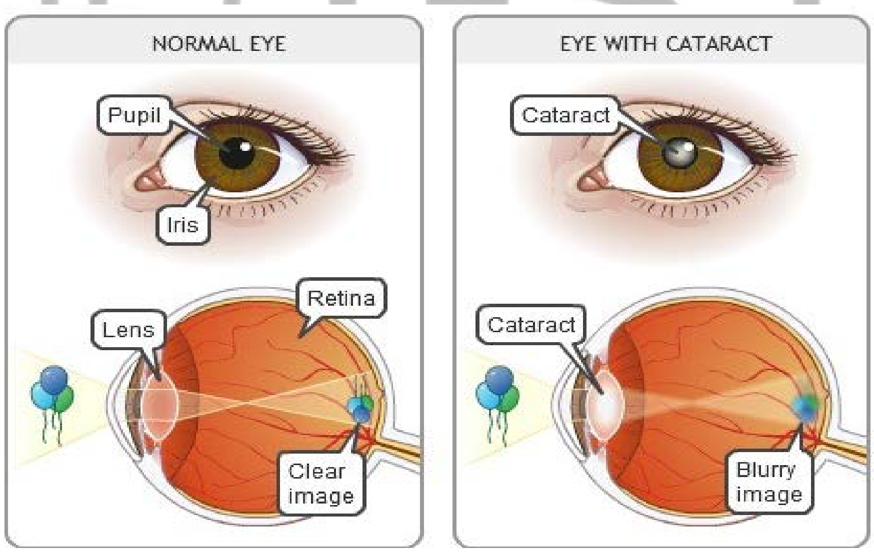

Figure 11 Formation of Cataract

3. Neurological Effects

When the nervous system is disrupted morphological, electrophysiological, and chemical modifications may arise by Electronic Medical Records (EMR). A significant change in these roles will eventually lead to a behavioral change in Figure 12. Evolution of blood-brain barrier, anatomy, electrophysiology, cell metabolism, reactions to medications that affect the nervous system is all the Neurological Symptoms recorded in the literature [36]. Figure 13 shows the microwave absorption level in brain tissue.

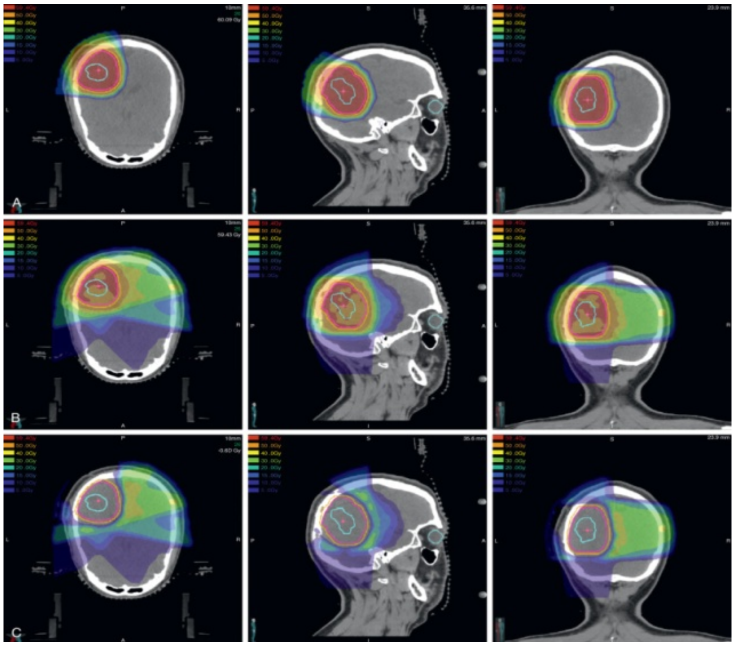

Figure 12 Effect of radiation on the nervous system

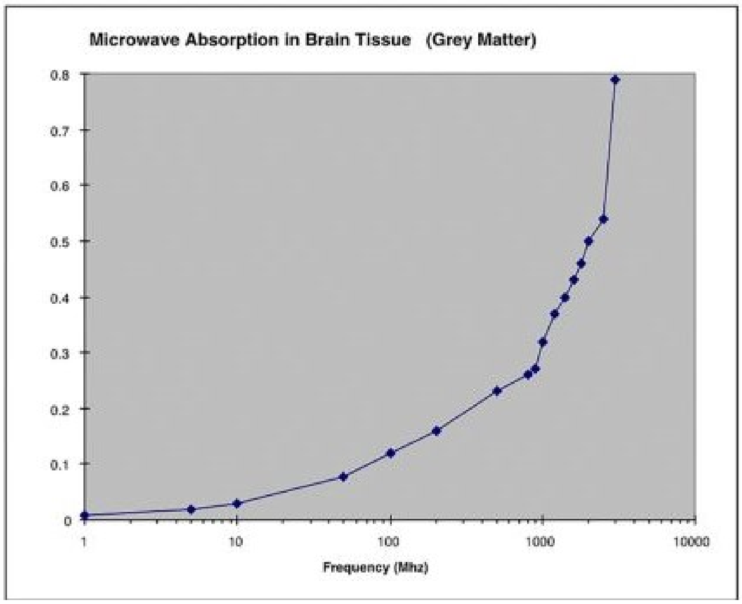

Figure 13 Microwave absorption level in brain tissue

4. Effects On Plants

The level of damage due to radiation in a plant is determined by the radiation absorbed by the plant and the time it is exposed to it. Figure 14 shows the damage due to 5G radiations [37]. Following are the harmful impacts on plants species with elevated doses of radiation:

- Chromosomal aberrations identified in the chromosome structure as visually visible changes.
- DNA injury, identified as harm to DNA molecules, including "inversion" of the DNA sequence, and portions of "deleted" sequences.
- The decrease in growth described as a decrease in organisms' growth rate.
- Fertility symptoms such as sterility diminished reproductive capacity and developmental abnormality, and limited infant viability.
- Seed germination reduced.
- The direct explosion may cause tissue burn damage.

Figure 14 Effect on capsicum and wheat plants

5. Effects On Aves (Birds)

Since 3G technology arrives, birds losing their nests and health issues recorded such as plumage loss, locomotive problems, decreased survival, and death have risen. The Birds influenced by MM Wave radiation include Rock Doves, House Sparrows, White Storks, MagpiesandCollared Doves. But not just the birds are affected by the non-ionizing radiation population of bee also diminished [30]. It decreases the Bee Queen's egg packing capacities that minimize the power of the colony. A 5G trial in the Netherlands killed 287 birds in December 2018, as shown in Figure 15.

Figure 15 Effects on Aves

6. Thermal Effects

As radiation is absorbed by electromagnetic radiation (EM), it is converted into heat. As a result of a temperature change, biological processes modify their roles. If electromagnetically radiated particles oscillate and gain energy, this allows them to oscillate. Intense radio waves can destroy the tissue and cook food thermally. Including lasers, visible and ultraviolet lasers with ample energy can also quickly set fire to the paper. Ionizing electromagnetic radiation will produce high-speed electrons in a sample and break up chemical bonds, but when these electrons interfere with other atoms in the sample, much of the energy will eventually be converted to thermal energy [38]. The thermal radiation is responsible for the reverse or time-reversed absorption process. Another piece of matter, when heated by energy stored in the material, will ultimately absorb the resultant radiation. The heat transfer method shown in Figure 16 is an important mechanism for radiation.

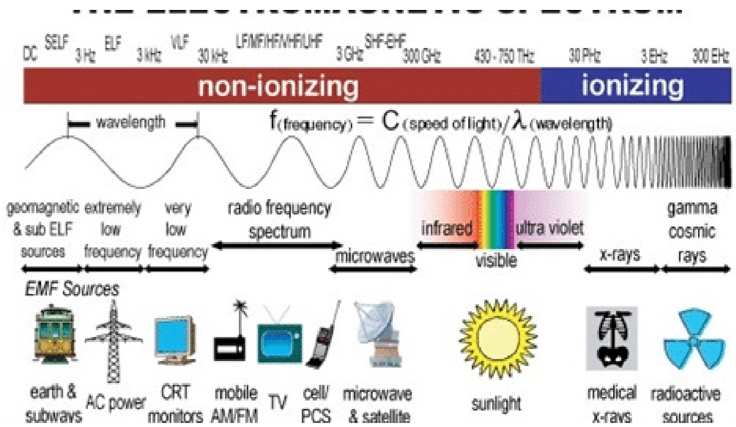

Figure 16 EM Spectrum

VIII. SPECIFIC ABSORPTION RATE

The radiation absorbed by the human body tissue measures in Specific Absorption Rate (SAR). Radiations are absorbed by the human body expressed in units of a watt per kg (W / kg). If the amount of heat is small, it can be dissipated by the body's thermo-regulatory system without adverse effects. If the temperature reaches approximately 1 to 2 degrees Celsius, then this power damage tissue. The single-cell phone has a SAR ranking (although it is withheld by other manufacturers). Radiations depend on their size, their antenna, and how they are stored and used. Tests have demonstrated a wide variety of responses to radiation from the customers of various mobile phone manufacturers and models. Figure 17 displays the SAR values for a variety of mobile phone types. No epidemiological studies on wireless communication for this spectrum range between 6 and 100 GHz should be recalled [12]. Radiofrequency electromagnetic fields have thermal biological consequences where the SAR levels are above a minimum limit of 4 W/kg triggering heating of tissues [11].

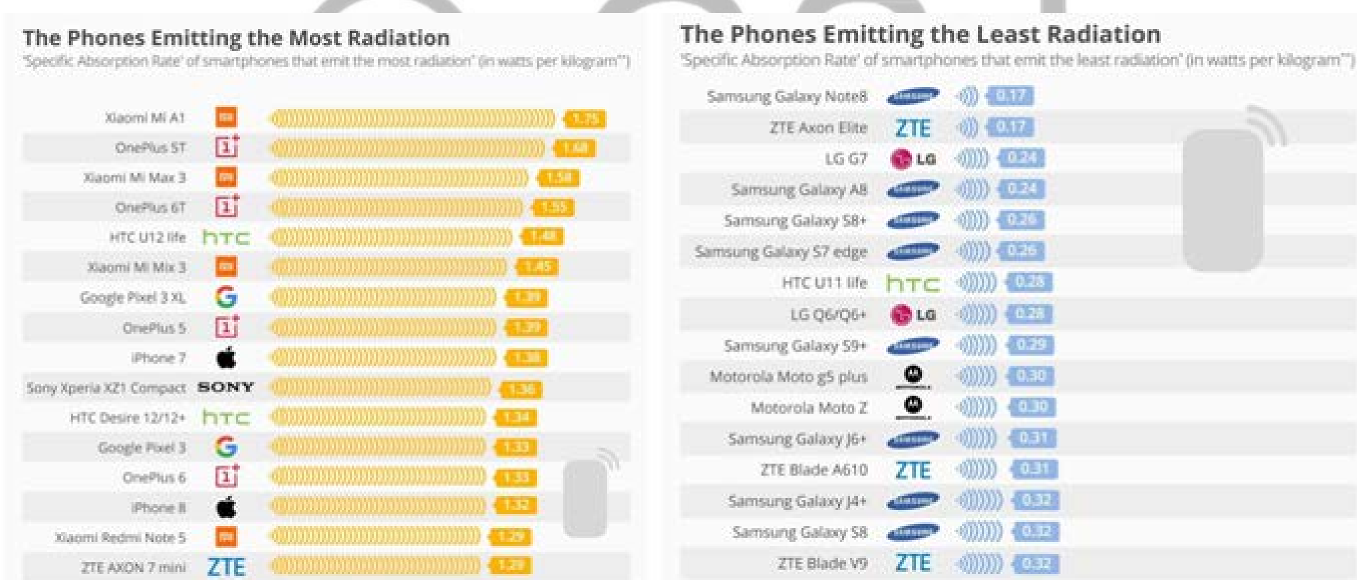

Figure 17 SAR values

IX. POSSIBLE SOLUTIONS

Radio Frequency (RF) is widely known as a power-independent technology for the Internet of Things (IoT) system [39]. The RF down converter is necessary to boost the wireless system's dynamic range, while the mixer stage is also a bonus for the entire Wi-Fi network to make a significant contribution to the total gain [40]. The Radio-frequency micro electro mechanical systems (RF MEMS) technology is emerging as a critical approach for meeting the challenging specifications of passive devices and networks of the next fifth (5G) generation technologies, including elevated operating frequencies, large tuning capability, decreased hardware reliability and low power consumption [41]. Aside from RF wireless techniques, which in particular were banned by international treaties as a tool of military-grade, we should establish alternate approaches based on proven electromagnet theories [42]. Possible approaches to implement modern methods 5G of connectivity that does not require wires or RFs.

i. The RNB consists of modulation of magnetic field lines free of curls (CFs) that stretch in line with infinity and reach all intermediates. CF communication is a directional controlling system. The advantage of CF interaction is that it propagates faster than light. The downside is that the device is not appropriate for general public use [7].
ii. The other method is quantum communications. This approach will provide for any individual with an endless number of limitless bandwidth channels. This approach is much quicker than light for contact. It does not require radio waves or cables. The optimal confidentiality of information provided by quantum communications helps each customer directly. Quantum communications in no way threaten the life or the climate. Quantum occurrences, however, were just a part of the natural world [35].

X. CONCLUSIONS

In the age of emerging networking systems, this has more inconveniences than advantages and has often become life-threatening. Through 5G technology, MMW offers high data levels and establishes a link with all IOTs that can be considered beneficial, but the negative effects of 5G MMW on human health and biodiversity are not negligible. When we aim to reduce results by bringing the benefit of SAR into account, 5G technology will then be seen as successful. The study aims to prove that Wireless Technology is one of the most damaging threats to the environment and wellbeing and the undermining personal freedom ever created without any solution other than termination. In humans, 4G and 5G cause multiple diseases and can kill everything. Furthermore, the study suggests some possible solutions that make 5G with no damage and available to the public also.

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