

5G Radiation and COVID-19: The Non-Existent Connection

Muhammad Uthman^{1*}, Farouq E. Shaibu¹, Bara'u Gafai Najashi², Ismail Farouk Labran³, Abubakar Sadiq Umar², Umar Sani Abdullahi²

¹Faculty of Engineering, University of Abuja

²Faculty of Engineering, Baze University, Abuja

³Air Force Institute of Technology, AFIT, Kaduna

*Corresponding author: m.uthman@yahoo.com

Abstract—With the outbreak of the Novel Coronavirus, COVID-19, towards the end of the year 2019 in Wuhan, China, a lot of misinformation and disinformation surfaced in print and electronic media linking COVID-19 to the upcoming 5G mobile technology. These publications allege many claims ranging from 5G causing COVID-19, to 5G spreads COVID-19 to 5G lowers human immunity. In this paper, we present an overview of the 5G mobile technology alongside an overview of coronavirus diseases and demonstrate that there is no connection between them by providing the scientific evidence of research carried out by international organizations in charge of 5G technology. We also state the medical explanation of what coronaviruses are, how they originate and how they are spread. It has been shown that there is no connection whatsoever between coronaviruses and 5G technology.

Keywords—COVID-19; ionizing; non-ionizing radiation; 5G network; mmWave.

I. INTRODUCTION

In December 2019 a novel coronavirus which was subsequently tagged COVID-19 by World Health Organization (WHO) was discovered in the city of Wuhan, Hubei province, China [1]. The COVID-19 outbreak was declared a pandemic by WHO in March 2020. COVID-19 like previous coronaviruses affect the respiratory systems of human beings and it is transferred from animals to human and from human to human [2]. Symptoms of the disease include dry cough, itchy throat, diarrhea, fever [2]. It is a very deadly disease and has caused the death of over 100,000 patients, over 430,000 patients recovered and 1,600,000 infections in over 230 countries worldwide as of the middle of April 2020 [3].

However, some erroneous publications suggested this deadly disease is caused or spread by the emerging 5G mobile standard that is going to significantly increase data speeds compared to the current 4G. In this paper, we address this issue that not only that there is no link between COVID-19 and 5G but also answers the question that 5G does not in any way cause or spread COVID-19.

The Fifth Generation (5G) of mobile communication is the fifth iteration of mobile technology that started with the First Generation (1G) in 1981 [4]. The frequency spectrum allocated to this system by the International Telecommunications Union (ITU) was 800MHz band and it was capable of voice communications only this relatively lower frequency can travel much farther and can penetrate obstacles easily, hence just a handful of transceivers is required to fully cover a city [5].

In 1991, the Second Generation (2G) mobile communication technology was rolled out with frequency band of 900MHz and 1.8GHz which brought digital communication but this meant that the range of these relatively higher signals is reduced and hence the number of transceivers required to give full city coverage increased significantly compared with 1G as can be seen in Fig. 1 [6]. The most popular of this incarnation was the GSM (Global System for Mobile) communications. This increase in frequency heralded digital communications which not only enabled voice communication, but data can also be sent across the channel in the form of SMS (Short Messaging Service) [6]. Before the advent of 3G, 2G continued its evolution to 2.5G which introduced new technologies like GPRS (General Packet Radio Service), HSDPA (High-Speed Downlink Packet Access), EDGE (Enhanced Data Rate for GSM Evolution) which greatly enhanced the data communications capabilities of the second generation of mobile communication to include MMS, WAP, email and internet access [6].

The Third Generation (3G) mobile communications arrived in 2001 and operated on the frequency band of 2.1GHz. This increased frequency band allowed for much higher data speeds to included not just full-fledged internet browsing but other services like video calls and video live streaming as well [7].

In 2009, the Fourth Generation (4G) mobile communications technology was rolled out and it was assigned a frequency from the 2GHz band [8]. This implies greater investment by the telecommunications companies to install a substantial number of transceivers to get similar coverage as compared to 3G or 2G to maintain the newfound data speeds which significantly increased data speeds and reduced latency for video calls and video live streaming [9] [10].

In the year, 2019, some countries started test running the Fifth Generation (5G) mobile communication. Three frequency bands were assigned for this new technology namely: the low band 850MHz, the mid-band 2.4GHz to 6GHz and the millimeter wave (mmWave), which starts around 24GHz and may go up to 70GHz [8]. As was observed with previous generations of mobile technology, the higher the frequency, the more transceivers required to give full coverage, because the signals travel shorter distances and are easier to get blocked by obstacles [11]. This is illustrated in Table 1.

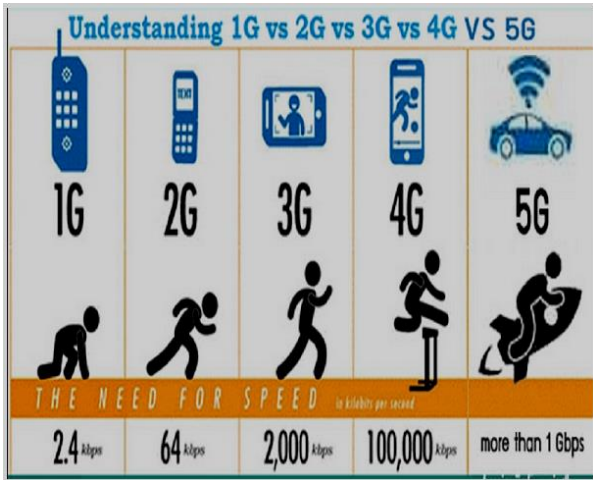


Fig.1: Understanding 1G, 2G, 3G, 4G vs 5G [12].

TABLE 1: COMPARISON OF MOBILE TECHNOLOGIES [13].

Technology	1G	2G	3G	4G	5G
Data Bandwidth	1.9Kbps	14.4Kbps-384Kbps	2Mbps	2Mbps-1Gpbs	1Gbps and higher
Service	Analog Voice	DIGITAL VOICE HIGHER CAPACITY Packetized data	Integrated high-quality audio, video, and data	Dynamic information access, wearable devices, HD streaming, global roaming	Dynamic information access, wearable devices, HD streaming, global roaming, any demand for users' upcoming technologies, global roaming
Standards	NMT, AMPS, Hicap, CDPD, TACS, ETACS	GSM, GPRS, EDGE	WCDMA, CDMA2000	All-access convergence including OFDMA, MC-CDMA, Network LMPs	CDMA and BDMA
Frequency	800-900 MHz	850-1900 MHz	1.6-2.5GHz	2-8GHz	LOW BAND 850MHZ MID BAND 2.4GHZ – 6GHZ MMWAVE From 24GHZ

II. ELECTROMAGNETIC RADIATION

Electromagnetic radiation (EMR) has been successfully employed in modern applications for many years. Its biological effects vary depending on its physical properties [14]. Electromagnetic spectrum ranges from a frequency of below 3Ghz (3×10^9) for Radio waves to above 3EHZ (3×10^{18}) for Gamma radiation as can be seen from Fig. 2. At the lower end of the for radio frequency, frequencies are applied in technologies like AM radio and Television and as we go higher in the spectrum, we have radiations like microwaves, visible light, ultraviolet rays and up to Xrays and gamma rays [15]. Frequencies below near-ultraviolet radiation are considered as non-ionizing meaning they do not have the capability of altering the atomic makeup of materials they come in contact with whereas frequencies above near-ultraviolet radiation are considered as ionizing radiation which is seriously harmful to biological materials they interact with e.g. Xrays, gamma rays and even sunlight [15] [16]. As can be seen, radiowaves and microwaves where 5G belong are not part of the ionizing part of the electromagnetic spectrum. As can also be observed from the electromagnetic spectrum, the higher the frequency the more energy it contains but the shorter the distance it can travel and also the easier it is to get blocked by obstacles.

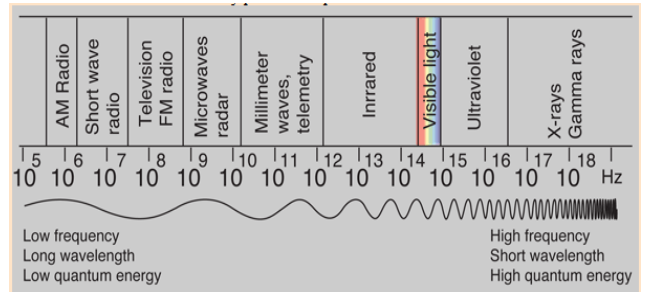


Fig 2: Electromagnetic Spectrum [15]

III. CLASSIFICATION OF RADIATION ACCORDING TO THEIR BIOLOGICAL EFFECT

Radiation exists all around us as naturally occurring and manmade radiation sources, and is in two forms: ionizing and non-ionizing radiation as shown in Fig. 3.

A. Ionizing Radiation

It is a form of energy that acts by removing electrons from atoms and molecules of materials that include air, water, and living tissue. Ionizing radiation can travel unseen and pass through these materials. This means radiation has enough energy to eject one electron from the atom of the crossed material [17].

B. Non-Ionizing Radiation

Non-ionization radiation exists all around us from many sources. Particle energy is not enough to eject an electron from the atom, therefore, it is said to have lower ionizing potential.

It is to the left of ionizing radiation on the electromagnetic spectrum in the figure below [17].

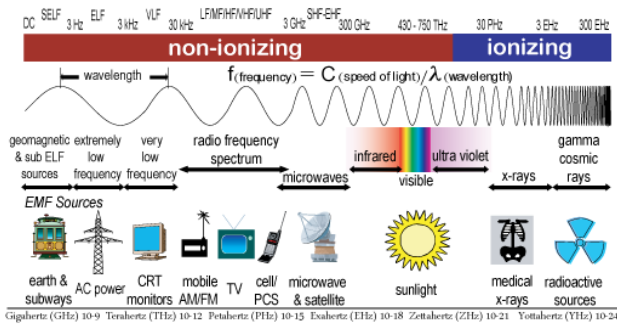


Fig. 3: Ionizing and Non-Ionizing Electromagnetic Radiation [16].

IV. SAFETY OF THE 5G FREQUENCY BAND AND ITS ENERGY LEVEL

The Specific Absorption Rate (SAR) is a measure of the rate at which energy is absorbed by the human body when exposed to a radio frequency (RF) electromagnetic field. It can also refer to the absorption of other forms of energy by tissue, including ultrasound [18]. It is defined as the power absorbed per mass of tissue and has units of watts per kilogram (W/kg). SAR is usually averaged either over the whole body or over a small sample volume (typically 1 g or 10 g of tissue) [18]. The value cited is then the maximum level measured in the body part studied over the stated volume or mass. The standard is set by international organizations such as the ICNIRP (International Commission on Non-Ionizing Radiation Protection) [18].

SAR for 5G in the mm-Wave region is 2W/Kg according to the European IEC (International Electrotechnical Commission) Standard SAR analysis averaged over 10g of tissue of the proposed dual-band 2x2 antenna array has been carried out on the human body using X-finite difference time domain electromagnetic simulation software, giving a safer limit of 0.37 and 1.34W/Kg which is less than 2W/Kg according to the European IEC Standard at 28 and 38GHz frequency bands respectively [19].

The mmWave mostly absorbed in outer skin layers and 15 years of studies with 13,000 exposures on volunteer subjects and there was no promotion or co-promotion of skin cancer in the animal study as well as no effect on male or female reproduction [20]. There are already existing applications in communications, radar, security, scanners. This is also highlighted in IEC Standard and Technical reports; IEC 62232:2017 Determination of RF field strength and SAR purpose of evaluating human exposure. IEC TR62269:2011/2019 Case studies supporting the implementation of IEC 62232- determination of RF field strength, power density, and SAR in the vicinity of radiocommunication base stations to evaluate human exposure [20].

For tissue/matter consisting of hydrogen, carbon, nitrogen, oxygen (which the human body falls under), radiations are

considered as ionizing radiation if their energy is greater than 1.24 eV [21].

Using the Plank-Einstein relationship between energy and frequency; the energy of a photon is determined by its frequency and each of the electrons in electron shell possesses a discrete amount of energy, designated by a quantum number, *n*, as shown in fig. 5.

$$E = hf \tag{1}$$

$$E = \frac{hc}{\lambda} \tag{2}$$

Where ‘*E*’ is the energy per photon in *Joules*

‘*h*’ - is the Planck constant in *J.S*

‘*c*’ - is the speed of light in a vacuum in *m/s*

‘*λ*’ - is the photon’s wavelength in *m*

‘*f*’ - is the frequency in *Hz*

The wavelength of such radiation must be 107 nm (0.1μm) and the frequency is to the order of approximately 3×10^{15} Hz for ionizing radiation.

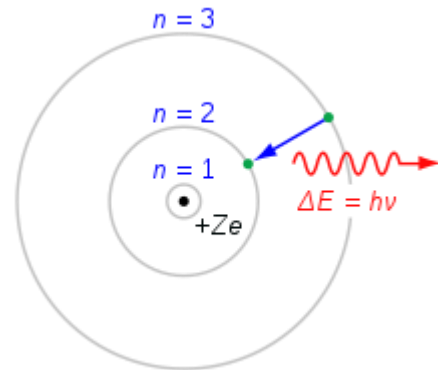


Fig. 5: Energy Level in an Electron shell

The frequency of a 5G network (24 GHz – 95 GHz) and is of the order of 10^9 Hz, which is a million times lower than what is considered as ionizing. It, therefore, means that photons from a 5G network can never ionize the human body. 5G network is not ionizing radiation and poses no harm to the body.

V. WHAT IS CORONAVIRUS (COVID-19)

Coronavirus is a disease pathogen and Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2) is the name given to the 2019 novel coronavirus. COVID-19 is the name given to the disease associated with the virus. SARS-CoV-2 is a new strain of the coronavirus that has not been previously identified in humans [22].

Coronaviruses are viruses that circulate among animals with some of them also known to infect humans. Bats are considered natural hosts of the viruses yet several other species of animals are also known to act as sources [2] [22]. For instance, Middle East Respiratory Syndrome Coronavirus (MERS-CoV) is transmitted to humans from camels, and Severe Acute Respiratory Syndrome Coronavirus-1(SARS-CoV-1) is transmitted to humans from civet cats [2] [22].

The novel coronavirus detected in China in 2019 is closely related genetically to the SARS-CoV-1 virus which emerged in China at the end of 2002 [22]. This caused more than 8000 cases in 33 countries over a period of 8 months and around one-tenth of people who developed SARS died [22].

While animals are believed to be the source of the virus, the spread is now from human to human. It is estimated that one person would infect two to three people. The virus is transmitted mainly via small droplets through sneezing, coughing or when people interact with each other for some time nearby usually less than a meter. These droplets can be inhaled or they or they can land on surfaces that others may come into contact with who can then get infected when they touch their nose, mouth or eyes [22].

COVID-19 and SARS are similar in many ways because both, are respiratory illnesses caused by coronaviruses, are believed to have originated from animals (in bats), jumping to humans via an intermediate animal host, are spread by respiratory droplets produced when a person with the virus coughs or sneezes, or by contact with contaminated objects or surfaces, have similar stability in the air and on various surfaces can lead to potentially serious illness, sometimes requiring oxygen or mechanical ventilation. There can be worsening symptoms later on in the illness for at-risk groups such as older adults and those with underlying health conditions. Presently, there are no specific treatments or vaccines [23].

VI. CORRELATION BETWEEN 5G RADIATION AND CORONAVIRUS: CAN 5G CAUSE CORONAVIRUS?

As discussed above it is established that there is no correlation between 5G radiation and the coronavirus (COVID-19), which is a biological pathogen. The COVID-19 is related to the SARS-CoV-2 which coincidentally originated in China in 2002 and that came about at a time 5G technology was not even in place. Hence, the reality is that there is a relationship between COVID-19 and SARS-CoV-2, but these coronaviruses are in no way associated with the 5G technology. Coronaviruses of which COVID-19 is a member of the family are biological diseases that become deadly to human beings when they are transferred from animals; radio wave radiation which are non-ionizing radiation that does not affect these viruses whatsoever. The ICNIRP Guidelines for limiting exposure to electromagnetic fields (100kHz to 300GHz) [18] published in March 2020 extensively studied health risk assessment in literature with references to the World Health Organisation (WHO), the Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR) - a European Commission Initiative, the Swedish Radiation

Safety Authority (SSM) amongst others. The guidelines looked at the effects of radiation on Brain Physiology and function; auditory, vestibular and ocular function; Neuroendocrine system; neurodegenerative diseases; cardiovascular system, autonomic nervous system, and thermoregulation; immune system and hematology; fertility reproductive and childhood development; and cancer [18]. They came up with a general conclusion that the only substantial health effects caused by exposure to radiofrequency EMF are nerve stimulation, changes in the permeability of cell membranes and effects due to temperature elevation, which comes about as a result of exposure above the restriction levels in ICNIRP guidelines [18]. Hence, this is the definitive proof that 5G radiation which is covered by these guidelines, has no connection with COVID-19 whatsoever.

CONCLUSION

From all the discussions it has been established that coronaviruses are not new disease pathogens but there have been various outbreaks of the disease over the years with various strains. The latest of which is COVID-19. 5G technology is still in development and has not been fully deployed around the world yet. As such, there is no correlation between COVID-19 and 5G technology. COVID-19 originate from animals (bats) and are transmitted to humans and subsequently spread from human to human, certainly not through 5G radiation.

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