International Journal of Advanced Trends in Computer Applications
www.ijatca.com

The Impact of EM radiations from 5G & 6G devices on human body

[1]Gaurav Gandhi, [2]Dr. Sharad Sharma
[1]Ph.d Scholar,
M.M. University, India
[2]Professor & Head, ECE
Department M.M. University, India
[1]Gauravphdmmu@gmail.com, [2]sharadpr123@rediffmail.com

Abstract: *Innovative advancements in the Telecommunication sector in form of 5G and 6G technologies have raised the issues pertaining to human health impacts by the electromagnetic waves (EMW) delivered by cell phone base transmitter stations (BTS). Present paper highlights the health issues, which might arise from EMW from the cell phone BTS. Because of super-fast speed and potential of lower latency of connectivity even in the far-flung areas, 5G and 6G technology will be exclusively relied upon for implementation in different industrial fields, research and development in the near future and will further satisfy the thorough need for bandwidth through positioning of huge number of heavily dense sited base stations working in the millimeter-wave extend. Presentation of new emission sources, working in correspondence to previously existing 2G/3G/4G versatile innovations, raises worries about surpassing the acceptable EMF exposure limits. Due to these services, cell phone clients and individuals living inside short proximity of the cell phone base stations have become progressively worried over the possible harmful effects of radiofrequency radiation generated by these devices to their health The way that this radiation is concealed, vague, and enters and leaves our bodies without our insight makes it considerably alarming.*

Keywords: Electromagnetic Radiations, 5G, 6G, Mobile Tower Radiation.

I. INTRODUCTION

Past decade has witnessed a steep surge in the global mobile data traffic and 23 times upsurge in data volume is expected by 2021 in data volume as compared to the entire global Internet traffic in 2005. Such is the trend of exponential growth in data volume that the International Telecommunication Union (ITU) has predicted that by 2030 overall mobile data traffic will reach astonishingly 5 zettabytes (ZB) per month. Latest attempt to up the speed of mobile communications technology is the fifth generation (5G) technology, which is the first generation mobile communication system that supports high frequency bands such as millimeter wave band exceeding wave lengths of 10 GHz. Furthermore, it is a technology that actualizes ultra-high speed wireless data communications of several gigabits per second using a frequency bandwidth of several-hundred megahertz, which is remarkably wider than that achieved by the existing modes of telecommunication. It is expected that 5G will attain its limits by the year 2030, leading to further research in the technology. With the evolution of artificial intelligence techniques, such as Internet-of-Things (IoT), Machine Learning (ML) and machine-type communications (MTC) etc, penetration of 5G will become more than necessary over traditional cellular networks. The reason behind this will be some important key performance indicators (KPIs), e.g. it can attain 1000* capacity surge as compared to the 4G networks, can deliver speed in gigabits per second as compared to megabits per second in 4G and many more[1]. Emergence of massive data juggling applications such as multi-way virtual meetings, virtual and augmented reality (VAR) based gaming, remote surgeries by means of Robotic arms, holographic projection, etc., to name just a few, is another indicative of the fct that 5G will have to sooner or later replace the existing networks. Furthermore, such will be the demand for the data that eventually 6G will have to be called upon, similar to the fact that introduction of multimedia services while 3G was the latest advancement available, led to introduction of 4G. In all the probabilities, 6G will continue to benefit from many 5G technologies, but further

advancements in the technologies will certainly be needed for leap ahead.

II. EM RADIATION AND STANDARDS

There are different forms of energy, each with distinct physical properties that can be measured and expressed in terms of frequency and wavelengths. Electromagnetic (EM) radiations are type of radiations, constituting electric field component and magnetic field component and display wave-like behavior as it travels through space. The wave like behavior lets the electromagnetic waves oscillate in phase perpendicular to each other and to the direction of energy propagation. The radiations have adverse effects on the environment and on living people and flora, which is referred to as biological radiation exposures. Various epidemiological analyses amongst exposed population are suggestive of cell damage and irreversible changes in the bodies of subjects, however not much is included in the medical curriculums and hence not all the clinicians are fully aware of EMF related health hazards, leaving them undiagnosed and inefficiently managed most of the times. Hazardous properties of X-rays have been thoroughly studied and now electromagnetic radiation (EMR) originating from overhead high tension wires, cell phones, and domestic electrical devices etc are attracting attention from the researchers, so that the potential health hazards can be explored [2]. Main aim of the current study is to explore possible health hazards of EMR in various situations [3].

III.ELECTROMAGNETIC SPECTRUM

Frequency of electromagnetic waves vary from Low to High and electromagnetic spectrum is described as the range of various wave frequencies emitted and the energies released from one or more sources over a particular area. The energies released by the transmission of EMW are referred to as types of EMR, wherein high frequency emission is via Gamma Rays, X-Rays and Ultra-violet light and lower frequency emission is from the household microwaves and the radio waves [4]. Furthermore, the medium frequencies are responsible for light wave emission, which facilitates normal vision along with the light perceived by us and the infra-red energy, is responsible for heat perception. For bare human eye, the spectrum of electromagnetic waves, such as the X-rays, UV rays and radio waves is undetectable and invisible. Because of this fact, these frequencies go unobserved and public exposure goes undetected till it is very late, moreover clinically too the symptoms appear in an individual when a particular limit of exposure is crossed for a particular EMW. Furthermore, the exposure to EMW may lead to alteration of cell structures at the tissue level and even might lead to breakage of chemical bonds, thus indicting mutation at the Deoxyribonucleic Acid (DNA) level, which may further lead to malignancy/cell death or mutation in genes of future generations.[5, 6].

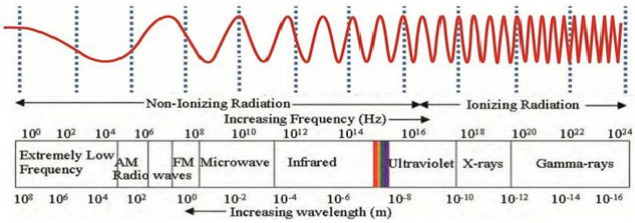

Figure 1: EM spectrum indicating radiation zones

Previous researches on the EMW have allowed to set appropriate reference values to these exposures and compliance to these values ensures admissible quantities of electric and magnetic field intensity, the power density and the Specific Absorption Rate (SAR). Given at any time of exposure, when the value of the EMW surpasses the admissible reference level, it becomes necessary to test the individual exposed on applicable field quantities. The level of over exposure decides the further course for application of preventive measures or conservative/medical management of the person/persons exposed.

IV. EMF EXPOSURE ZONES

In a given set of population there is always a Controlled or Occupational public exposure category and a Uncontrolled or the General Public exposure category, where Controlled/ Occupational Category is the category comprising of specific residential population and Uncontrolled/General public category is the random resident and nonresident population of that particular area. Depending upon the level of exposure in a particular geographical area, following three zones are categorized (Figure 2):

1	➢ Compliance Zone:	Potential exposure to the EMF is less than the permissible limits for both controlled and uncontrolled population.
2	➢ Occupational Zone:	Exposure less than permissible limits for the controlled population while more for uncontrolled population.
3	➢ Excedance Zone:	Potential exposure exceeds permissible limits for both the Controlled and uncontrolled populations.

It is pertinent to mention here that the exposure assessment is made only in the case, when intentional emitters are present and is carried out at all the possible locations of public exposure during their routine course of activities. Most widely researched topic in the recent past has been the radiations from the Mobile Base Transceiver Stations (BTS).

Figure 2: EMF exposure zones around a base station antenna

V. RADIATIONS FROM MOBILE BTS

BTS are established by the telecom service providers at strategically appropriate places to ensure proper and wide coverage and meeting the capacity requirements of the area. Multiple antennas are installed on these BTS's to ensure coverage of whole the area, where every antenna radiates its own electromagnetic field. A typical BTS radiation is shown in figure.

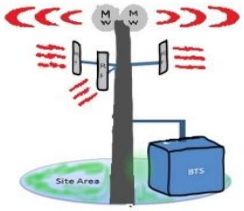

Figure 3: Base station radiation

A specific number of radio transmitters is also being installed at the BTS, which have the identical maximum output power. These outputs are combined and fed via cables to the base station antenna, which is mounted at the top of a tower/pole (or other suitable structure), making the radiated power equal to the sum of the output power from the transmitters except for a small loss that occurs in the combiner and connecting cables. However the schedule of operation of these transmitters is directly proportional to the call traffic in the concerned sector, making the level of exposure to maximum in a given area at the time of peak traffic. This illustrates that the EM exposure will be maximum at the time of peak traffic at a given area or also is suggestive of the fact that the areas with higher call traffic are at risk of maximum EM exposure.

VI. HEALTH EFFECTS FROM EM RADIATIONS

Researchers have been conducting experiments on lab animals by exposing them to EM radiations and it was found that certain diseases developed in them, but the fact has not yet been established in the human beings. However, the debate on effect of EM radiations and its potential health hazards is a hot topic of research among various researchers including those from medical background. Subsequent sections quickly sum up the possible health effects of EM radiations on the mankind.

Cancer

Non-ionizing RF radiation from mobile phones have been categorized in Group 2B as "Possibly oncogenic to humans" in 2010 [7] by The International Agency on Research on Cancer (IARC). Clinical trials on animals exposed to various EMF levels produced by RF equipment in the Lab setup have shown systemic oncogenic impact [8], [9], which include development of rare cancers e.g. glial tumors of the heart, parotid organ tumors, and many other threatening tumors in the brain and other organs.

Male Fertility

As indicated by a subset of studies significant levels of EM radiations might be related to negative impacts on reproductive health as far as sperm mobility and fertilization competence, which can be correlated with the fact that more number of couples are becoming infertile since the start of the century [10]. Yet, in our best knowledge, the association of such impacts with EM radiations from correspondence communication equipment is not scientifically proven.

Glucose absorption

EM radiations may disturb the Glucose absorption process in the human cells .The impact can be seen in the body organs affected by significantly high levels of EM radiations e.g., the brain.[11]

Dermatological Effects

The EM radiations with extreme power density have potency to increase temperature of the uncovered body tissues i.e. the Epidermis, and might get penetrated deeper into the other skin layers. Conversely, modest confined heat exposure can be compensated by the body's heat regulation system, but high portions of absorbed RF exposure can begin a sensation of warmth in the human skin, causing minor skin burns and other skin diseases like dermatitis etc[12].

Ocular Effects
High levels of with adequately high power density may cause numerous ocular impacts, including cornea issues, cataracts, and retina damages [13].

Electromagnetic Hypersensitivity

A few people report that EM radiations make a few affectability side effects to them, e.g., migraine, burning sensations, weariness, stress, and rashes. Though several autonomous investigations have exhibited that such side effects are not associated with the degrees of EM radiations. [14]

COVID -19 Disease
In recent past, many fake theories have emerged which are claiming a correlation between EM radiation from 5G communication equipment and spread of the novel coronavirus, [15]. Specifically, these theories comprise:

- Higher disease rates for areas of domain exposed to EM radiation from 5G trial preliminaries (e.g., Wuhan district, Lombardy area) as compared with those not secured by 5G.
- A hazardous interaction at a cell level between the DNA and EM radiation from 5G equipment, causing a lethal irritation of lungs;
- An alleged communication between the Ribo Nucleic Acid (RNA) of the COVID-19 infection and the mm-Waves of 5G equipment.

However as of now there are no scientific facts which prove these theories, in spite of the fact that they are widespread among the public. As indicated by the UK National Health Service (NHS) [16], the dispersion of these fake theories attempting to associate COVID-19 and 5G is shocking and hazardous.

Oxygen Effects
Another general claim attempting to interface EM radiation from 5G devices and health risks state that 5G devices absorb oxygen out of the lungs. Further it is claimed that, it will also increase levels of carbon dioxide in the environment because for improved signal coverage tree cutting is necessary. Matter of the fact is that, the first claim is baseless and has scientific basis and for second claim, it has been observed that there was no improvement in signal coverage by cutting the trees. Hence, the statement about the rise in CO2 emissions due to 5G is false information.

VII. CONCLUSION

To conclude, it is submitted that health risks from EM radiation from 5G and 6G equipment are not supported by any logical and correspondence proof and it is merely on the basis of whims and fancies of some researchers or general public. The first clinical investigations on health risks from EM radiations began almost 60 years back, and precisely a huge number of discoveries from that point forward revealed either no health risks or questionable discoveries. A nearly modest number of investigations have professed to find some proof of danger, despite the fact that those investigations have not ever been reproduced. As reproducibility is a key factor on the side of good science. Despite the fact that it is important to proceed with additional investigates on all the related human health risks chances which are not demonstrated at this point. It is widely acceptable that potential dangers lie in everything we do in our daily lives like, driving, cooking, eating outside, etc but the fact is whether the dangers are reasonable or not for a human being. Further, it is a question to look upon, that whether due to some wild fantasies, rolling out of new technologies shall be brought to a Halt.

REFERENCES

[1] J. G. Andrews, S. Buzzi, W. Choi, S. V. Hanly, A. Lozano, A. C.K. Soong, and J. C. Zhang, “What will 5G be?,” IEEE J. Sel. Areas Commun., vol. 32, pp. 1065–1082, Jun. 2014

[2] C. W. Hsieh and W. C. Ko, "Effect of high-voltage electrostatic field on quality of carrot juice during refrigeration," *LWT-Food Science and Technology*, vol. 41, pp. 1752-1757, 2008.

[3] D. A. Larrabee, "Teaching Electromagnetic Radiation effects on Humans," 2006, pp. 52-56.

[4] K. Mann and J. RAschke, "Sleep under exposure to high-frequency electromagnetic fields," *Sleep Medicine Reviews*, vol. 8, pp. 95-107, 2004.

[5] D. A. A. Mat, F. Kho, A. Joseph, K. Kipli, S. Sahrani, K. Lias, and A. Marzuki, "The effect of headset and earphone on reducing electromagnetic radiation from mobile phone toward human head," 2010, pp. 1-6.

[6] E. Bergstram, O. Hernell, L. Ã. Persson, and B. Vessby, "Insulin resistance syndrome in adolescents," *Metabolism*, vol. 45, pp. 908-914, 1996.

[7] IARC Working Group on the Evaluation of Carcinogenic Risks to Humans et al., “Non-ionizing radiation, part 2: Radiofrequency electromagnetic fields,” International Agency for Research on Cancer (IARC),Tech. Rep., 2013, vol. 102.

[8] I. S. Group et al., “Acoustic neuroma risk in relation to mobile telephone use: results of the interphone international case–control study,” Cancer epidemiology, vol. 35, no. 5, pp. 453–464, 2011.

[9] C.-K. Chou, A. W. Guy, L. L. Kunz, R. B. Johnson, J. J. Crowley, and J. H. Krupp, “Long-term, low-level microwave irradiation of rats,” Bioelectromagnetics, vol. 13, no. 6, pp. 469–496, 1992.

[10] O. Erogul, E. Oztas, I. Yildirim, T. Kir, E. Aydur, G. Komesli, H. C.Irkilata, M. K. Irmak, and A. F. Peker, “Effects of electromagnetic radiation from a cellular phone

on human sperm motility: an in vitro study," Archives of medical research, vol. 37, no. 7, pp. 840–843, 2006.
[11] N. D. Volkow, D. Tomasi, G.-J. Wang, P. Vaska, J. S. Fowler, F. Telang, D. Alexoff, J. Logan, and C. Wong, "Effects of cell phone radiofrequency signal exposure on brain glucose metabolism," The Journal of the American Medical Association (JAMA), vol. 305, no. 8, pp. 808– 813, 2011.
[12] R. Roelandts, "Cellular phones and the skin," Dermatology, vol. 207,no. 1, p. 3, 2003.
[13] J. Elder, "Ocular effects of radiofrequency energy," Bioelectromagnetics, vol. 24, no. S6, pp. S148–S161, 2003.
[14] G. J. Rubin, J. D. Munshi, and S. Wessely, "Electromagnetic hypersensitivity: a systematic review of provocation studies," Psychosomatic Medicine, vol. 67, no. 2, pp. 224–232, 2005.
[15] R. Cellan-Jones, "Coronavirus: Fake news is spreading fast," Available at https://www.bbc.com/news/technology-51646309 ,Feb 2020.
[16] Coronavirus: NHS director 'outraged and disgusted' at 5G conspiracy attacks, available at https://tinyurl.com/v8rq66m.

Author Profile

Gaurav Ghandhi, received his B.Tech Electronics and Communication Engineering from PTU University, Jalandhar, India in 2012 and M.Tech in Electronics and Communication Engineering from Mullana deemed university, Ambala, India in 2015. Presently, he is working towards the Ph.D. degree in Electronics and Communication Engineering from Mullana deemed university, Ambala, India. His research interests are wireless, 5G technology optimization techniques.

Prof.(Dr.) Sharad Sharma, received his B.Tech in Electronics Engineering from Nagpur University, Nagpur, India in 1998 and M.Tech in Electronics and Communication Engineering from Thapar Institute of Engineering and Technology, Patiala, India in 2004 and the Ph.D. degree in Electronics and Communication Engineering from National Institute of Technology, Kurukshetra, India. He has conducted many workshops on Soft Computing and its applications in engineering, Wireless Networks, Simulators etc. He has opened up a student chapter of IEEE as Branch Counselor. His research interests are routing protocol design, performance evaluation and optimization for wireless mesh networks using nature inspired computing.