



ISSN 2047-3338

# Cellular Phones: The Solution or the Pollution

Aaruni Goel<sup>1</sup>, Paresh Pathak<sup>1</sup>, Madhup Sharma<sup>1</sup> and Mridul Vaish<sup>2</sup>

<sup>1</sup>I.T. Department, IIMT Engineering College, Meerut, India

<sup>2</sup>School of CS/IT, Shobhit University, Meerut, India

aruni.goel@gmail.com, pareshbhu@gmail.com, j.madhup@gmail.com, mridul.v@rediffmail.com

**Abstract**— Cell phones are now the necessity of mass of people throughout the world. The capability of cell phone is now not only limited to make and receive calls but it has already advanced towards storing data, taking pictures, listening music and watching videos. Modern cell phones are providing internet access, sending and receiving files of different formats through Blue-tooth, and some cell phones are having GPS (Geo Positioning System) technology which allows the user to find out traffic conditions nearby etc. Even remote and undeveloped countries are accessing cell phone technology and wireless services. But cell phones addiction also gives birth to many psychological and mental problems too. Psychiatrists believe that mobile phone addiction is going to be one of the biggest non-drug addictions which disturb the social life. Many scientists also believe that the radiation from the mobile phones may cause the users different types of problems. Further microwaves can also be harmful due its thermal effect which we observe in daily life in the form of warming up of food through microwave oven. In this paper, we are emphasizing these issues in detailed manner.

**Index Terms**— MS (Mobile Stations), MSC (Mobile Switching Center), BTS (Base Transceiver Stations), Co-Channel Interference, Cognitive Load and E-Waste

## I. INTRODUCTION

IN today's usage of cellular system is a part and parcel for every person. Even the financially weaker section knows the necessity of this electronic device. Since ages the mode of communication remained very important in the form of messengers, letters and recently in the form of fixed telephones i.e. in all phases of all centuries. But after the year of 2000 a revolution came upon by which all the sections of the society were feeling comfortable in placing mobile phones and this happened due to the following three factors: i) Portability of device, ii) Due to low calling cost in communication and, iii) Ease of usage.

Technically speaking a cellular network is based on radio waves which are dispersed over land in the form of called cells. The combinations of these cells provide radio coverage over a large area. For the above said task, Mobile Stations (MS)-Our Simple handset, Base Transceiver Stations (BTS)-Antennas/Towers who provides link for communication and passed the signal to the nearby MSC and Mobile Switching

Stations (MSC)-The station who used the CDMA or FDMA or TDMA technologies for long haul communication, are important parts of cellular networks. These enable the MSs to communicate with each other and also with fixed landline even if the movement of MSs is intercellular.

In a cellular system, the area is divided into regular shaped cells, which can be hexagonal, square, circular or some other irregular shapes. But to make our calculations easy we prefer hexagonal shapes. Each of these cells is assigned multiple frequencies for e.g. ( $f_1 - f_4$ ) which have corresponding radio base stations as shown in Figure 1 by representing the frequencies in the form 1-4. The group of frequencies can be reused in other cells, provided that the same frequencies are not reused in adjacent neighboring cells as that would cause co-channel interference [1].

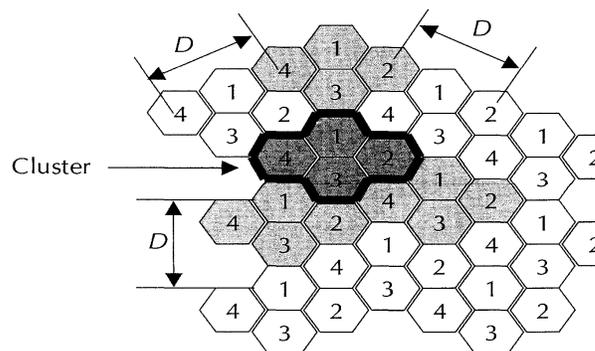


Fig. 1. Cellular frequency pattern

Technically cellular networks have number of advantages:

- Increased capacity in terms of memory and processing power.
- Reduced power use to save battery power.
- Larger coverage area which extends from nationally to internationally i.e. global.
- Reduced interference from other signals with the help of upcoming technologies.

But despite of above stated advantages cell phones are having serious disadvantages. These disadvantages are the

serious flaws of cellular systems In this paper will cover the two major drawbacks which can suffer the persons in near future:

## II. PSYCHOLOGICAL IMPACTS

Before going on more details about Psychological Impacts we would like to address about the two important psychological terms- Inattentional blindness and Cognitive load.

*Inattentional blindness:* It is the failure to notice a fully-visible, but unexpected object because attention was engaged on another task, event, or object. This typically happens because humans are overloaded with inputs i.e. many thoughts. It is impossible to pay attention to every single input that is presented. A person's attention cannot be focused on everything, and therefore, everyone experiences inattentional blindness. People can falsely believe that they do not experience inattentional blindness. This is due to the fact that they are unaware that they are missing things.

Working memory has been defined as the system which actively holds information in the mind to do verbal and nonverbal tasks such as reasoning and comprehension, and to make it available for further information processing. Working memory tasks are those that require the goal-oriented active monitoring or manipulation of information or behaviors in the face of interfering processes and distractions. The cognitive processes involved include the executive and attention control of short-term memory which provide for the interim integration, processing, disposal, and retrieval of information.

The term *cognitive load* is used in cognitive psychology to illustrate the load related to the executive control of working memory. Theories contend that during complex learning activities the amount of information and interactions that must be processed simultaneously can either under-load, or overload the finite amount of working memory one possesses. All elements must be processed before meaningful learning can continue [2].

All the characteristics of human nature and human mind are based on above said two definitions and results the following [3], [4]:

1). Cell phone use in many situations results in overcapacity – both physical and mental. It is like that if one is busy in talking in heavy traffic areas then his concentration on the local surroundings would be little and there is possibility that he might be not aware the car coming very fast from his back.

2). It has seen many times ringing tone requires higher attention to phone. It is like that even the ringtone of neighbor is ringing, the attention of individual diverts in much extent with respect to local surrounding conditions.

3). It has been observed that Cell phone usage in public places enhances the reaction time and reduce attention regarding the surroundings. It is like the analogy that the way of conversations and bodily activities varies from person to person depending upon the conversation. In this manner it can disturb or make annoyed the person(s) nearby to him. It simply means that surroundings can also get disturbed from the person who has place or attend the call.

4). At the time of driving during the usage of Cell phone conversation or otherwise can divert the attention of driver can result an accident. Since we know that increase reaction time not only reduce attention but also, and reduce the visual field attention. Various Researches suggest that Cognitive load (The psychological result of perception and learning and reasoning) rises above visual sensation and diverts attention. Further Memory of visual inputs (seen objects in surroundings) and Response will drastically reduce if the cognitive load increases when using cell phone along with driving even if the conversation is going on speaker phone. It should also be noted that during driving the hands, legs and body position always play the crucial role in terms of balancing the vehicle.

5). No-Mo phobia (NoMobile phobia) : It can be any of the condition(s) when a cell phone user has either no available calling credit or discharge battery in his phone or lose cell phone contacts or lose his phone . In this situation for a time being he becomes mentally unbalanced.

6). Ringtone anxiety (Ringxiety): It is the state in which user is wrongly believing that his phone is ringing or vibrating. Some sort of addiction state is that he use to check his mobile phone the missed calls or messages very frequently in addition to leaving is important task.

## III. PHYSICAL IMPACTS

*E-Waste:* The outdated or dead cell phones are the important becoming one of the important foundation for electronic waste. These e-wastes pollutes our environment in great manner. There should be proper recycle procedure laid by government otherwise the toxic chemicals like, lead, zinc, mercury etc in the electronic components of mobile phones can definitely contaminate human beings through poisonous vegetables, fruits and drinking water. Avoidance of e-waste and encouragement to Green electronics is the only way of prevention [5].

*Radiation Hazards:* Cell phone technology emits electromagnetic radiation in the Giga hertz range closer to microwave range and with similar properties. But researches has proved that human head absorbs some radio waves (Fig. 2).

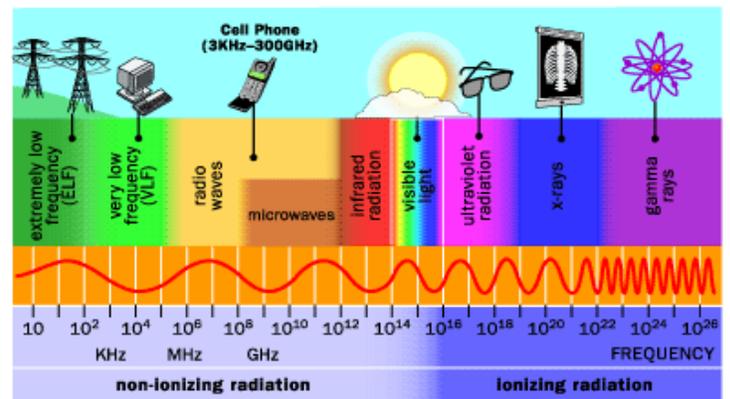


Fig. 2: Frequency graph

### A. Cell Phone Radiation Emission Process

During conversation on a cell phone, a transmitter takes the sound of voice and encodes it onto a continuous sine wave which is just a type of continuously varying wave that radiates out from the antenna and fluctuates evenly through space. These Sine waves are calculated in Hertz i.e. at one second the number of times wave moves up and down. This encoded voice sound is then sends to the antenna, which further sends the signal out to the tower. These outgoing signals are made up of electromagnetic radiation. These radiations are made up of waves of electric and magnetic energy moving at the speed of light. All electromagnetic energy falls somewhere on the electromagnetic spectrum, which ranges from extremely low frequency (ELF) radiation to X-rays and gamma rays (Fig. 2) [6], [11].

*Specific Absorption Rate (SAR)* is used to measure the radiation absorbed by the human body and calculated in terms of W/Kg for 1 gm tissue. According to researchers the SAR range prescribed for safer side for cell phone user should be set in between 1.6 to 2 W/Kg averaged for 1 gram tissue. If the SAR level is above the limit, it may cause both Ionization and Non Ionization or Thermal effects in the body especially in the ear and head since these are at the “Near Field Zones” of the radiation. Till date the cell phones from 0.35W/Kg to 1.59W/Kg range of SAR is available [7], [3].

*Ionizing Radiation* - This type of radiation contains enough electromagnetic energy to strip atoms and molecules from the tissue and alter chemical reactions in the body. Gamma rays and X-rays are two forms of ionizing radiation. Gamma-rays are not stopped by the skin. They can change DNA by modifying the genetic material of the cell and thereby causes cancer and hereditary disease. Gamma radiation at high level of radiation causes leukemia, lung, liver, skeletal and other solid cancers which leads to death. X-ray is a type of high energy radiation and can be destructive to all living tissues which can cause DNA damage and mutations. The X-rays have fatal effects on pregnancy and childbirth which can deform the body of the infant. X-rays can harm the tissue in the bones which is called bone marrow. X-ray can cause the loss of hair on the head. X-rays also cause cancer development specially the thyroid cancer [3], [8], [9].

*Thermal Radiation* - This type of radiation is faced by the person who uses mobile handset for hours in a day results problems in internal ear, head surface and even in the brain. Internal ear has a organization filled with fluid which are more vulnerable to the heating effect. Microwave causes dielectric heating of body tissues which are rich in water and exhibit dielectric property (+ve and -ve ions). These tissues heat up through the rotation of polar molecules such as water. This friction causes heating of the affected tissue. Temperature in the internal ear, brain etc increases to 1 degree or more after 15 minutes use of mobile phone.

Head is in the “near field” of radiation, so that most of the heating effect occurs in the head. This adversely affects the functioning of these organs since these have fluid filled cavities. In short the thermal effect can cause- Mood alteration and lack of concentration, Lethargy and lack of sleep, Whistling sound in the ear, Premature Cataract as

Cornea of eye lacks blood supply and heat cannot be disposed, irritation in the ear drum and internal sensory cells of ears due to piercing sound from speakers of cell phone etc..

Non-ionizing radiation is not as hazardous with respect to Ionizing radiation and usually not enough to cause any type of long-term damage to tissues. Radio-frequency energy, visible light and microwave radiation are considered non-ionizing [3], [8], [10].

### B. Precautions to Be Taken to Avoid Radiations

A cell phone user must take care about the following safety measures to protect himself or others by adopting following proposals [12], [13]:

1. Cell phones should be carried on in a bag or pouch close to the body. Switching off the phone by activating miscall alerts is also the good solution if not using such pouches to avoid radiations at lowest. Land line phones should be preferred for longer conversations.
2. Cell phone should be operated using text messages and if not possible then usage should be in Speaker mode.
3. Cell phone if in the shirt pocket then it is suggested that the key pad side should face the chest for lesser effect of the radiation.
4. Smartphone emits large quantity of radiation since it is performing multifunction like a computer so keeping the longer time close to the body is risky.
5. Avoid the effects of Passive Radiation by moving away from people using the Cell phone.
6. Cell phones should be kept away or not used from Kids specially the newly born baby because the cranial bones (the part of the skull that encloses the brain) are not thick in kids and too much thin even vacant in newly born baby. Therefore the chance of penetration of radiation into their brain is higher than in adults.
7. One should dial and wait for few seconds till the remote person attend the phone. It is so because at the time of dialing and ringing, level of radiation is very high. It is also recommended that phone should be moved away from the ear occasionally to spread the radiation.
8. Cell phone should not be used in moving vehicles like Car, Train, and Buses etc since the cell phone emits double amount of radiation to keep link with the strongest tower.
9. Cell phone should not be used during or just after charging as the radiation levels are very high if the battery is full or charging.
10. One should check the signal range indicator in the Cell phone before initiating the call. If it is weak, staying for sometime is better until it reaches full range since radiations are quiet high in low range condition because the cell phone at that time is trying to make the link with a tower having strong signals.
11. Cell phones should not kept near Electronic Medical equipments or other sensitive devices because radiation can make them unreliable.

12. Cell phones should not be used inside the Petrol filling stations or near LPG cylinders since the Static electricity in the atmosphere may explode by the Cell phone radiation and may cause fire.
13. Laptops also generate very high radiations. It is due to the fact that around 50-60 degree heat is liberate by the fan present on the bottom side of the laptop and is sufficient to heat up the lower abdomen. Further, one should always keep a safety distance from Electronic devices that emitting radiations. Researches say that the minimum distance should be 3 feet for computer and 6 feet for Televisions.

#### IV. CONCLUSION

As far as we concern the thermal effects and radiations are definitely the alarming bells and the consequences will be seen in near future. Further the persons living near to the cellular towers are also prone to danger of health hazards. A German study published in 2004 titled ‘The Influence of Being Physically Near to a Cell Phone Transmission Mast on the Incidence of Cancer’, showed a 3 times higher risk of developing cancer for people who lived within 400 meters of a cell phone tower for a period of five years. Those health effects apply to adults, children can be expected to have even more severe health issues due to the increased absorption of the same radiation levels. At last, the effect of radio frequency emissions and its radiation requires more research and experiments because mobile technology is the new technology and we are those who should know that what we are leaving for our descendants.

#### REFERENCES

- [1] “Cell Phone Carriers.” Mobyedia. The cellreception website. [Online]. Available: <http://www.cellreception.com>.
- [2] Hyland, G.J. “The Physiological and Environmental Effects of Non-Ionising Electromagnetic Radiation”. The whale.to website. [Online]. Available: <http://www.whale.to/b/hyland1.html>
- [3] Hyland, G.J. “Physics and Biology of Mobile Telephony.” The Lancet 356 (2000): 1833-1836.
- [4] The howstuffworks website. [Online]. Available: <http://www.howstuffworks.com/cell-phone-radiation.htm>.
- [5] Sadetzki, Siegal, Angela Chetrit, Avital Jarus-Hakak, Elisabeth Cardis, Yonit Deutch, Shay Duvdevani, Ahuva Zultan, Ilya Novikov, Laurence Freedman, and Michael Wolf. “Cellular Phone Use and Risk of Benign and Malignant Parotid Gland Tumors – a Nationwide Case-Control Study.” American Journal of Epidemiology 167 (2008): 457-467.
- [6] Hyland, G. J. “How Exposure to Mobile Phone Base-Station Signals Can Adversely Affect Humans.” (2005). The tetrawatch website. [Online]. Available: [http://www.tetrawatch.net/papers/hyland\\_2005.pdf](http://www.tetrawatch.net/papers/hyland_2005.pdf).
- [7] United States. Office of Engineering and Technology (OET). Federal Communications Commission (FCC). “Radio Frequency Safety – Cellular Telephone Specific Absorption Rate (SAR).” The fcc.gov website. [Online]. Available: <http://www.fcc.gov/oet/rfsafety/sar.html>.
- [8] Eger, Horst, Klaus Uwe Hagen, Birgitt Lucas, Peter Vogel, and Helmut Voit. “The Influence of Being Physically Near to a Cell Phone Transmission Mast on the Incidence of Cancer.” Umwelt-Medizin-Gesellschaft 17 (2004): The poerwatch.uk

- website. [Online]. Available: [http://www.powerwatch.org.uk/news/20041118\\_naila.pdf](http://www.powerwatch.org.uk/news/20041118_naila.pdf).
- [9] Oberfeld, Gerd, Enrique A. Navarro, Manuel Portoles, Ceferino Maestu, and Gomez-Perretta Claudio. “The Microwave Syndrome – Further Aspects of a Spanish Study.” (2004). The tetrawatch website. [Online]. Available: [http://www.tetrawatch.net/papers/hyland\\_2005.pdf](http://www.tetrawatch.net/papers/hyland_2005.pdf)
- [10] Salford, Leif G., Arne E. Brun, Jacob L. Eberhardt, Lars Malmgren, and Bertil R. Persson. “Nerve Cell Damage in Mammalian Brain After Exposure to Microwaves From GSM Mobile Phones.” Environmental Health Perspectives 111 (2003): 881-883. The ehponline website. [Online]. Available: <http://www.ehponline.org/members/2003/6039/6039.html>.
- [11] Rothman, Kenneth. “Epidemiological Evidence on Health Risks of Cellular Telephones.” The Lancet 356 (2000): 1837-1840.
- [12] The wikianswers website. [Online]. Available: [http://wiki.answers.com/Q/What\\_is\\_the\\_effect\\_of\\_gamma\\_rays\\_on\\_the\\_human\\_body](http://wiki.answers.com/Q/What_is_the_effect_of_gamma_rays_on_the_human_body)”.
- [13] The gq.com website. [Online]. Available: <http://www.gq.com/cars-gear/gear-andadgets/201002/warning-cell-phone-radiation>.