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SURVEY AND ASSESSMENT OF RADIATION LEVELS ASSOCIATED WITH MOBILE AND WIRELESS TELECOMMUNICATION MAST IN RESIDENTIAL AND OFFICE AREAS WITHIN KADUNA METROPOLIS

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ABSTRACT

This paper is aimed at survey of the EM radiations from GSM masts around residential and office areas of Kaduna metropolis. It's focused on carrying out study on the electromagnetic exposure emitted by mobile phone base stations. Mast from each of the service providers were surveyed (AIRTEL, ETISALAT, GLO, MTN). Radio frequency Electromagnetic Force (RF EMF) strength meter was used to obtain readings from around the mast. The Electric field strength E and magnetic field strength Hwas measured at 0, 8, 16, 24, 32, 40m away from the mast in N/C andT respectively.The readings obtained were analyzed and compared with the International Commission on Non-ionizing Radiation Protection (ICNIRP) and the Institute of Electrical and Electronic Engineers (IEEE) exposures limits for radio frequency waves. The results showed that electromagnetic exposures from the mast are quite below the exposure limits. This research workhasestablished that the populations in Kaduna metropolis are less subjected to any adverse health effects emanating from the Global System of telecommunication masts.

Keywords; Telecommunication, Mast, Electric Field, Magnetic Field, and Power Density

INTRODUCTION

The telecommunication sector is a very important sector of the Nigerian economy and indeed of any economy. Communication to an economy is important and cannot be overemphasized. Specifically, telecommunication sector is central to the development process of a healthy economy and societal growth. Telecommunication is the primary means of transmitting information, resulting to installation of telecommunication mast and around residential and office areas which may have negative impacts on the life of people living around. Some blame the telecommunication companies for poor planning. Others might wonder whether it is the complexity of telecommunication systems that is an obstacle to improvement which is hard to overcome.

Telecommunication mast has been studied differently which has received comparatively little attention. A survey paper by Akindele O Akin (2014) investigates the location adequacy of telecommunication masts and residents livability in Osogbo, Nigeria and observed that there are physical, healths and environmental perceived problems at certain distances from mast.Using a descriptive cross-sectional survey, the health hazards of non-ionizing radiation from telecommunication mast on the exposed community were assessed and presents by Akintonwa et al (2009).This study establishes that there are health implications of exposure to mast radiation and minimizing them will go a long way to improve healthy living. The synergistic hazard effect of high voltage cable and telecom masts erected close to each other due to improper sitting can easily be imagined. Cell phones serve as tool for social connection and managing social relationships among people (Banjo, Hu and Sundar, 2008). However, there is currently considerable confusion over the health and safety issues relating to non-ionizing radiation emitted by GSM telephony base sections and handset. There is obviously conflicting information from the various scientific sources and environmental groups with respect to health hazards associated with GSM telephony (Yusuf, 2003). Hamblin and Wood (2002) claimed that exposures to electromagnetic radiation can affect the natural rhythms of the brain's electrical activity, as measured by Electroencephalogram. Fernie (2005) iterated that studies of the effects of exposure to electromagnetic fields on populations of wild birds can provide further insights into the potential impacts on animal and human health. According to Cherry (2009), cell sites are risk factors for cancer, specifically brain tumors and leukemia; heart attack and heart disease, particularly arrhythmia, effects including sleep disturbance, learning difficulties, depression among others.

Contrariwise, some research works opposed the assertion that erection of GSM mast within residential neighborhoods has negative effect on people's health. For instance, Changnuad et al. (1999) looked at the short time effects of pulse microwave radiation on rodents and the result produced negative evidence of the effect of mast on these animals. These further alleviated the fears of people who live in close proximity to these masts. In September 1999, the Health Council of the Netherlands received a request from the Minister of Housing, Spatial Planning and the Environment; Minister of Health, Welfare and Sport; the state Secretary of Social Affairs and Employment and the State Secretary of Transport, Public Works and Water Management to advise on whether exposure to electromagnetic fields used for the data transfer between mobile telephones and base stations may result in negative health consequences. A large number of scientific studies agree that it is probable that the physical characteristics of electromagnetic fields are not the direct or contributory caused of health problems attributed to electromagnetic fields (electromagnetic hypersensitivity). A local study on the hazard of non-ionizing radiation of telecommunication mast in an urban area of Lagos Nigeria by Akintonwa et al (2009), also supported headache being the most frequently observed symptoms of the hazard profile. Also no evidence of cancer or tumor was discovered in that study for the above mentioned reason (Antonelli, 1991). Erection of telecommunication masts is practically indispensable for the case of high volume data transfer with guaranteed security and quality (Alleman, 1989). They support antenna at a reasonable height to transmit and receive waves. This accounts for the preponderance of the masts in the areas requisite for human habitation. The EM wave used for wireless and mobile telecommunication is on a broad range called radio frequency RF radiation. It frequency ranges from 1KHz – 300GHz. In a narrow range, however the EM wave is called micro-wave (MW) radiation with frequency of 300MHz – 300GHz (NCRP. 1993). According to Cember (1996), RF radiation is defined arbitrary as electromagnetic radiation in the frequency range of 3 KHz to 300MHz whereas the arbitrary definition of MW includes EM radiation whose frequency ranges from 300MHz to 300GHz.

According to kiefer (1990), RF extends from 300KHz to 300MHz and MW covers the range from 300MHz to 300GHz. Based on MW and RF bound designation, RF is described as high frequency (HF) radiation, whereas MW s described as ultra-high frequency (UHF) radiation (Cember, 1996). The TWs have short wavelength of approximately 32.8m based on industrial, scientific and medical application on RFs and MWs. The short wavelength of MW allows EM energy to be transmitted through the air of free space in relatively sharply focused intense beam similar to a beam of light and these beams can carry more information than the RF. Also the MW has more information carrying capacity due to its bandwidth since information is transmitted in a band of frequencies (Cember. 1996). At frequencies from 10MHz to 300GHz heating is the major effect of absorption of electromagnetic energy and temperature rises of more than 1-2°C can have adverse health such as heat exhaustion and heat stroke (ACGIH, 1996). Studies on workers in thermally stressful environments have shown worsening performance of simple task as body temperature rises to a level approaching physiological heat stress (Ramsey, and kwon, 1988). In addition, according to ICNIRP (2009), sources of RF used for wireless communication, data transmission, or food processing generate much lower field at the position of the users than those used for broadcasting, industrial heating and plasma discharge.Under cellular and animal studies, exposure of laboratory animals to EMF producing absorption in excess of approximately 4WkgD has revealed characteristic pattern of thermoregulatory response in which body temperature initially rises and then stabilizes following the activation of thermoregulatory mechanism (Michelson, 1983).

In this research data were collected from neighborhoods whereGSM and UMTS service providers'transmission masts situated within Kaduna, Nigeria. Erections of telecommunication mast are practically investigated inselected areas.

MATERIALS AND METHOD

The methodology used includes calibration of the equipment, data collection from the surveyed masts of the GSM and UMTS service providers. The primary and secondary data collected was used to calculate the electric field and magnetic field beamed out from the masts at various distances. The primary data includes the facts and figures relating to electric field and magnetic field of transmission mast in selected areas of Kaduna metropolis using the EMF Strength meter. The secondary data consist of existing information collected by other researcher.

EQUIPMENT AND CALIBRATION

The instruments used for this study were RF EMF strength meter, model 480836. The RF EMF strength meter is a broadband isotropic instrument. This meter is a broadband device for monitoring high-frequency radiation in the specific ranges of 900MHz, 1800MHz, and 2.7GHz. Other measurements can be made, for reference purposes only, using the entire range of 50MHz to 3.5GHz. The non-directional electric field arid high sensitivity also allows measurements of electric field strength in TEM cells and absorber rooms. The unit of measurement and the measurement types are expressed in units of electrical and magnetic field strength as well aspower density. At high frequencies, the power density is of particular significance. It provides a measure of the power absorbed by a person exposed to the field. This power level must be kept as low as possible at high frequencies. The meter can be set to display the instantaneous value, the maximum value measured or the average value. Instantaneous and maximum value measurements are useful for orientation.

SERVICE PROVIDERS MAST SURVEYED

Major Nigeria's service providers were considered: Airtel, Etisalat, Glo and MTN. Six base stations from each service provider were selected making a total sum of twenty four base stations that were surveyed. Each base station carries either three dual band antennas or six single band antennas.The antennas are arranged into three sectors at 120^0 apart. The height of the towers ranges from 25m to 55m. Each base station is fenced, which means that no individual resides within the immediate vicinity of the base station except for Glo network, the security guards have a small room apartment within.

DATA COLLECTION

Measurements were taken at 0, 8, 16, 24, 32, 40m away from the mast, starting from 40m to 0m. The base of fences served as the origin of the measurement. At each points, the values of electric field and magnetic field strengths were measured while the equipment was in maximum mode. The readings were represented in a tabular form, and a graph of power density against distance was plotted in other toshow the nature of the curves.

RESULTS ANDDISCUSSION

This paper established that electric field strength E (V/M) and magnetic field strength H (A/M) beams emanate from telecommunication mast of various service providers (AIRTEL, ETISALAT, GLO, and MTN N), with use of RF strength mater data of emanated radiations was collected at each mats. The data obtained are presented on table 1 to 5. Analyzing the tables indicates that for AIRTEL mast (see table 1), the electric field (E) and the magnetic field (H) decreases from the distance 0m-16m with increase from 16m-32m then decreases at 40m, the power density range was found to be (0.0004-0.0019)(W/m^3), with maximum at 32m and minimum at 16m. For the ETISALAT mast (see table 2), the electric field (E) increses from 0m-8m and decreases from 8m-40m while the magnetic field (H) increases from 0m-8m, decreases from8-24m and increases from 24m-40m, the power density range was found to be (0.0005-0.0034)(W/m^3), with maximum at 8m and minimum at 0m. For the GLO mast (see table 3), the electric field (E) decreases from the distance 0-16m with increase at 24m and decreases from 24-40m, the magnetic field (H) decreases from 0m-40m the power density range was found to be (0.0007-0.0025)(W/m^3), with maximum at 0m and minimum at 16m. For the MTN mast (see table 4),the electric field (E) and the magnetic field (H) decrease at distance of 0m-8m, but increase from the distance 16m-24m,while at a distance of 32m-40m the electric field increases where as the magnetic decreases, the power density range was found to be (0.0026-2.1308)(W/m^3), with maximum at 40m and minimum at 16m. Table 5 shows a comparising of the result obtained in this reseach with the standard value given by ICNIRP,FCC and IEEE respectively, and also the percentage ratio (PR) of the maximum power density obtained at each mast (AIRTEL, ETISALAT, GLO, and MTN N). when compared with the standard values given by ICNIRP which is given to be 4.5W/m^3, FCC which is given to be 6.05W/m^3, and IEEE which is given to be 6.05W/m^3, It is observed that the MTN N mast has the highest PR when compared to ICNIRP 47.35% and FCC and IEEE 35.220%, AIRTEL mast has the lowest PR when compared to ICNIRP 0.04%, and the GLO mast has the lowest PR when compared to FCC and IEEE 0.041%. Graph 1-5 indicates the nature of the curves present in the obtained readings between each of the mast (AIRTEL, ETISALAT, GLO, and MTN N) power density in watts per square meter (W/M^2) and the distance in meters (m).

Table 1: Data from AIRTEL Mast with ID: 047

DISTANCE	ELECTRIC FIELD STRENGTH (N/C)	MAGNETIC FIELD STRENGTH(T)	Power density (W/m^3)
0	0.8312	0.002010	0.0017
8	0.620	0.001895	0.0012
16	0.3502	0.001066	0.0004
24	0.4862	0.001238	0.0006
32	0.6198	0.003008	0.0019
40	0.582	0.001023	0.0006

Table 2: Data from ETISALAT Mast with ID: 154

DISTANCE	ELECTRIC FIELD STRENGTH (N/C)	MAGNETIC FIELD STRENGTH(T)	Power density (W/m^3)
0	0.4031	0.001149	0.0005
8	1.9780	0.001710	0.0034
16	1.1720	0.001490	0.0017

24	0.6731	0.001278	0.0009
32	0.6432	0.001982	0.0013
40	0.6129	0.002145	0.0013

Table 3: Data from GLO Mast with ID: KAD060

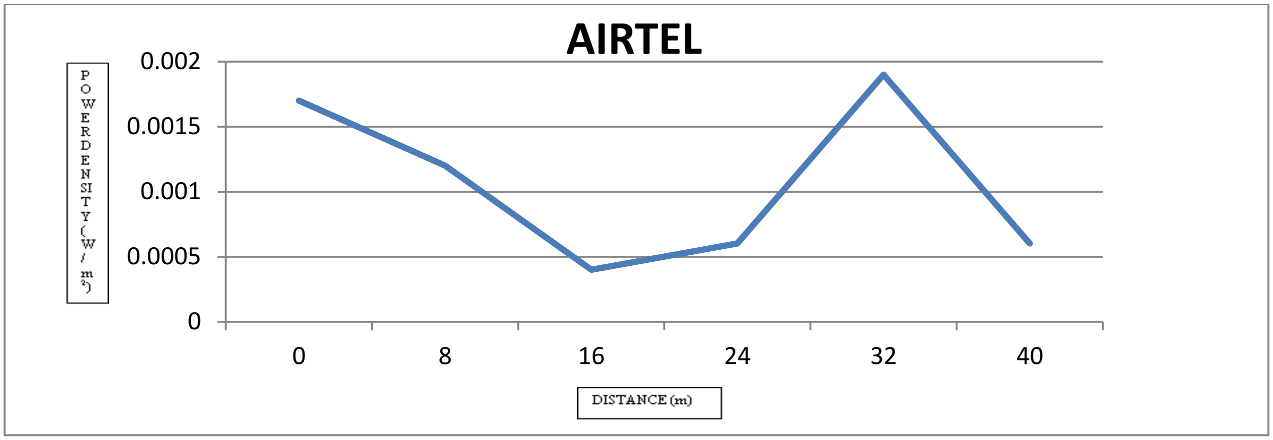
DISTANCE	ELECTRIC FIELD STRENGTH (N/C)	MAGNETIC FIELD STRENGTH(T)	Power density (W/m^3)
0	0.6452	0.003800	0.0025
8	0.3900	0.002925	0.0011
16	0.2497	0.002877	0.0007
24	0.6307	0.002510	0.0016
32	0.5312	0.002214	0.0012
40	0.582	0.001393	0.0008

Table 4: Data from MTN Mast with ID: 0163

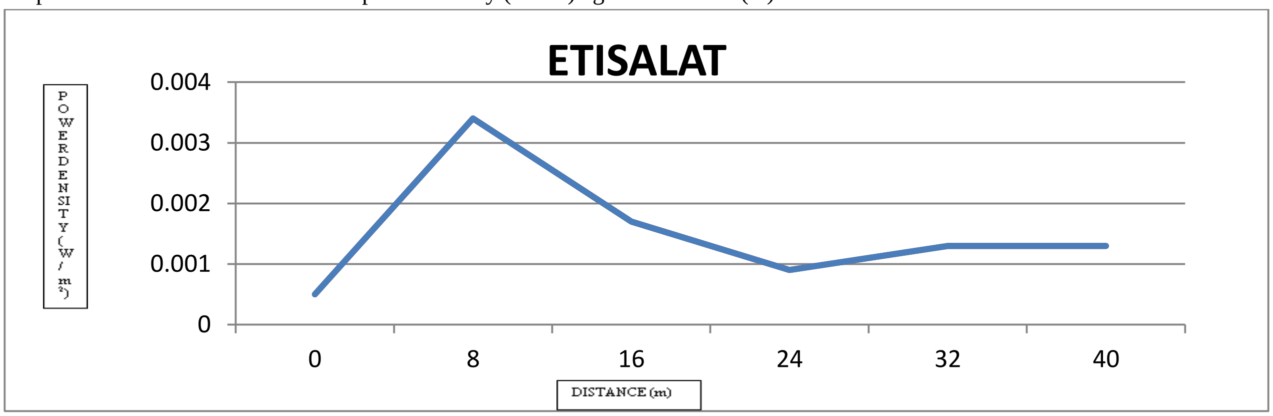
DISTANCE	ELECTRIC FIELD STRENGTH (N/C)	MAGNETIC FIELD STRENGTH(T)	Power density (W/m^3)
0	2.127	0.978	2.0802
8	1.999	0.679	1.3573
16	2.565	0.001024	0.0026
24	3.076	0.001225	0.0038
32	2.369	0.8883	2.1044
40	2.452	0.869	2.1308

Table 5:Comparising of the result obtained and Percentage Ratio (PR) of the Maximum Power Density of Each Service Provider with the standard value given by ICNIRP, FCC, and IEEE.

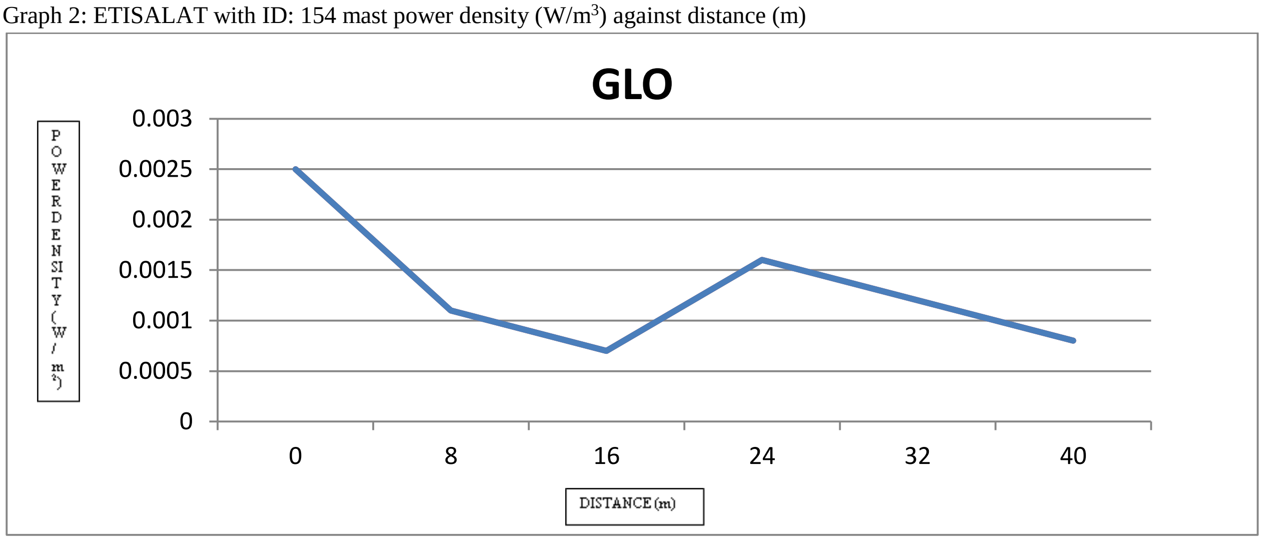
SERVICE PROVIDERS MAST	MAXIMUM POWER DENSITY (W/m^3)	STANDARD LIMITGIVEN			PR WITH ICNIRP (%)	PR WITH FCC (%)	PR WITH IEEE (%)
		ICNIRP (W/m^3)	FCC (W/m^3)	FCC (W/m^3)			
AIRTEL	0.0019	4.50	6.05	6.05	0.04	0.661	0.0661
ETISALAT	0.0034	4.50	6.05	6.05	0.07	0.056	0.056
GLO	0.0025	4.50	6.05	6.05	0.05	0.041	0.041
MTN N	2.1308	4.50	6.05	6.05	47.35	35.220	35.220



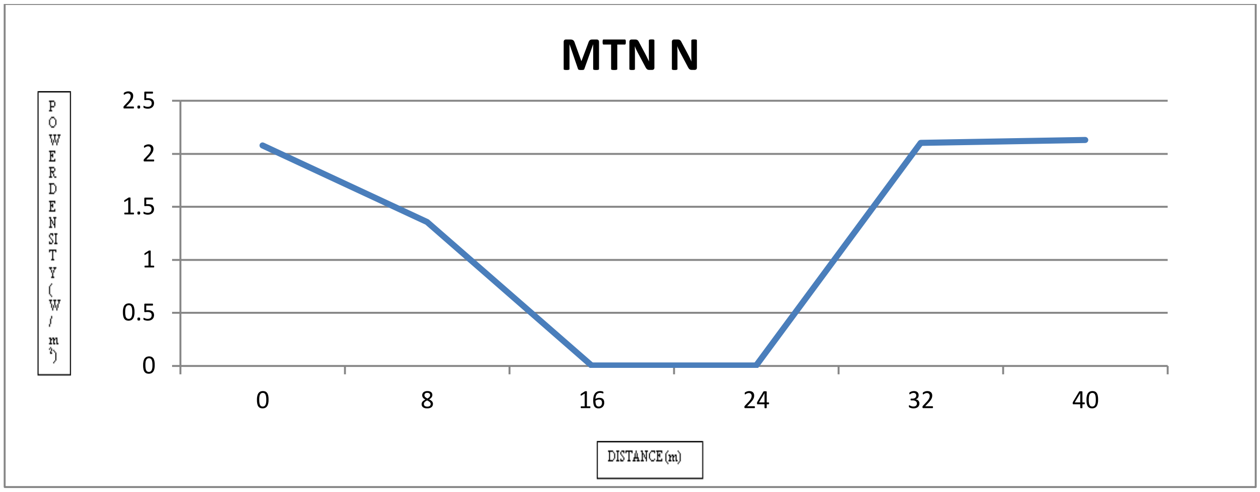
Graph 1: AIRTEL with ID: 047 mast power density (W/m^3) against distance (m)



Graph 2: ETISALAT with ID: 154 mast power density (W/m^3) against distance (m)



Graph 3: GLO with ID: KAD060 mast power density (W/m^3) against distance (m)



Graph 4: MTN N with ID: 0163 mast power density (W/m^3) against distance (m)

CONCLUSION

In this research, the maximum power density value of each service provider mast was compared with the standard exposure limit given by ICNIRP (4.5W/m^3), FCC and IEEE (6.05W/m^3). The result shows that the values of the power density obtained from this research work falls below the standard exposure limit. The result also established that the exposure rate of the electromagnetic beams emanating from telecommnicaton service providers mast (AIRTEL, ETISALAT, GLO, and MTN N) causes very less hazardous health effect, apparently, the population who reside within the vicinity of such telecommnication mast are safe from electromagnetic forces and ionising radiation emanations. It is concluded that the use of such telecommunication mast safe for the people living within at the moment.

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