DISTRIBUTION OF RADIOFREQUENCY RADIATION AROUND BASE STATIONS IN LAUTECH ENVIRONMENT

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ABSTRACT
This study reports the measurements of the power density around base stations located in the Ladoke Akintola University of Technology, Ogbomoso (LAUTECH) environment. Eight (8) mobile phone stations located around LAUTECH belonging to three mobile phone network providers; MTN, GLOBACOM and AIRTEL were studied. The locations of the base stations are; MTH area, NUT area, Nurudeen school area, Under G area, New LAUTECH College, School gate and Dorcas hostel. The power density around each of the base station was measured at distances of 0 and 50m from the base station. The results obtained gave power densities ranging from between 0.194 - 0.200 µW/cm^2 and 0.136 – 0.151 µ W/cm^2 at distances of 0 and 50m respectively. These results are much less than the 200µW/cm^2 recommended by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) thus the base stations may be regarded as not constituting any health hazard to the people around the base stations.

INTRODUCTION

Mobile phone is an electronic device used mainly for communicating either between short distances or a very far distance. Mobile cell phone is used by all adult youth and children, most especially in urban cities, school environment e. t. c. The race of telecommunication technology began in Nigeria, when the commercial service of the GSM (Global System of Mobile communication) was launched in August 2001(Akinloye and Okeya, 2008).

Since then mobile phone has become the backbone of everything. Business organizations depend on the use, people don't have to travel long distances to see their family members and students don't have to spend too much on textbooks before they can study. This telecommunication technology delivers to their doorsteps e-books with little or no payment.

Electromagnetic energy is used by lots of electronic products. The type of electromagnetic energy that is widely in use is radiofrequency (RF) energy, including radio waves and microwaves which are used for providing telecommunication broadcast and other services.

Electromagnetic fields associated with mobile telephones occur in an environment that already contains a wide range of electromagnetic frequencies, RF from 30 kHz to 300 GHz. Frequencies used by mobile telephones depend on the operator and the kind of technology used, which range from 850 MHz to 1900 MHz and will reach 2200 MHz with the development of the new Universal Mobile Telecommunication System (UMTS) technology and 4000 MHz with the projected Terrestrial Trunked Radio (TETRA) system (Akinloye and Okeya, 2008).

Reports indicate that as at 2010 MTN Nigeria had 123 million subscribers, GLOBACOM had 42.5 million, CELTEL now AIRTEL had 25 million, while Etisalat had 5 million and Multilinks had 2.6 million subscribers.

Mobile phone systems have two specific features which have aroused legitimate concern among the general public, they are; for handsets: the proximity of the telephone antenna to the head during phone conversation and for base stations: the increase in the number of antennas in the immediate environment.

The more mobile phones are used, the more base stations will need to be erected, to meet the demand for call traffic.

The possible effects on human health of exposure to RF and microwave radiations are of public concern near the locations of radio and television transmitters, mobile base stations, wireless networks and the like. It has been the utmost concern to investigate non-ionizing radiation levels that result from these sources and their effects on humans. Several studies have been initiated all over the world to determine the safe levels of exposure to RF radiation for occupational workers and the general public. In view of this, the present study is concerned with the effect of RF radiation around base stations located within the Ladoke Akintola University of Technology (LAUTECH) environment on the health of the population.

METHODOLOGY

The study was carried out at base stations located within the Ladoke Akintola University of Technology (LAUTECH) area in Ogbomoso North Local Government Area, Ogbomoso, Nigeria. The population of Ogbomoso by the 2006 census was estimated to be 861000 (Nigerian Statistical Institute, 2006).

Eight (8) mobile phone station sites located around the LAUTECH environment comprising Department of Mathematics, Kudirat Abiola Building, LAUTECH Annex College of Medicine, The University Gate, Dorcas Hostel, Agbeke Hostel, Nigeria Union of Teachers Building and Nurudeen Grammar School environments were identified for measurement of the radio frequency (R.F) distribution around them. This is in order to determine the exposure levels resulting from the radiofrequency radiation emitted by these base stations. Figure 1 shows the locations of the base stations studied.

RF Field strength meter TDM-200 a product of Laplace Instruments was employed for the measurements of the RF radiation around the base stations shown in Figure 1. The meter measures the power density of radio waves and other radiofrequencies. Two points were chosen for the readings. The position at which the base station is located indicated by 0 m and at a distance of 50 m from the base station. Readings were taken at 6:00 a.m., 12:00 noon and 6:00 p.m. respectively every day for a period of three months at the chosen locations.

In order to get a true measurement of the total RF power density the meter was first placed vertically, for which readings were obtained, thereafter it was placed horizontally and a reading was also obtained. The two readings were summed up to give the sum of vertical and horizontal power densities.

The sum of these two readings was the true power density from the transmitters at each of the base stations. This procedure was repeated for the eight locations. In the course of the measurement, it was ensured that no obstacles were between the meter and the source in order to obtain accurate readings.

RESULTS AND DISCUSSION

The results for the measurements of the power density variation with distance averaged to 7 days for the selected mobile phone base stations are presented in Tables 1 – 8, while Table 9 presents the mean values of the measurements.

According to the results obtained for A1 (Table 1), the power density variation with distance ranged from 0.194 – 0.199 μWcm^{-2} at 0m and 0.139 – 0.151 μWcm^{-2} at 50m. For A2 (Table 2), the power density ranged from 0.198 – 0.199 μWcm^{-2} at 0 m and 0.142 – 0.147 μWcm^{-2} at 50m. For A3 (Table 3), the power density ranged from 0.199 – 0.200 μWcm^{-2} at 0m and 0.144 – 0.150 μWcm^{-2} at 50m. A1, A2 and A3 belong to MTN network provider. Thus for the MTN network the power density ranged from 0.194 – 0.200 μWcm^{-2} for 0 m and from 0.139 – 0.151 μWcm^{-2} at 50 m.

For B1 (Table 4), the power density ranged from 0.198 – 0.199 μWcm^{-2} at 0m and 0.138 – 0.146 μWcm^{-2} at 50 m. For B2 (Table 5), the power density ranged from 0.198 – 0.199 μWcm^{-2} at 0 m and 0.144 – 0.150 μWcm^{-2} at 50 m. For B3 (Table 6), the power density ranged from 0.198 – 0.199 μWcm^{-2} at 0 m and 0.136 – 0.140 μWcm^{-2} at 50 m. B1, B2 and B3 belong to GLOBACOM network and the variation of the power densities is between 0.198 and 0.199 μWcm^{-2} for 0 m and between 0.136 and 0.150 μWcm^{-2} at 50 m.

For C1 (Table 7), the power density ranged from 0.197 – 0.200 μWcm^{-2} at 0 m and 0.138 – 0.149 μWcm^{-2} at 50 m. For C2 (Table 8), the power density ranged from 0.198 – 0.200 μWcm^{-2} at 0 m and 0.144 – 0.151 μWcm^{-2} at 50 m. C1 and C2 belong to AIRTEL network and the power densities obtained for the base stations vary between 0.197 and 0.200 μWcm^{-2} at 0 m and between 0.138 and 0.151 μWcm^{-2} at 50 m.

In general the results show that locations A1, B1, B2 and B3 recorded the same range of values at 0 m which is 0.198 – 0.199 μWcm^{-2} while A3 and B2 at 50 m recorded the same range of 0.144 – 0.150 μWcm^{-2}. A3, C1 and C2 recorded the highest values of 0.200 μWcm^{-2} at 0 m and 0.151 μWcm^{-2} at 50 m. The locations A1, A2 and A3, which belong to the MTN network have values in the range 0.194 – 0.200 μWcm^{-2} at 0 m and 0.139 – 0.151 μWcm^{-2} at 50 m. The locations B1, B2 and B3, belonging to GLOBACOM network recorded values in the range 0.198 – 0.199 μWcm^{-2} at 0 m and 0.138 – 0.150 μWcm^{-2} at 50 m. The locations C1 and C2 belonging to AIRTEL network recorded values in the range 0.197 – 0.200 μWcm^{-2} at 0 m and 0.138 – 0.151 μWcm^{-2} at 50 m.

The power density values obtained in this work which range from 0.136 – 0.200 μWcm^{-2} are comparable with those obtained in a study by Per-Line et al. (2000) whose values fall within the range 0.082 – 0.178 μWcm^{-2}. The recommended limit by the ICNIRP (2008) which is 200 μWcm^{-2} is much greater than the values obtained in this study (0.136 – 0.200 μWcm^{-2}). In view of this it may be assumed that the study area does not contain RF radiation that may result in health hazard for the populace within the immediate physical environment.

CONCLUSION

This study has determined the distribution of RF radiation around base stations in LAUTECH environment. This was undertaken by measuring the power density variation around the eight mobile phone base stations located within the LAUTECH environment with a RF Field Strength Meter. The base stations investigated belong to three mobile networks in Nigeria (MTN, GLOBACOM and AIRTEL). This study focused in particular on the investigation of the associated health effects that the distribution of RF radiation can pose on the people in the immediate physical environment. The results of the study showed that the power density variation with distance ranged from 0.136 - 0.200 μWcm^{-2} up to a distance of 50 m. When compared with the recommended limit of 200 μWcm^{-2} by the ICNIRP (2008), the results obtained are found to be much smaller.

RECOMMENDATIONS

Although the values of the power densities obtained in this work fall below the ICNIRP (2008) recommended limit, it is advisable that the construction of mobile phone base stations in accessible areas close to commercial areas, schools, sports facilities, residential areas or areas where there are concentrations of people for a large part of the day be discouraged in order to avoid unnecessary exposure of the populace.

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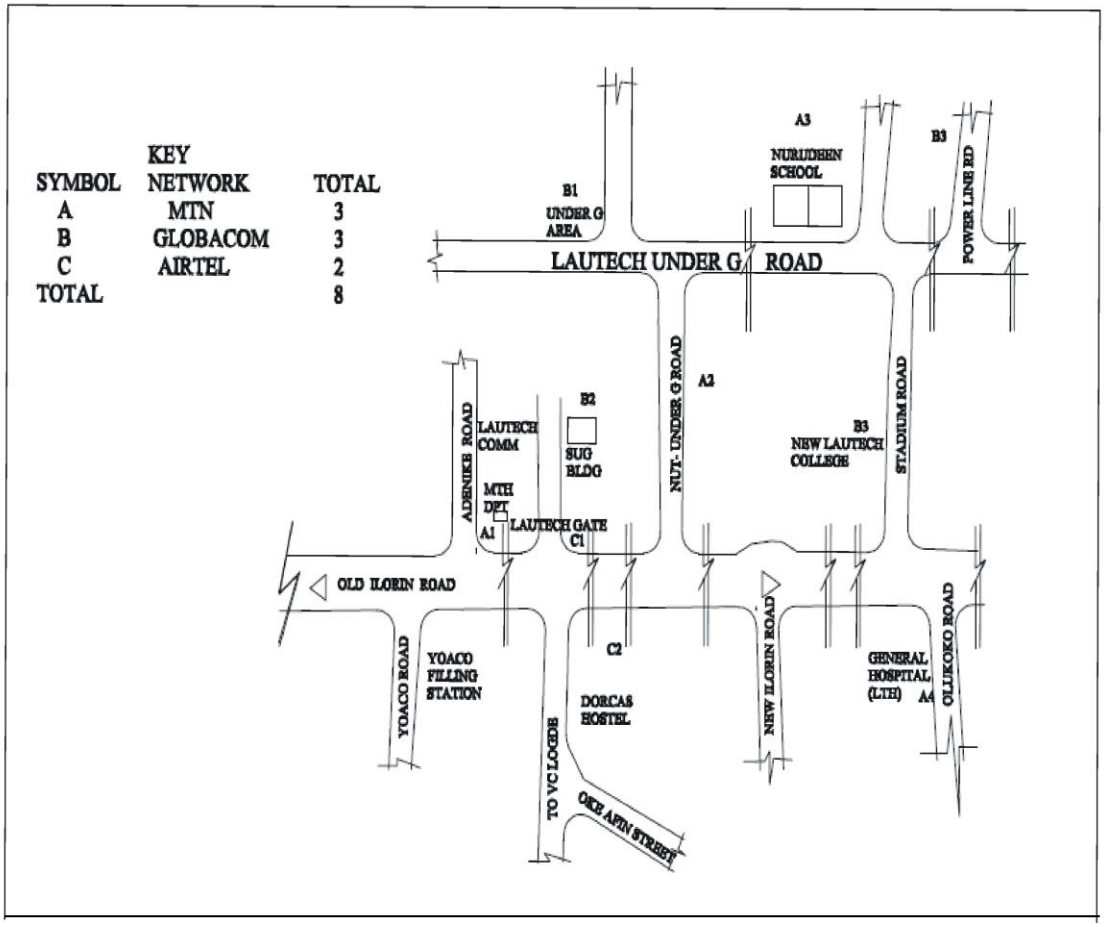

Fig. 1: Map showing the Base Stations studied

Table 1: POWER DENSITY VARIATION WITH DISTANCE FOR MTH AREA (A1: MTN NETWORK) (μWcm^{-2})

Days	Distance/m	6:00 am	12:00 noon	6:00 pm	Average
1	0	0.198	0.196	0.198	0.197
	50	0.140	0.137	0.141	0.139
2	0	0.199	0.196	0.198	0.198
	50	0.142	0.138	0.143	0.141
3	0	0.199	0.189	0.196	0.195
	50	0.143	0.139	0.145	0.142
4	0	0.197	0.189	0.197	0.194
	50	0.142	0.140	0.144	0.142
5	0	0.200	0.197	0.199	0.199
	50	0.151	0.150	0.151	0.151
6	0	0.199	0.198	0.199	0.199
	50	0.143	0.141	0.142	0.142
7	0	0.200	0.197	0.199	0.199
	50	0.145	0.143	0.144	0.144

Table 2: POWER DENSITY VARIATION WITH DISTANCE FOR NUT ROAD (A2: MTN NETWORK) (μWcm^{-2})

Days	Distance/m	6:00 am	12:00 noon	6:00 pm	Average
1	0	0.198	0.197	0.198	0.198
	50	0.146	0.143	0.146	0.145
2	0	0.198	0.197	0.198	0.198
	50	0.146	0.143	0.145	0.145
3	0	0.198	0.198	0.198	0.198
	50	0.144	0.143	0.144	0.144
4	0	0.199	0.198	0.199	0.198
	50	0.142	0.142	0.142	0.142
5	0	0.199	0.199	0.199	0.199
	50	0.142	0.141	0.142	0.142
6	0	0.198	0.199	0.199	0.199
	50	0.144	0.145	0.145	0.145
7	0	0.200	0.199	0.199	0.199
	50	0.148	0.146	0.147	0.147

Table 3: POWER DENSITY VARIATION WITH DISTANCE FOR NURUDEEN SCHOOL UNDER G (A3: MTN NETWORK) (μWcm^{-2})

Days	Distance/m	6:00 am	12:00 noon	6:00 pm	Average
1	0	0.200	0.199	0.199	0.199
	50	0.146	0.143	0.145	0.145
2	0	0.199	0.198	0.199	0.199
	50	0.145	0.143	0.144	0.144
3	0	0.200	0.199	0.199	0.199
	50	0.151	0.150	0.150	0.150
4	0	0.199	0.198	0.199	0.198
	50	0.146	0.145	0.144	0.145
5	0	0.200	0.199	0.199	0.199
	50	0.151	0.149	0.149	0.150
6	0	0.199	0.199	0.199	0.199
	50	0.146	0.144	0.145	0.145
7	0	0.200	0.199	0.199	0.199
	50	0.148	0.145	0.147	0.147

Table 4: POWER DENSITY VARIATION WITH DISTANCE FOR UNDER G AREA (B1: GLOBACOM NETWORK) (μWcm^{-2})

Days	Distance/m	6:00 am	12:00 noon	6:00 pm	Average
1	0	0.199	0.198	0.199	0.199
	50	0.140	0.139	0.139	0.139
2	0	0.198	0.197	0.198	0.198
	50	0.139	0.136	0.140	0.138
3	0	0.200	0.199	0.199	0.199
	50	0.149	0.141	0.139	0.143
4	0	0.199	0.198	0.199	0.199
	50	0.142	0.139	0.139	0.140
5	0	0.200	0.199	0.199	0.199
	50	0.148	0.138	0.138	0.141
6	0	0.198	0.198	0.198	0.198
	50	0.146	0.147	0.145	0.146
7	0	0.200	0.199	0.199	0.199
	50	0.139	0.139	0.140	0.139

Table 5: POWER DENSITY VARIATION WITH DISTANCE FOR SUG AREA LAUTECH (B2: GLOBACOM NETWORK) (μWcm^{-2})

Days	Distance/ m	6:00 am	12:00 noon	6:00 pm	Aver age
1	0	0.200	0.197	0.199	0.199
	50	0.152	0.147	0.150	0.150
2	0	0.199	0.196	0.198	0.198
	50	0.148	0.147	0.149	0.148
3	0	0.198	0.199	0.197	0.198
	50	0.144	0.143	0.144	0.144
4	0	0.199	0.198	0.198	0.198
	50	0.148	0.146	0.147	0.147
5	0	0.200	0.199	0.199	0.199
	50	0.148	0.146	0.147	0.147
6	0	0.199	0.196	0.198	0.198
	50	0.152	0.147	0.151	0.150
7	0	0.200	0.198	0.199	0.199
	50	0.152	0.146	0.151	0.150

Table 6: POWER DENSITY VARIATION WITH DISTANCE FOR NEW LAUTECH COLLEGE (B3: GLOBACOM NETWORK) (μWcm^{-2})

Days	Distance/ m	6:00 am	12:00 noon	6:00 pm	Average
1	0	0.199	0.198	0.199	0.199
	50	0.137	0.136	0.136	0.136
2	0	0.198	0.197	0.198	0.198
	50	0.138	0.137	0.136	0.137
3	0	0.199	0.199	0.198	0.199
	50	0.139	0.139	0.138	0.139
4	0	0.199	0.199	0.198	0.199
	50	0.139	0.139	0.138	0.139
5	0	0.198	0.197	0.198	0.198
	50	0.138	0.137	0.138	0.138
6	0	0.200	0.199	0.199	0.199
	50	0.140	0.139	0.139	0.139
7	0	0.200	0.198	0.199	0.199
	50	0.141	0.139	0.139	0.140

Table 7: POWER DENSITY VARIATION WITH DISTANCE FOR SCHOOL GATE (C1: AIRTEL NETWORK) (μWcm^{-2})

Days	Distance/ m	6:00 am	12:00 noon	6:00 pm	Average
1	0	0.198	0.195	0.197	0.197
	50	0.139	0.136	0.138	0.138
2	0	0.199	0.197	0.198	0.198
	50	0.140	0.139	0.140	0.140
3	0	0.200	0.198	0.198	0.199
	50	0.152	0.140	0.148	0.147
4	0	0.200	0.199	0.200	0.200
	50	0.153	0.141	0.152	0.149
5	0	0.198	0.199	0.199	0.199
	50	0.142	0.140	0.141	0.141
6	0	0.199	0.196	0.198	0.198
	50	0.141	0.138	0.139	0.139
7	0	0.199	0.197	0.198	0.198
	50	0.140	0.139	0.139	0.139

Table 8: POWER DENSITY VARIATION WITH DISTANCE FOR DORCAS HOSTEL (C2: AIRTEL NETWORK) (μWcm^{-2})

Days	Distance/ m	6:00 am	12:00 noon	6:00 pm	Average
1	0	0.200	0.199	0.200	0.200
	50	0.152	0.149	0.149	0.150
2	0	0.200	0.199	0.199	0.199
	50	0.152	0.149	0.148	0.150
3	0	0.199	0.198	0.199	0.199
	50	0.150	0.149	0.150	0.150
4	0	0.200	0.199	0.200	0.200
	50	0.151	0.150	0.151	0.151
5	0	0.199	0.198	0.199	0.199
	50	0.150	0.148	0.150	0.150
6	0	0.200	0.199	0.200	0.200
	50	0.152	0.150	0.151	0.151
7	0	0.199	0.197	0.198	0.198
	50	0.149	0.147	0.148	0.148

Table 9: POWER DENSITY VARIATION FOR THE BASE STATIONS

Network	Location	Range (μWcm^{-2})	
		0 (m)	50 (m)
MTN	A1	0.194 – 0.199	0.139 – 0.151
	A2	0.198 – 0.199	0.142 – 0.147
	A3	0.199 – 0.200	0.144 – 0.150
GLOBACOM	B1	0.198 – 0.199	0.138 – 0.146
	B2	0.198 – 0.199	0.144 – 0.150
	B3	0.198 – 0.199	0.136 – 0.140
AIRTEL	C1	0.197 – 0.200	0.138 – 0.149
	C2	0.198 – 0.200	0.144 – 0.151