REPORT

THE NATIONAL SURVEY ON CONFORMITY OF TELECOMMUNICATIONS BASE STATIONS IN UGANDA TO ICNIRP[1] GUIDELINES AND ITU[2] STANDARDS

SUMMARY

The development of wireless technology in Uganda is evidenced by the growth of the telecommunications network infrastructure. Consequently, this has sparked public debate about the potential health risks or hazards associated with the exposure to electromagnetic fields - EMF (radio frequency emissions) generated by the infrastructure and related services.

In accordance with its mandate, the Uganda Communications Commission (UCC) conducts national surveys and upon request investigations to evaluate compliance of the telecommunications installations in respect to human exposure to EMF. In the last national survey that was conducted between April 2021 and March 2022, countrywide, it was found that the highest mean value of the ICNIRP maximum value (%) was 0.008%, which is very much lower than the public reference level (100%) of the ICNIRP guidelines. The collocated sites displayed slightly higher values than the single and shared sites, but still very much lower than the public reference level of the ICNIRP guidelines. The public interviews indicated that a person's level of education has no bearing on uncertainty about the presence of base station sites in their proximity and underscored the need for more awareness to increase confidence among the communities.

[1] International Commission on Non-Ionising Radiation Protection

[2] International Telecommunications Union

1. INTRODUCTION

1.1. The Uganda Communications Commission (UCC) conducted a national survey on conformity of telecommunications base stations in Uganda to ICNIRP guidelines and ITU standards. The survey was conducted from April 2021 to March 2022.

2. BACKGROUND

2.1. The growing demand for mobile services has necessitated the expansion of telecommunications infrastructure or base station sites [comprising of base transceiver stations - BTS, towers/masts, antenna, and other supporting equipment] required to ensure appropriate network coverage and good quality of service and experience.

2.2. As of March 2022, there were 30.6 million mobile phone subscriptions and over 4300 base station sites. This sector's expansion, which translates into the expansion of telecommunications network infrastructure, has sparked public debate about the potential health risks or hazards associated with the electromagnetic field - EMF (radio frequency emissions) generated by the infrastructure and related services.

2.3. In recognition of the importance of this subject and the need to build confidence in the use of ICTs through ensuring the health and safety of users and compliance of ICT equipment, infrastructure, and services, UCC conducted the national survey on conformity of telecommunications base stations in Uganda to ICNIRP guidelines and ITU standards.

2.4. UCC continues to conduct on-request investigations in response to public requests.

3. OBJECTIVES

3.1. The aim of this survey was to conduct electromagnetic fields (EMF) exposure measurements, assessments, and interviews to determine the magnitude of uncertainty among the public.

3.2. Specifically, the survey was intended to:

a) Assess the compliance of the telecommunications installations with the internationally specified standards and requirements
b) Assess the likelihood of human exposure to the radiation/emissions from the antennas at these installations
c) Evaluate the magnitude of public uncertainty among persons living in proximity to the base station sites.

3.3. This survey was specific to public exposure.

4. METHODOLOGY

4.1. The survey adopted a mixed methods approach that involved EMF measuring equipment, calculations, as well as conducting face to face interviews using a well designed and tested questionnaire.

4.2. The survey sample was generated from a combined list of all the base stations from the mobile networks. During the sampling, a 4.46 desired degree of precision and a 95% confidence level were used. The base stations were categorized according to regions and the Probability Proportional to Size (PPS) applied in selection of sites.

4.3. The survey involved a two-tier level of assessment: conducting EMF exposure assessment and conducting interviews to determine the magnitude of uncertainty among the public.

4.4. **Technical assessment**

4.4.1. The technical assessment of the survey was guided by the international standards and guidelines to which Uganda subscribes:

- The ITU recommendations on; guidance on complying with limits for human exposure to EMF, and guidance on measurement and numerical prediction of EMFs for compliance with human exposure limits for telecommunications installations [K.52, and K.61, and other supporting recommendations: K.70, K.91 and K.121]
- The ICNIRP guidelines for limiting exposure to EMFs (100kHz to 300GHz) [ICNIRP 2020]

4.4.2. The measurements were taken using tools: Aaronia AG analyser (Spectran HF 60105, 1MHz- 9.4GHz), Aaronia Omnilog antenna 90200, 700MHz – 2.5GHz, Aaronia Hyperlog directional antenna 60100 EMC, 680MHz – 10GHz and a tripod stand.

4.4.3. The technical assessments considered the exposure levels from the antennas at the base station sites in comparison with the ICNIRP public reference levels.

4.4.4. Deriving ICNIRP maximum value = (power density received from measurement/incident power density) %; (S/Sinc)% as per the frequency range, i.e.

a) Frequency range 400-2000MHz; [S/[f/200]] %;
b) Frequency range 2 – 300GHz; (S/10) %

Comparison of results from assessment with the ICNIRP public reference level. A value of 100% or more indicates emissions have exceeded the reference levels.

4.4.5. At each selected location, the highest signal strength along with the respective frequency and power density were read off for the selected frequency band. The downlink frequency bands (assignment status of access frequency bands in Uganda as of March 2021) for: 800MHz, 900MHZ, 1800MHz, 2100MHz and 2600MHz were selected at each location and power density recorded for each band.

4.4.6. The assessment applied the ICNIRP 2020 guidelines. A 60 second averaging time for measurements was sufficient, unless in cases where there was a significant variation in exposure from the results at a specific site that required measurement across the 30-minute interval.

4.4.7. The assessments (measurement and calculation) parameters considered for this survey are indicated in Table 1 below.

Table 1: Measurement Parameters

Location	**Signal strength (dBm)**	**Frequency F (MHz)**	**Power density S (W/m^2)**	**ICNIRP max Value**	**Summation of ICNIRP max at each selected location for all frequency bands considered**
District, site name/GPS location as per sample selection given (indicate whether single, shared or collocated).	*Highest signal strength read off at each selected location at a site for frequency bands considered.*	*Frequencies recorded.*	*Power density recorded for each frequency recorded.*	*Calculation for each measurement received.*	*Summation of ICNIRP max value at each selected location at a given site*

4.5. Public interviews

4.5.1. Face to face interviews were conducted with members of the public found settled in neighbouring areas to the selected base station sites, using an open-ended questionnaire. The interviews were conducted to evaluate the magnitude of the public uncertainty and concern regarding living in proximity to the base station sites.

4.5.2. Selection of the respondents was random, alternating between gender (Male and Female). At most three persons were interviewed around each selected site.

4.5.3. Data was collected using the Personal Data Assistant (PDA).

5. RESULTS AND DISCUSSION

5.1. Findings from measurements and calculations

5.1.1. Measurements were conducted at 360 sites, including: single[3], shared[4] or collocated[5] sites. Figure 1 shows a visual representation of selected sites on Google Earth Pro.

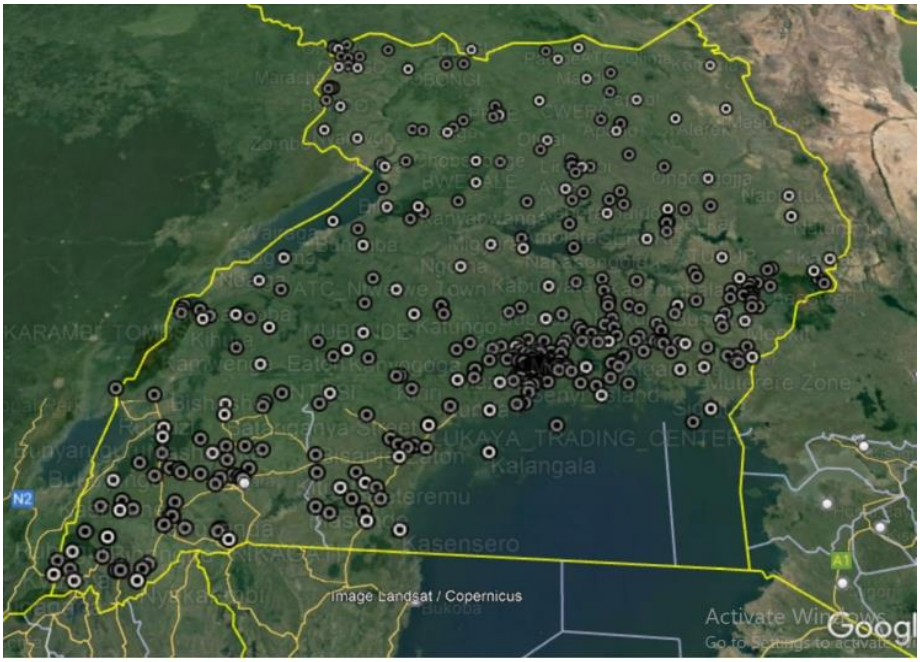

Figure 1: Visual representation of selected sites on Google Earth Pro

5.1.2. Click here to access the results

5.1.3. Figure 2 shows the mean ICNIRP maximum values (%) across the regions where measurements were taken. The results showed that at all sites where measurements were conducted, the public reference levels defined under the ICNIRP guidelines were a very small percentage.

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[3] In this survey: a site with only one base station.

4 In this survey: a site with two or more base station sharing passive infrastructure like mast or rooftop.

5 In this survey: a site at which two or more base stations are on same ground [including roof tops] within in a distance 0 – 70m.

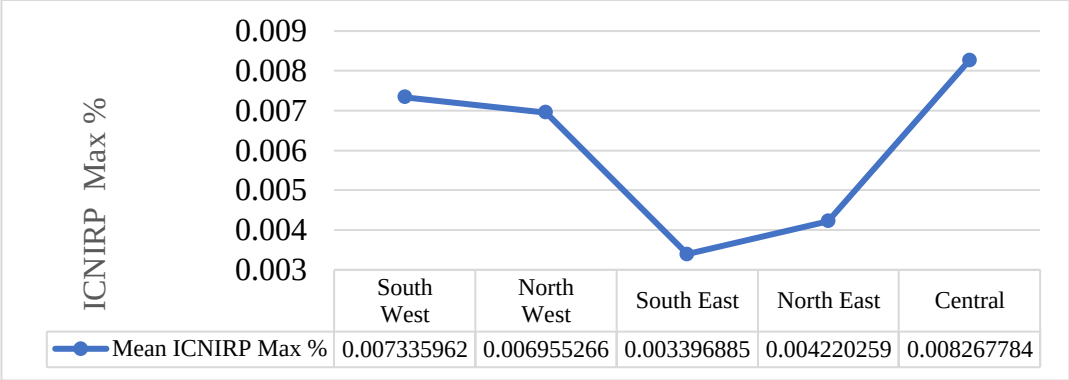

Figure 2: Mean ICNIRP max values across regions

5.1.4. It can be seen in Figure 2 that the highest mean value for the ICNIRP maximum value (%) was 0.008%, which is a very small fraction from the public reference level of the ICNIRP guidelines (i.e., 100%).

5.1.5. Notably, the results suggest that there was generally a negligible variation in terms of exposure throughout various environments selected for the assessment. Whereas the results of the collocated sites display a slightly higher decimal than for the single and shared sites as shown in figure 3, there is still no appreciable difference between the results from the single, shared, and collocated sites.

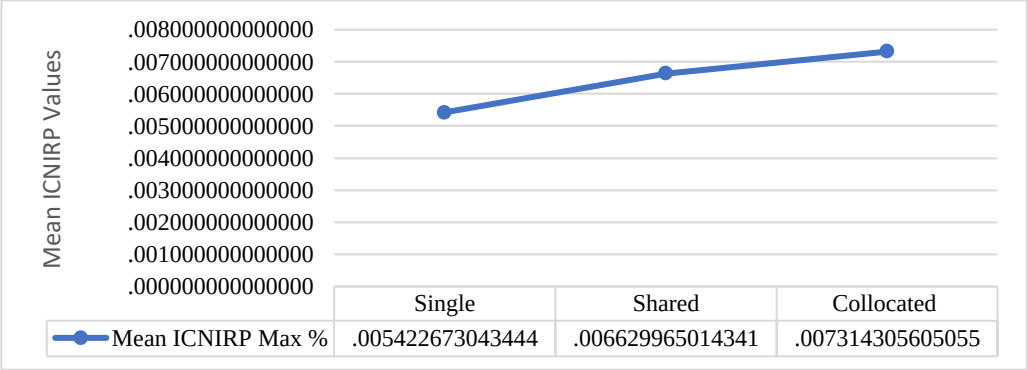

Figure 3: Mean ICNIRP Max% for single, shared, and collocated sites

5.1.6. These results can thus suggest that the emissions from the sites are within the acceptable limits of the public reference level under the ICNIRP guidelines.

5.2. Findings from the public interviews

5.2.1. The level of uncertainty for persons living near the base station sites was assessed through public interviews. **Click here to access the full report** However, key highlights of the results of the public interviews revealed the following:

a) About seven (7) in every ten (10) respondents (71.3%) were aware of the network service and infrastructure provider in their community. This is because some members were sensitized and involved prior to the deployment of the base stations, while others were motivated by network improvements, and recognizing the branded vehicles during site construction.
b) Approximately eight (8) in every ten (10) respondents (80.3%) knew why base station sites are deployed near human settlements.
c) Approximately six (6) in every ten (10) respondents (63.3%) were unaware of any community sensitization and consultation prior to site development.
d) Similarly, nearly six (6) in every ten (10) respondents had no substantial concerns or worry about the deployment of base station sites near human settlements.
e) Four (4) out of ten (10) respondents (40%) expressed concern and worry about the deployment of base station sites near human settlements. These concerns included, among others: noise from the generator, poor network connections, health risks such as cancer related illness, male infertility and headaches, devaluation of land, lack of privacy, and limited community consultations and awareness regarding the risks.

5.2.2. Additionally, the analysis demonstrated that a person's level of education had little or no bearing on their uncertainty regarding the presence of base station sites in their proximity.

6. CONCLUSION

6.1. Conducting EMF assessments around base station sites in the country is important for regulatory compliance purposes, as well as to build public confidence in the use of ICT services.

6.2. The technical assessment results show the highest measurement levels are way below the public reference level of the ICNIRP guidelines. This would suggest that:

a) The base stations where assessments were conducted are safe for the public and not likely to pose any harm.
b) From analysis, the results are indicative that the base station sites are compliant.

6.3. The results from the public interviews conducted to evaluate public concerns around base station sites inform on the need for adequate awareness and sensitization to create confidence among the communities.