



**DRAFT FRAMEWORK FOR ASSESSMENT OF EXPOSURE TO RADIO FREQUENCY
ELECTROMAGNETIC FIELDS(RF-EMF)**

2024

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Terms and Definitions

Quality of Service	The performance of a system/solution as compared to the set performance metrics
Quality of Experience	The subjective satisfaction and overall user perception when utilising a system or service
Electromagnetic Fields	The energy dissipated into the environment by radio frequency equipment, natural phenomenon like the sun, and human activities that use electricity
Radio Frequency	Electromagnetic signals characterised by alternating currents within the range of 3 kHz to 300 GHz, typically used in various communication and wireless technologies
Know Your Customer	Activities undertaken by organisations to verify and validate the identify of their clients
Electric Field Strength	The magnitude of the electric field at a specific point in space, measured in volts per meter (V/m)
Magnetic Field Strength	The magnitude of a magnetic field , in form of force exerted by magnetic fields on materials or charged particles measured in amperes per meter (A/m)
Power Density	The amount of electromagnetic energy transmitted through a specific area, measured in watts per square meter (W/m ²).
Specific Absorption Rate (SAR)	The rate at which RF energy is absorbed by the human body when exposed to an RF electromagnetic field, measured in watts per kilogram (W/kg)

Abbreviations and Acronyms

CA	Communications Authority of Kenya
COSMOS	Cohort Study of Mobile Phone Use and Health
EMF	Electromagnetic Fields
KHZ, MHZ, GHZ	Kilohertz, Megahertz, Gigahertz
IARC	International Agency for Research on Cancer
ICNIRP	International Commission on Non-Ionizing Radiation Protection
ICT	Information and Communications Technology
KYC	Know Your Customer
KHz	Kilo Hertz
QoS	Quality of Service
QoE	Quality of Experience
RF	Radio Frequency
SAR	Specific Absorption Rate
WHO	World Health Organisation

1. Introduction

The Communications Authority of Kenya (CA) is the regulatory authority for the communications sector in Kenya. Established in 1999 by the Kenya Information and Communications Act, 1998, the Authority is responsible for facilitating the development of the information and communications sectors including; broadcasting, cybersecurity, multimedia, telecommunications, electronic commerce, postal and courier services.

The Authority is also responsible for protecting consumers of Information and Communications Technology (ICT) in so far as their Safety, Health, Quality of Service (QoS) and Quality of Experience (QoE) is concerned.

The consumer protection functionality is achieved through tariff regulation, Type Approval of ICT equipment, monitoring QoS/QoE of voice and data services, monitoring frequency use and interference, inspection of ICT equipment installation and ensuring proper Know Your Customer (KYC) measures are implemented.

The Authority has developed various regulations, guidelines and code of practice that helps in realisation of the consumer protection functionality.

2. Background

In line with its mandate, of licensing and regulating of postal and information and communication services ,as per section 5 of KICA, Authority licenses ICT service providers who deploy transmitters that generate Electromagnetic Field (EMF) radiation in the radio frequency spectrum. The emitted RF-EMF radiation has to be kept within internationally agreed limits to avoid possible harmful effects on living organism.

At the international level , there are concerted efforts geared towards research on the effects of RF-EMF on the human health . These organisations include the the World Health Organisation (WHO), whose charter includes protection of public health , and as such in response to public concern over health effects of EMF exposure, established the International EMF Project in 1996 to assess the scientific evidence of possible health effects of EMF in the frequency range from 0 to 300 GHz.

The efforts to seek for scientific evidence on the effects of RF-EMF on the human health by the WHO were also informed by classification of radiofrequency electromagnetic fields as possibly carcinogenic to humans, by the International Agency for Research on Cancer (IARC) , a specialised cancer agency of the WHO. This classification was evidenced on increased risk for glioma, a malignant type of brain cancer, associated with wireless phone use.

However recent results of the Cohort Study of Mobile Phone Use and Health (COSMOS) project, from IARC, which investigates the potential long-term health effects related to the use of wireless communication technologies, indicates people with more hours of mobile phone calls do not have a higher risk of developing a brain tumour compared with light users of mobile phones.

There also exists the International Commission on Non-Ionizing Radiation Protection (ICNIRP) a non-profit organization with a scientific mission, which involves development and dissemination of science-based advice on limiting exposure to non-ionizing radiation. It assess the risk of NIR exposure and provide exposure guidance formulated in form of Guidelines, Reviews and Statements.

The International Telecommunications Union (ITU), the United Nations specialized agency for information and communication technologies (ICTs), makes recommendations on various facets of the ICT sector, including EMF matters.

The three entities, ITU, WHO and ICNIRP collaborate on matters RF-EMF, and have set various limits to which human beings can be exposed to RF-EMF emissions, without adverse effects.

With the Authority being a member of the ITU, it has therefore recognised and domesticated various telecommunication standards developed at the ITU.

This RF-EMF framework is therefore geared towards adoption and domestication of International RF-EMF standard and guidelines as developed by the WHO, ICNIRP and the ITU.

3. Objective

This assessment of exposure to RF-EMF framework aims to:

- a) Specify maximum levels of exposure to RF-ElectroMagnetic Fields
- b) Provide general procedures for limiting the exposure of the general public and personnel working in the vicinity of RF and microwave devices to specified levels.
- c) Provide a reporting template for assessment of exposure to RF-EMF

The framework is applicable :

- a) Wherever the general public (including persons of any age or health status) may be exposed to RF fields and whenever employees may be exposed in the course of their work.
- b) To continuous and discontinuous RF electromagnetic fields exposure at single or multiple frequencies within the range 100 kHz to 300 GHz.
- c) To situations where RF fields are produced, either deliberately or incidentally, by the operation of equipment or devices. It is the responsibility of the manufacturer/supplier, installer, employer/service provider and user to ensure that all devices and installations are operated in such a way as to achieve compliance with the requirements of this Framework.

4. RF-EMF Exposure Assessment Principles

This Framework is anchored on the following foundational guidelines

- a) Health of both the public and occupational workers at or near ICT installations.
- b) Safety of both the public and occupational workers at or near ICT installations
- c) Maintaining the QoS and QoE from ICT systems

5. Sources of EMF

There exists two type of Electromagnetic Fields (EMFs) Emissions, namely Ionizing and Non Ionizing radiations. The Ionizing radiations are emmited by frequencies that have enough power to change the sub-atomic composition of other atoms they come in contact with . The Non Ionizing radiations are from frequencies with low power and therefore do not have sufficient energy to change the sub-atomic composition of other atoms they come in contact with.

The sources of Non ionizing radiation include radiofrequency waves used in telecommunication services, microwaves used in home kitchen appliances , infrared used in home infotainment devices and visible light from the sun.

Ionizing radiations emanates from radioactive activities like nuclear energy generation, and other activities , like nuclear decay that generate alpha and beta particles , as well as from gamma and x-rays used in medical equipment.

This framework focus on the RF-EMF radiations , which are Non-ionizing radiations. A summary of EMF sources is depicted in figure 1.

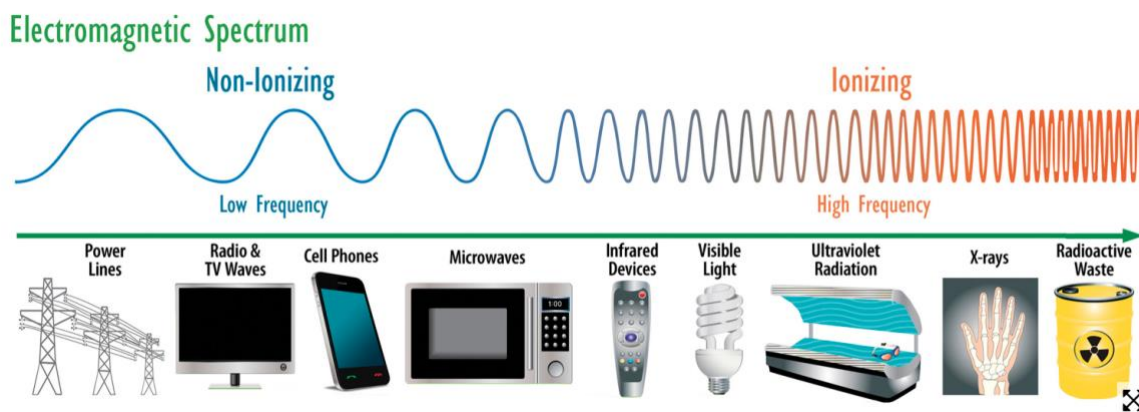


Figure 1: Sources of EMF

The entire range of the Electromagnetic Spectrum , which consists of ionizing and non-ionizing radiation is depicted in figure 2.

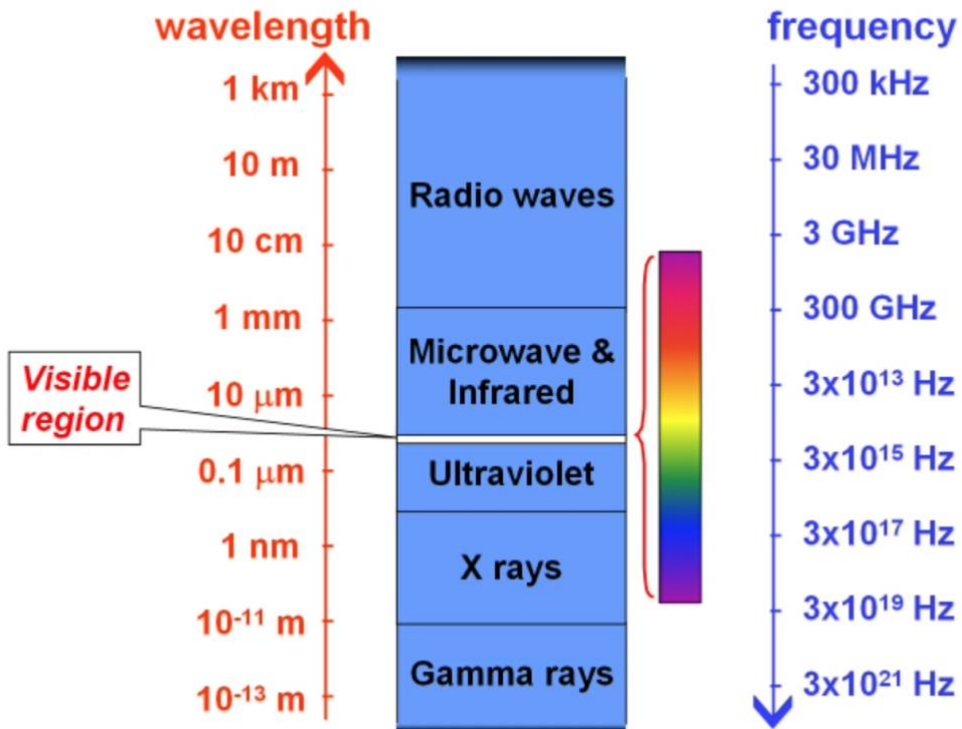


Figure 2: The Electromagnetic Spectrum Range

The EMF radiations normally move from their source to potential target equipment and non-targeted equipment, and are affected by the environment in which they propagate as shown in figure 3.

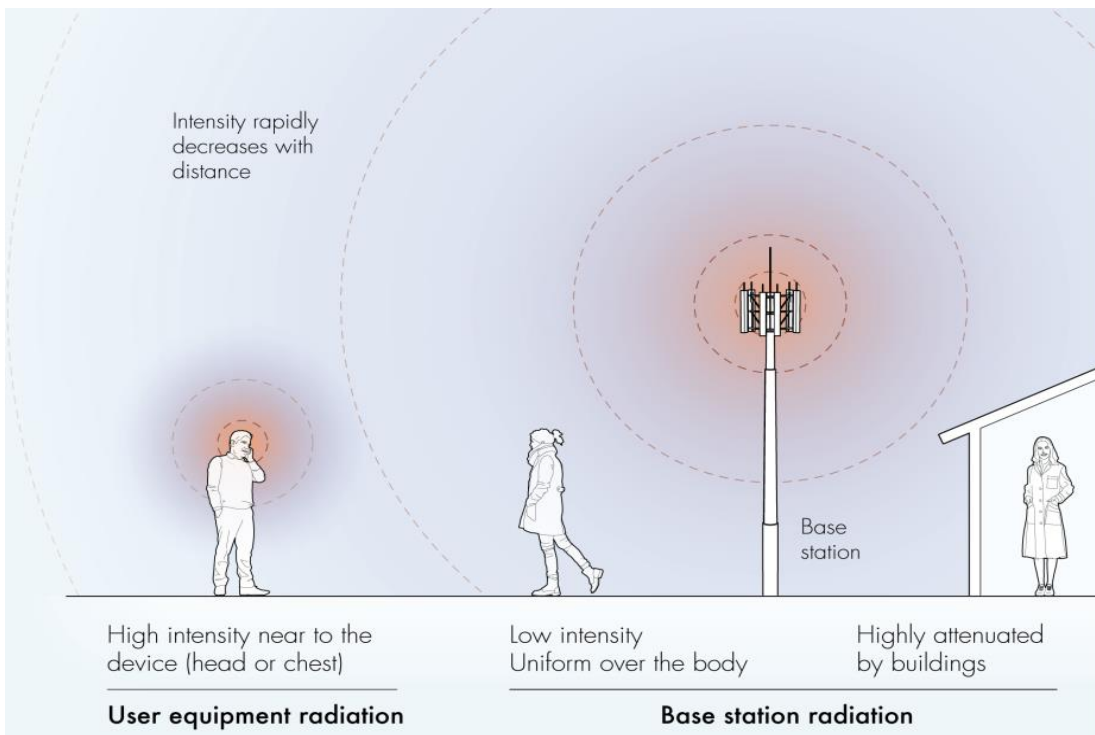


Figure 3 : Flow of EMF Radiations

6. Assessment of RF-EMF from ICT Installations

RF-EMF assessments can be done using two techniques, namely, calculation or measurement. ICT service providers will be required to assess EMF exposure levels from their ICT installations and provide three forms of assessments results.

The Baseline results, which are results before installation of ICT equipment, Projected EMF results based on the proposed installations, and annual audit of the EMF exposures of at least half of their ICT installations at random sites, provided subsequent audits covers sites not audited in the immediately preceding year.

Measurements will be recorded in Electric Field Strength (V/m), Magnetic Field Strength (A/m) and Power Density (W/m²) and Specific Absorption Rate (SAR) (W/kg). The EMF measurement shall be provided alongside site parameters such as antenna height, frequency and transmit power.

Assessment of site compliance with the RF-EMF limits shall be based on methods provided in international technical standards produced by the International Electrotechnical Commission (IEC) and the International Telecommunications Union (ITU).

The EMF measurement shall:

- a) use the best estimates of the 3D antenna pattern gain,
- b) take into account the different positions, tilt angles and directions;
- c) use reduction factors to account for attenuation of the RF-EMF through walls or windows to estimate RF-EMF levels inside buildings from external antennas,
- d) Use the best estimates of system losses (i.e. feeder, combiner, connector and antenna losses)
- e) Avoid the use of Enhancement factors for ground reflections in areas that are not close to the ground, like elevated antennas on free standing masts
- f) Use appropriate near field calculation methods to obtain accurate antenna far-field beam pattern, and the far-field gain close to an antenna

Service provider declaration of EMF compliance shall be based on actual maximum parameters, in line with the actual maximum transmitted power or EIRP approach to RF-EMF compliance as specified in IEC 62232, including:

- a) Declaring compliance using the actual maximum power or EIRP (time-averaged value) threshold configured on the site.
- b) Verifying that the actual maximum threshold is not exceeded during operation using monitoring counters and control features.
- c) Ensuring that counters and control features are validated using the methods specified in IEC 62232.
- d) Compliance and Enforcement of EMF Exposure Assessment

The Authority shall periodically, and in an adhoc basis, verify the reported EMF exposure measurement from audits done by service providers. Service providers found to be having sites whose EMF exposure exceeds the set levels shall as a first measure be notified to correct the exposure levels, after which continued violations will be dealt with in line with the Kenya Information and Communications Act, 1998.

The reporting template to be used by service providers shall be as shown in Form 1.

Measurement of Electromagnetic Fields Exposure

Service Provider /Site Owner				
Date of Measurement				
Site Name				
Site location (county, Sub-County, Town /Village)				
Site Coordinates				
Site Frequency				
Site Service (Broadcasting/Telecommunication /PMR)				
	Power Density	Electric Field	Magnetic Field	SAR
Measurements Values				
ICNIRP Limits				
Compliance Status (Complied/Not Complied)				

Form 1: EMF Exposure Measurement Template

This form shall be annexed to the quarterly returns form, but shall be filled annually by service providers for all new sites in the reporting financial year.

7. RF-EMF Safety Limits

Based on the International Commission for Non-Ionizing Radiation Protection (ICNIRP) 2020 guidelines, and the International Telecommunications Union (ITU) ITU-T Recommendations K.91, K.52, K.61, K.70 and K.83, this framework sets the RF-EMF safety limits for Electric Field, Magnetic Field and Power Density as in figure 4.

Exposure scenario	Frequency range	Incident E-field strength; E_{inc} ($V m^{-1}$)	Incident H-field strength; H_{inc} ($A m^{-1}$)	Incident power density; S_{inc} ($W m^{-2}$)
Occupational	0.1 – 30 MHz	$660/f_M^{0.7}$	$4.9/f_M$	NA
	>30 – 400 MHz	61	0.16	10
	>400 – 2000 MHz	$3f_M^{0.5}$	$0.008f_M^{0.5}$	$f_M/40$
	>2 – 300 GHz	NA	NA	50
General public	0.1 – 30 MHz	$300/f_M^{0.7}$	$2.2/f_M$	NA
	>30 – 400 MHz	27.7	0.073	2
	>400 – 2000 MHz	$1.375f_M^{0.5}$	$0.0037f_M^{0.5}$	$f_M/200$
	>2 – 300 GHz	NA	NA	10

^aNote:

1. “NA” signifies “not applicable” and does not need to be taken into account when determining compliance.
2. f_M is frequency in MHz.
3. S_{inc} , E_{inc} , and H_{inc} are to be averaged over 30 min, over the whole-body space. Temporal and spatial averaging of each of E_{inc} and H_{inc} must be conducted by averaging over the relevant square values (see eqn 8 in Appendix A for details).
4. For frequencies of 100 kHz to 30 MHz, regardless of the far-field/near-field zone distinctions, compliance is demonstrated if neither E_{inc} or H_{inc} exceeds the above reference level values.
5. For frequencies of >30 MHz to 2 GHz: (a) within the far-field zone: compliance is demonstrated if either S_{inc} , E_{inc} or H_{inc} , does not exceed the above reference level values (only one is required); S_{eq} may be substituted for S_{inc} ; (b) within the radiative near-field zone, compliance is demonstrated if either S_{inc} , or both E_{inc} and H_{inc} , does not exceed the above reference level values; and (c) within the reactive near-field zone: compliance is demonstrated if both E_{inc} and H_{inc} do not exceed the above reference level values; S_{inc} cannot be used to demonstrate compliance, and so basic restrictions must be assessed.
6. For frequencies of >2 GHz to 300 GHz: (a) within the far-field zone: compliance is demonstrated if S_{inc} does not exceed the above reference level values; S_{eq} may be substituted for S_{inc} ; (b) within the radiative near-field zone, compliance is demonstrated if S_{inc} does not exceed the above reference level values; and (c) within the reactive near-field zone, reference levels cannot be used to determine compliance, and so basic restrictions must be assessed.

Figure 4: EMF Exposure limit for Electric Field, Magnetic Field and Power Density

Exposure limits for specific Absorption Rate (SAR) are as shown in Figure 5.

Exposure scenario	Frequency range	Whole-body average SAR ($W kg^{-1}$)	Local Head/Torso SAR ($W kg^{-1}$)	Local Limb SAR ($W kg^{-1}$)	Local S_{ab} ($W m^{-2}$)
Occupational	100 kHz to 6 GHz	0.4	10	20	NA
	>6 to 300 GHz	0.4	NA	NA	100
General public	100 kHz to 6 GHz	0.08	2	4	NA
	>6 to 300 GHz	0.08	NA	NA	20

^aNote:

1. “NA” signifies “not applicable” and does not need to be taken into account when determining compliance.
2. Whole-body average SAR is to be averaged over 30 min.
3. Local SAR and S_{ab} exposures are to be averaged over 6 min.
4. Local SAR is to be averaged over a 10-g cubic mass.
5. Local S_{ab} is to be averaged over a square 4-cm² surface area of the body. Above 30 GHz, an additional constraint is imposed, such that exposure averaged over a square 1-cm² surface area of the body is restricted to two times that of the 4-cm² restriction.

Figure 5: SAR EMF Safety Limits

8. Access Controls to RF-EMF Sites




Sites with EMF emissions considered as occupational exposures shall have necessary pre-access controls that will include:

- a) Supervised access,
- b) EMF awareness briefings,
- c) Signs
- d) Barriers

9. Signage for RF-EMF Sites

The design of broadcast transmission sites and mobile network base station sites should prevent the public from straying into regions designed as exclusion zones. Recommended signage shall be as detailed in table 3.

Table 1: Recommended RF-EMF Sites Signage

HAZARD LEVEL	SIGN	DESCRIPTION	placement
CAUTION		<ul style="list-style-type: none"> • Area of Unrestricted Occupancy • Minor Injury Possible from Misuse 	On the Fence, Gate or Rooftop access to the RF equipment typically 20 – 35 metres
WARNING		<ul style="list-style-type: none"> • Area of Restricted Occupancy (Authorised Personnel Only) • Serious Injury Possible from Misuse 	At the base of the tower or Roof Top mast with RF Equipment, typically 10 – 20 metres.
DANGER		<ul style="list-style-type: none"> • Area of Denied Occupancy • Critical Injury Possible 	At the edge of compliance zones of an RF equipment, typically 1- 5 metres Transmitting equipment must be powered off prior to access.

10. Employee Exposure to RF- EMF

Where employees are liable to be exposed to EMFs at work, the employer is required to carry out a risk assessment, which will be carried out by a competent person and shall include measuring or calculating the levels of EMFs. This exposure assessment shall take into consideration the frequency, level, duration and type of exposure.

Possible situations that may necessitate this assessment include location of an office or work facility in close proximity of ten (10) metres from a mast with more than 3 antennas, and employers with employees who wear active or passive implanted medical devices, employees with medical devices worn on the body.