TANZANIA COMMUNICATIONS REGULATORY AUTHORITY

RADIO FREQUENCY BAND PLAN FOR AMATEUR SERVICES

First Version

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RADIO FREQUENCY BAND PLAN FOR AMATEUR SERVICES

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Acronyms and Abbreviations

For the purpose of this document, the following abbreviation applies: -

ITU	International Telecommunication Union
IARU	International Amateur Radio Union
HAZMAT	Hazardous Materials
NVIS	Near-Vertical-Incidence Sky-Wave
OSCAR	Orbiting Satellite Carrying Amateur Radio
AMSAT	Amateur Satellite
VHF	Very High Frequency
HF	High Frequency
MF	Medium Frequency
EME	Earth-Moon-Earth

PART 1: Introduction

The Tanzania Communications Regulatory Authority (TCRA) Act of 2003, and Electronic and Postal Communications Act of 2010, mandate TCRA to manage, assign and promote the efficient use of the radio frequency spectrum resource in the United Republic of Tanzania.

The radio frequency spectrum is part of electromagnetic waves propagated in space and used as a communication medium for all wireless systems. The radio frequency spectrum is scarce public resource and thus subject to transparent, predictable and coherent governing policies, legislations and regulations. It requires proper and timely management in order to accommodate the current and future emerging technologies.

Radio frequency spectrum supports a wide range of services including amateur services, amateur satellite services, mobile broadband, radio and television broadcasting, satellite communication, mobile phones, Wi-Fi, air travel, maritime communications, defense, emergency services and multiple applications such as two-way radio. These services that use radio communications underlie many aspects of our lives therefore how spectrum is managed and made available for use is of critical importance.

The radio frequency band plan for Amateur Services and Amateur Satellite Services is in line with the frequency allocation under International Telecommunication Union (ITU) region 1.

The amateur radio service (*amateur service* and *amateur-satellite service*) is established by the International Telecommunication Union (ITU) through the International Telecommunication Regulations. National regulatory bodies regulate technical and operational characteristics of transmissions and issue individual stations licenses with an identifying call sign. Prospective amateur operators are tested for their understanding of key concepts in electronics and the host government's radio regulations. Radio amateurs use a variety of communication modes such as voice and text, and have access to radio frequency spectrum to enable communication across a city, region, country, continent, the world, or even into space.

Article 1.56 of ITU Radio Regulations, defines the **amateur service** as *"A radiocommunication service for the purpose of self-training, intercommunication and technical investigations carried out by amateurs, that is, by duly authorized persons interested in radio technique solely with a personal aim and without pecuniary interest".* The ITU Radio Regulations. Article 1.57, defines the **amateur-satellite service** as: *"A radiocommunication service using space stations on earth satellites for the same purposes as those of the amateur service"*.

Radio amateurs have made significant technical contributions to the field of radio propagation, HF single-sideband radio, HF data communication systems, digital radio protocols and communications-satellite design. Amateur radio continues to play an important role in disaster communications. It has a unique ability to provide radiocommunication independent of the telephone network or other radio services, particularly in the first few days before relief agencies are at the scene and have set up emergency telecommunication services.

The amateur services include self-training as an important purpose. This includes training of young people in radiocommunications. Radio amateurs have the opportunity of planning, designing, building, operating and maintaining a complete radio station, which contributes to the telecommunication human resources development of a country.

Amateur Radio provides important societal, educational, and emergency communication services to the community. Modern networked communication systems are delicate and interdependent, and often fail during natural disasters. Traditionally, trained Amateur Radio operators have provided communication support to government and relief agencies in times of national disaster. This has been recognized by many governments who now include Amateur Radio operators in formal disaster drills.

Amateur Radio has tremendous educational value for science and technology students. The Amateur Radio communities in some developed countries have an active schools program where school students have been able to build satellites, learn modern software coding techniques, and even talk directly by radio with astronauts on the International Space Station.

Like most high technology areas these days Amateur Radio operations, equipment, and software is developed and carried out by a global community. If the United Republic of

Tanzania is to benefit from all the opportunities Amateur Radio has to offer, then spectrum allocation and technical standards need to be harmonized with global standards.

The International Amateur Radio Union (IARU) is the Federation of the national amateur radio associations existing in most countries. It represents the amateur and amateur-satellite services in the ITU and regional telecommunications organizations, and is a Sector Member of the ITU Radiocommunication and Telecommunication Development Sectors.

PART 2: Scope and Purpose

This document details the Radio Frequency Bands allocated for Amateur Services and Amateur Satellite Services. It explains the importance of amateur radiocommunication services during natural disasters and other catastrophic events when normal communications are temporarily interrupted or inadequate for the needs of human relief operations. It also explains the Amateur networks available for emergency telecommunications, It further elaborates the Amateur Earth Station and Experimentations in the Amateur-Satellite Services.

PART 3: Recommendations related to Amateur services and Amateur Satellite Services

RECOMMENDATIONS	TITLE
Recommendation ITU-R M.1041	Future Amateur Radio Systems
Recommendation ITU-R M.1042	Disaster Communications in the amateur and amateur satellite systems
Recommendation ITU-R M.1043	Use of Amateur and Amateur Satellite Services in developing countries
Recommendation ITU-R M.1044	Frequency Sharing Criteria in the Amateur and Amateur Satellite Services
Recommendation ITU-R M.2164	Guidance on technical and operational measures for the use of the frequency band 1 240-1 300 MHz by the amateur and amateur-satellite service in order to protect the radio navigation-satellite service (space-to-Earth)

PART 4: Amateur Services

The Amateur Radio Service is a radio communication service in which radio apparatus is used for the purpose of self-training, intercommunication of technical investigation by individuals who are interested in radio techniques solely with a personal motive, without money- or profit-making interest. It is therefore a non- profit service. Enthusiasts who constantly perpetuate this service are called **Radio Amateur.**

Amateur radio, is a hobby engaged in by millions throughout the world. Hence, it is a global fraternity of people with common, yet widely varying interests, able to exchange ideas and learn more about each other.

An important point to note is that the Amateur radio service is a direct radio to radio communication, which means there is no need to go through a network provider in order to contact another Radio Amateur.

4.1 Societal benefits of Amateur Services

The following are the societal benefits of Amateur Services that are formally recognized by International Telecommunication Union (ITU):

(i) Amateur services provide communications during natural disasters and other catastrophic events when normal communications are temporarily interrupted or inadequate for the needs of human relief operations.

(ii) In times of disasters, if most terrestrial-based networks are destroyed or impaired, other networks in the amateur and amateur-satellite services may be available to provide basic, on site communications capability.

(iii) Important attributes of the amateur services include stations distributed throughout the world which have trained radio operators capable of reconfiguring networks to meet the specific needs of an emergency

(iv) The amateur services have pioneered new and novel techniques for radio reception and transmission using inexpensive equipment with relatively small antennas.

(v) Amateur services contribute to the training of operators and technical personnel, which is of particular benefit to developing countries.

4.2 Role of the amateur service in emergency telecommunications

Its wide scope of activities and the skills of amateur radio operators make the amateur service a valuable asset in emergency telecommunications. It has a large number of operational amateur stations in almost all countries of the world, providing a robust network independent from any other. In many cases, it has provided the first, and sometimes the only, link outside the area affected by disaster. The amateur service has training programmes and emergency simulation exercises developed by some of the national amateur radio societies.

Typical situations for which the amateur service can supplement emergency communications include:

(i) *Initial emergency alerts* may originate from individual amateur stations to bring an incident to the attention of competent institutional emergency services.

(ii) In *search and rescue* operations, amateur stations can reinforce the professional teams by increasing their communication capabilities and reporting observations.

(iii) *Hospitals* and similar establishments might in the aftermath of a disaster be without communications. Local amateur radio emergency groups prepare in advance for such assistance.

(iv) *Hazardous materials (HAZMAT)* and other incidents may require the evacuation of residents, and coordination between the disaster site and the evacuation sites or shelters. Amateur emergency stations may be asked to establish communications with such institutions.

4.3 Amateur networks available for emergency telecommunications

(i) Short-range networks

Amateur short-range networks provide operational or tactical communications at the site of a disaster and with the surrounding areas. They can include fixed, mobile and nomadic equipment typically using frequencies in the bands 50-54 MHz, 144-148 MHz and 420-450 MHz, noting that there are regional and national differences in these frequency ranges.

Repeater stations are used to extend the communication range of VHF and UHF stations. Positioned in elevated locations, they allow communication between fixed or mobile amateur stations separated by obstructions such as mountains or tall buildings when operating in an urban environment. A repeater station receives on one channel and transmits on a different frequency, usually within the same frequency band.

(ii) Medium-range networks

Amateur medium-range networks typically provide communication from the disaster site to organizational and administrative centres outside an affected area, or to headquarters of response providers in neighbouring countries. They also ensure communication with vehicles, vessels and aircraft operating outside the coverage of available VHF or UHF networks. Communication at medium distances of up to 500 km may be accomplished by near-vertical-incidence sky-wave (NVIS) propagation at lower MF/HF in bands 1 800-2 000 kHz, 3 500-4 000 kHz and 7 000-7 300 kHz, noting that there are regional and national differences in these bands. In addition, several national administrations have designated specific frequencies (channels) for amateur radio emergency traffic and related training.

(iii)Long-range networks

Amateur long-range networks provide communication with headquarters of international emergency and disaster response providers. They serve as backup connections between offices of such institutions in different countries or on different continents. Amateur stations routinely communicate over long distances typically beyond 500 km, using oblique-incidence sky-wave propagation in bands from 3 500 kHz through 29.7 MHz.

4.4 Amateur Authorization

The Amateur Authorizations are issued in the following category:

(i) Amateur Radio Station

The Amateur Radio Station Authorization allows operation in all Amateur bands stipulated in part 6. Class A Amateur is also authorized to operate Beacons and Repeaters and to be a responsible person to supervise activities of Club Stations or training for novices or students.

(ii) Amateur Experimental

The Amateur Experimental Authorization allows operations in all Amateur bands with powers as given in part 6. The Amateur Experimental Authorization is limited to be granted to Amateur Societies, Club Stations, university or college facilities established for Amateur use.

(iii) Amateur Novice Station

The Amateur Novice Station Authorization allows only operation in VHF band 144 – 146 MHz. A person with Amateur Novice Station Authorization is not allowed to operate Beacons and Repeaters and / or to supervise activities of Club Stations or training for novices or students.

Amateur Satellite Service is one category of Amateur Authorization and allowed within the Amateur Satellite bands as given in part 7.3.

PART 5: Amateur Services Radio Frequency Band Plan

The following table describes the radio frequency bands available for the amateur service.

Frequency Band	Wavelength	Amateur Service Status in Tanzania	Maximum Power (EIRP) Transmission Allowed in Watts	Applications
MEDIUM FREQUENCY (MF)				
135.7 – 137.8 KHz	2206 m	Secondary	1	Propagation in this band permits short-range communications during daytime hours and longer range communications via ionospheric refraction at night, when D layer absorption weakens. Power output is limited to 1 W e.i.r.p. which is sufficient for transcontinental and transoceanic transmissions at night.
472- 479 KHz	630 m	Secondary	1	Propagation in this band permits short-range communications during daytime hours and longer range communications via ionospheric refraction at night, when D layer absorption weakens. Power output is limited either 1 W or 5 W e.i.r.p.,

Frequency Band	Wavelength	Amateur Service Status in Tanzania	Maximum Power (EIRP) Transmission Allowed in Watts	Applications
				depending stations location (see RR Nos. 5.80A and 5.80B)
1810 - 1850 KHz	160 m	PRIMARY	400	Its propagation characteristics allow short-range communications during daytime hours, and medium and long-range communications during night-time hours. This band is particularly useful during sunspot minima, when the maximum usable frequency (MUF) is below 3 500 kHz.
HIGH FREQUENCY (HF)				
3500 - 3800 KHz	80 m	PRIMARY	400	This band is used for contacts over distances of up to 500 km during the day, and for distances of 2 000 km and more at night. It is heavily used during communications emergencies.
7000 - 7100 KHz	40 m	PRIMARY	400	The 7 MHz band is heavily used 24 hours each day. During daylight hours, the band carries the bulk of amateur sky wave communication over distances of less than 1 300 km.
7100 - 7200 KHz	40 m	PRIMARY	400	
10100 - 10150 KHz	30 m	Secondary	400	This band is in use 24 hours each day, as a bridge between the 7 MHz and 14 MHz bands.
14000 - 14350 KHz	20 m	PRIMARY	400	This is the most popular band for international communications.

Frequency Band	Wavelength	Amateur Service Status in Tanzania	Maximum Power (EIRP) Transmission Allowed in Watts	Applications
18068 - 18168 KHz	18 m	PRIMARY	400	The band is used as an alternative to 14 MHz which is often congested with traffic.
21000 - 21450 KHz	15 m	PRIMARY	400	These bands are used particularly during the daytime and when sunspot activity is high.
24890 - 24990 KHz	12 m	PRIMARY	400	This band is used particularly during the daytime and when sunspot activity is high.
28000 - 28800 KHz	10 m	PRIMARY	400	
29000 - 29700 KHz	10 m	PRIMARY	400	
VERY HIGH FREQUENCY (VHF)				
50 - 54 MHz	6 m	Secondary	120	This band is used for local communication at all times including via repeaters. Use of this band may also include telecommand of objects such as models by radio amateurs. The band may also be used on occasion for communication for distances up to 2 000 km by sky wave, tropospheric scatter, earth-moon-earth (EME), sporadic reflection from the E layer of the ionosphere (Es) and scattering by the ionized trails of meteors (MS).
144 - 146 MHz	2 m	PRIMARY	400	This band is heavily used throughout the world for

Frequency Band	Wavelength	Amateur Service Status in Tanzania	Maximum Power (EIRP) Transmission Allowed in Watts	Applications
				short-range communications, including the use of repeaters. This band is actively used for Earth-Moon-Earth (EME) communications using analogy and digital modulation techniques, for different types of radio waves propagation – tropospheric scattering and super refraction (TROPO), scattering by irregularities in the lower ionosphere (FAI), scattering by the ionized trails of meteors (MS) as well as ionospheric scattering in the circumpolar regions during polar storms (AURORA) making it possible to contact, using analogy and digital modulation techniques, over distances of up to 2 000-3 000 km. This band is actively used for local communications in times of disasters. It is also used for contacts with the use of repeaters on board amateur satellites.
ULTRA HIGH FREQUENCY(VHF)				
430 - 440 MHz	70 cm	PRIMARY	400	This band is used for short-range communications including repeaters and amateur analogue and

Frequency Band	Wavelength	Amateur Service Status in Tanzania	Maximum Power (EIRP) Transmission Allowed in Watts	Applications
				digital television. It is also used for Earth- Moon-Earth (EME) communications using analogue and digital modulation techniques. Tropospheric scattering and super refraction (TROPO) makes it possible to contact over distances of up to 1 000 km. It is also used for contacts with the repeaters on board amateur satellites.
1240 - 1300 MHz	23 cm	Secondary	120	This band is used for communications using analog and digital modulation techniques, as well as for digital television and repeater networks. Tropospheric scattering and super refraction (TROPO) makes it possible to contact over distances of over 1 000 km. This band is the most popular for Earth-Moon-Earth (EME) communications using analog and digital modulation techniques. Also, this band is used for contacts on board amateur satellites.
2300 - 2450 MHz	13 cm	Secondary	120	This band is used for narrowband, data and television communications and for experimentation. It is also used for Earth-

Frequency Band	Wavelength	Amateur Service Status in Tanzania	Maximum Power (EIRP) Transmission Allowed in Watts	Applications
				Moon-Earth (EME) communications and for contacts with the use of repeaters on board amateur satellites (mainly space-Earth
SUPER HIGH FREQUENCY(SHF)				
5650 - 5725 MHz	5 cm	Secondary	120	This band is used for narrowband communications, data links and for Earth-Moon-Earth communications using analog and digital modulations techniques.
5830 - 5850 MHz	3 cm	Secondary	120	
10 - 10.45 GHz	3 cm	Secondary	120	This band is used for narrowband communications, short range wideband communications, television (including repeaters), and for Earth-Moon-Earth (EME) communications using analog and digital modulation techniques. It is the most popular band above 1.3GHz. Certain propagation conditions such as TROPO or RAINSCATTER can result in communications ranges in excess of 1 000 km.
10.45 - 10.5 GHz	1.2 cm	Secondary	120	This band is used for short-range communications and for experimentation. Amateur satellites may

Frequency Band	Wavelength	Amateur Service Status in Tanzania	Maximum Power (EIRP) Transmission Allowed in Watts	Applications
				operate in the band 10.45-10.5 GHz.
24 - 24.05 GHz	1.2 cm	PRIMARY	120	These bands (at 24 GHz, 47 GHz and 76 GHz) are largely used for narrowband communications and for experimentation, and also for Earth-Moon-Earth (EME) communications.
24.05 - 24.25 GHz	1.2 cm	Secondary	120	
EXTREMELY HIGH FREQUENCY (EHF)				
47 - 47.2 GHz	6 mm	PRIMARY	120	These bands (at 24 GHz, 47 GHz and 76 GHz) are largely used for narrowband communications and for experimentation, and also for Earth-Moon-Earth (EME) communications.
76 - 77.5 GHz	4 mm	Secondary	120	
77.5 - 78 GHz	4 mm	PRIMARY	120	
78 - 81 GHz	4 mm	Secondary	120	
122.25 - 123 GHz	2 mm	Secondary	120	
134 - 136 GHz	2 mm	PRIMARY	120	
136 - 141 GHz	2 mm	Secondary	120	Bands at 122 GHz and above are largely used for narrowband communications and experimentation
241 - 248 GHz	1 mm	Secondary	120	
248 - 250 GHz	1 mm	PRIMARY	120	

PART 6: Amateur Satellite Services

The amateur-satellite programme began in 1961 with the design and launch of OSCAR (the first satellite using the acronym Orbiting Satellite Carrying Amateur Radio). The original Project OSCAR group was responsible for the first 4 amateur satellites. In 1969 the Radio Amateur Satellite Corporation (AMSAT) was formed in the USA. This was followed by the establishment of organizations in other countries including Argentina, Australia, Brazil, Chile, Denmark, Germany, Italy, India, Japan, Republic of Korea, Malaysia, New Zealand, Portugal, the Russian Republic (and the former Soviet Union), the Republic of South Africa, Spain, Sweden, Turkey and the United Kingdom. With some exceptions, these satellites were built by licensed radio amateurs, including university students.

Recent developments in nano and pico-satellites (such as CubeSats) have led to a considerable increase in university and other groups developing and launching amateur satellites in addition to the original AMSAT groups.

Most satellites have been of the low-Earth-orbiting (LEO) type. Some have been designed for highly elliptical orbits (HEOs). Owing to cost, there have been no geostationary satellite orbit (GSO) satellites in the amateur-satellite service. Technology developed in the amateur-satellite service has been applied directly to commercial LEO satellite systems, and the amateur-satellite service has served as a training ground for design engineers.

6.1 Amateur Earth Stations

Amateur earth stations in the amateur-satellite service fall into two classes: telecommand and users. Telecommand stations located throughout the world are privileged to turn amateur satellites on and off, and to modify their operation in accordance with ITU RR No. 25.11. User stations are licensed amateur stations with essentially the same equipment as used for terrestrial amateur operations. The primary differences are antennas and transmitter-receivers optimized for amateur-satellite operations.

An increasingly common practice is for multiple amateur stations to receive telemetry and automatically upload it to the telecommand station via the Internet to provide greater orbital coverage.

6.2 Experimentations in the Amateur-Satellite Services

The amateur-satellite service is highly experimental. It was not certain at the beginning of the OSCAR programme whether small groups of amateurs could design satellites, arrange for their launch, develop sufficient financial resources, and manage orbiting satellites. These questions were answered positively in the early years of the programme. Each satellite offered new challenges that were successfully met by licensed amateurs.

Because resources were scarce and were scattered in different countries, it became necessary to use “distributed engineering” to accomplish design, construction and testing of amateur satellites. Internet e-mail, amateur-satellite conferences and amateur radio communications were instrumental in the coordination.

In addition to solving “radio” design challenges, many lessons were learned concerning the physical and thermal design of the spacecraft, attitude control, power system management and orbital mechanics. The amateur-satellite service has proven to be a good training ground for satellite technology.

6.3 Amateur Satellite Services Radio Frequency Band Plan

The following table describes the radio frequency bands available for the amateur satellite service.

Frequency Band	Wavelength	Amateur Service Status in Tanzania	Maximum Power (EIRP) Transmission Allowed in Watts	Applications
HIGH FREQUENCY (HF)				
7000 - 7100 KHz	40 m	PRIMARY	400	These bands are identified only for limited satellite application, such as ionospheric research, because of potential interference to and from terrestrial users.
7100 - 7200 KHz	40 m	PRIMARY	400	
14000 - 14350 KHz	20 m	PRIMARY	400	
18068 - 18168 KHz	18 m	PRIMARY	400	

21000 - 21450 KHz	15 m	PRIMARY	400	
24890 - 24990 KHz	12 m	PRIMARY	400	
28000 - 28800 KHz	10 m	PRIMARY	400	This band is used primarily in conjunction with an input or output in the 144 MHz band.
29000 - 29700 KHz	10 m	PRIMARY	400	
VERY HIGH FREQUENCY (VHF)				
144 - 146 MHz	2 m	PRIMARY	400	These bands are in heavy use by numerous amateur satellites for inputs and outputs.
ULTRA HIGH FREQUENCY(VHF)				
435 - 438 MHz	70 cm	PRIMARY	400	These bands are in heavy use by numerous amateur satellites for inputs and outputs
1260 - 1270 MHz	23 cm	Secondary	120	These bands are used as alternatives to the 144 MHz and 435 MHz bands because of congestion.
2400 - 2450 MHz	13 cm	Secondary	120	
SUPER HIGH FREQUENCY(SHF)				
5650 - 5670 MHz	5 cm	Secondary	120	These bands are used for experimental amateur satellites.
5830 - 5850 MHz	3 cm	Secondary	120	
10.45 - 10.5 GHz	1.2 cm	Secondary	120	These bands are used for

24 - 24.05 GHz	1.2 cm	PRIMARY	120	experimental amateur satellite communications.
EXTREMELY HIGH FREQUENCY (EHF)				
47 - 47.2 GHz	6 mm	PRIMARY	120	These bands are used for experimental amateur satellites.
76 - 77.5 GHz	4 mm	Secondary	120	
77.5 - 78 GHz	4 mm	PRIMARY	120	
78 - 81 GHz	4 mm	Secondary	120	
134 - 136 GHz	2 mm	PRIMARY	120	
136 - 141 GHz	2 mm	Secondary	120	
241 - 248 GHz	1 mm	Secondary	120	
248 - 250 GHz	1 mm	PRIMARY	120	

PART 7: Document Administration

7.1 Amendment

TCRA may from time-to-time, review, and update or modify this document to ensure its continued service and to meet the international and/or national performance requirements as necessary.

7.2 Compliance

Appropriate provisions of the TCRA Act, 2003, the Electronic and Postal Communications Act, 2010 and the Electronic and Postal Communications (Radiocommunication and Frequency Spectrum) Regulations, 2018, shall be used for compliance of this document and effective from the date it has been published.

7.3 Publication

This document shall be published on the TCRA website https://www.tcra.go.tz for public information, compliance and reference purposes.

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