TANZANIA COMMUNICATIONS REGULATORY AUTHORITY

RADIO FREQUENCY BAND PLAN FOR AERONAUTICAL COMMUNICATION SERVICES

First Version

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RADIO FREQUENCY BAND PLAN FOR AERONAUTICAL COMMUNICATION SERVICES

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Acronyms and Abbreviations

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

AM(R)S	Aeronautical Mobile (Route) Service
AMS(R)S	Aeronautical Mobile-Satellite (Route) Service
ARNS	Aeronautical Radionavigation Service
MSS	Mobile-Satellite Service
RLS	Radio Location Service
RNS	Radionavigation Service
RNSS	Radionavigation-Satellite Service
UAS	Unmanned Aircraft System
CNPC	Command and Non-Payload Communications
SHF	Super Ultra-high Frequency (3-30 GHz)
Tx	Transmission
UHF	Ultra-high Frequency (300-3000 MHz)
VLF	Very-high Frequency (30-300 MHz)
VHF	Very-low Frequency (3-30 kHz)
CNS	Communications, Navigation and Surveillance
ILS	Instrument Landing Systems
DME	Distance Measuring Equipment
GP	Glide Path
ADS-B	Automatic Dependent Surveillance Broadcast
ATM	Air Traffic Management
GNSS	Global Navigation Satellite System
VOR	VHF Omnidirectional Radio Range
ADF	Automatic Direction Finding
LDACS	L-band Digital Aeronautical Communication Systems
GNSS	Global Navigation Satellite Systems
ASDE	Airport Surface Detection Equipment

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.

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

The spectrum for aeronautical services is used to facilitate ground-to-ground communication, ground-to-air communication and air-to-air communication. Effective communication is a very important aspect of aviation safety. As the major means of communication between pilots and air traffic controllers (ATC) is through radio communication.

Aeronautical services are recognized internationally to be prime users of radio frequencies without which aircraft operations would not be capable of meeting the global demand for safe, efficient and cost-effective transport. The prominent safety-of-life element, present during all phases of an aircraft's flight, is accorded special treatment internationally and is granted protection from harmful interference through agreed measures.

PART 2: Scope and Purpose

This document details the Radio Frequency Band Plan and Channel arrangements for the aeronautical frequencies. It provides guidance on how the radio frequency spectrum for aeronautical services is used to facilítate ground-to-ground comunicación, ground-to-air communication and air-to-air communication**.**

PART 3: Recommendations related to aeronautical radiocommunications services

RECOMMENDATIONS	TITLE
Rec. M.1318	Evaluation model for continuous interference from radio sources other than in the radionavigation-satellite service to the radionavigation-satellite service systems and networks operating in the 1164–1215MHz, 1215–1300MHz, 1559–1610 MHz and 5010– 5 030 MHz bands
Rec. M.1582	Method for determining coordination distances, in the 5 GHz band, between the international standard microwave landing system stations operating in the aeronautical radionavigation service and stations of the radionavigation-satellite service (Earth-to-space)
Rec. M.1831:	A coordination methodology for radionavigation-satellite service inter-system interference estimation
Rec. M.1901	Guidance on ITU-R Recommendations related to systems and networks in the radionavigation-satellite service operating in the frequency bands 1 164–1 215 MHz, 1 215–1 300 MHz, 1 559–1 610 MHz, 5 000–5 010 MHz and 5 010–5 030 MHz
Rec. M.1906:	Characteristics and protection criteria of receiving space stations and characteristics of transmitting earth stations in the radionavigation-satellite service (Earth-to-space) operating in the band 5 000–5 010 MHz
Rec. M.2031:	Characteristics and protection criteria of receiving earth stations and characteristics of transmitting space stations in the radionavigation-satellite service (space-to-Earth) operating in the band 5 010–5 030 MHz
Rec. S.1342	Method for determining coordination distances, in the 5 GHz band, between the international standard microwave landing system (MLS) in the aeronautical radionavigation service (ARNS) and non-geostationary mobile-satellite service stations providing feeder uplink services
Rep. M.2219	Radionavigation-satellite service applications for the 5 000–5 010 MHz and 5 010–5 030 MHz bands
Rep. M.2262	Potential interference between the ICAO standard microwave landing system (MLS) operating above 5 030 MHz and radionavigation-satellite service (RNSS) systems in the band 5 000– 5 030 MHz
Rec. M.629	Use for the RN service of the frequency bands 2 900– 3 100 MHz, 5 470–5 650 MHz, 9 200–9 300 MHz, 9 300– 9 500 MHz and 9 500–9 800 MHz

Rec. M.1461	Procedures for determining the potential for interference between radars operating in the radiodetermination service and systems in other services
Rec. M.1465	Characteristics of and protection criteria for radars operating in the radiodetermination service in the frequency band 3 100– 3 700 MHz

PART 4: CNS (Communications, Navigation and Surveillance) systems

Communications, Navigation and Surveillance (CNS) system is categorized into the following three main parts: -

(i) Communications:

It refers to voice and data communication. In terms of voice communication, it includes the VHF and HF radio communications equipment that supports ground-to-ground communications, ground-to-air communications and air-to-air communications. VHF data communication supports ground communication services to TCAA tower to provide the flight plan and routine air traffic management (ATM). Also, flight plans must be sent to the destination Airport through data communication through VSAT. The VSAT system facilitates data communications, and voice for real-time and critical communication.

(ii) Navigation:

This includes the Instrument Landing Systems (ILS) which consists of three subsystems known as Distance Measuring Equipment (DME), Glide Path (GP) and Localizer. The Distance Measuring Equipment (DME) assists the pilot on the cock pit to know exactly how far the aircraft is to the runway. The Glide Path (GP) informs the pilot the descending angle, which is normally supposed to be three (3) degrees. The localizer assists the pilot during descending to maintain the center line on the runway.

(iii) Surveillance:

This includes the Secondary and Primary Radar Systems that are used for interrogation and broadcast information between the radar and airborne. The surveillance mechanism

also uses the **automatic dependent surveillance-broadcast** (ADS-B). This technology uses Global Navigation Satellite System (GNSS) equipment and a transponder-like broadcaster to determine the aircraft's height, position and speed, and broadcast this, along with its identity, twice per second.

PART 5: Aeronautical Frequency Bands Services and Use

Bands	Frequency Spectrum	Aviation Usages	Type of Services
LF & MF	200-405 kHz, 415-495 kHz, 505-526.5 kHz	**Navigation;** Non-Directional Beacon (NDB)	ARNS
HF	2850-3025 kHz, 3025-3155 kHz, 3400 - 3500 kHz, 3800- 3900 kHz, 3900-3950 kHz, 4650-4700 kHz, 4750 - 4850 kHz, 5450-5480 kHz, 5480 -5680 kHz, 5680-5730 kHz, 6525-6685 kHz, 6685-6765kHz, 13200-13260 kHz, 13260-13360 kHz, 15010-15100 kHz, 17900-17970 kHz, 17970-18030 kHz , 21924 -22000kHz	**Communication;** Air-ground Communication (HF voice and data)	AM(R)S
	3023 kHz, 5660 kHz	**Communication;** Search and Rescue	AM(R)S
VHF	74.8-75.2 MHz	**Communication;** Air-ground Communication (HF voice and data)	ARNS
	108-117.975 MHz	**Navigation;** VOR/ILS localizer GBAS/VDL Mode 4 (voice and data)	ARNS AM(R)S
	117.795-137 MHz	**Communication;** Air-ground and air-air	AM(R)S AMS(R)S

Bands	Frequency Spectrum	Aviation Usages	Type of Services
		communications (VHF voice and data)	
	121.5/123.1 & 243 MHz	**Avionics and Airborne Equipments;** Emergency distress frequency	AM(R)S
UHF	328.6-335.4 MHz	**Navigation;** ILS glide path	ARNS
	406-406.1 MHz	**Avionics and Airborne Equipments;** Emergency locator transmitter (ELT)	MSS
UHF or L	960-1164 MHz	**Navigation;** Distance Measuring Equipment (DME) TACAN **Communication;** LDACS (for datalink), Navigation; LDACS (for Alternative-PNT)	ARNS AM(R)S
	978 MHz	**Communication;** Universal Access Transceiver (UAT)	AM(R)S
	1020- 1040 MHz and 1080-1100MHz	**Surveillance;** Secondary Surveillance Radar (SSR) 1090 Extended Squitter ADS-B Airborne collision avoidance system (ACAS)	ARNS
	1164-1215	**Navigation;** DME/Global Navigation Satellite System (GNSS)	ARNS/RNSS
	1215-1400 MHz	**Surveillance;** Primary Surveillance Radar (PSR)	ARNS
	1525-1559 MHz	**Communications;** Satellite Communications	MSS (space-Earth)
	1559-1610 MHz	Navigation; GNSS	ARNS/RNSS
	1610-1626.5 MHz	**Communications;** Satellite Communications	AMS(R)S (s-E, E-s)
	1626.5-1660.5 MHz	**Communications;** Satellite Communications	MSS(Earth-space)
UHF or S	2700- 2900 MHz	Surveillance; PSR	ARNS RNS/RLS

Bands	Frequency Spectrum	Aviation Usages	Type of Services
	3800-4200 MHz	Satellite Feeder Links to Air Traffic Services (ATS) in Africa	
SHF or C	4200-4400 MHz	**Avionics and Airborne Equipment;** Radio Altimeter Wireless Avionics Intra-Communications (WAIC)	ARNS
	5000- 5250 MHz	**Navigation;** Microwave Landing System (MLS) UAS CNPC/Airport Surface Communication (AeroMACS)	ARNS AM(R)S/AMS(R)S
	5350-5470 MHz	**Avionics and Airborne Equipment;** Airborne Doppler radar	ARNS
SHF or X	8750- 8850 MHz	**Avionics and Airborne Equipment;** Airborne Doppler radar	ARNS/RLS
	9000- 9500MHz	**Surveillance;** Precision Approach Radar (PAR)/Airborne weather radar/ASDE	ARNS/RNS
SHF or Ku	13.25-13.4 GHz	**Avionics and Airborne Equipment;** Airborne Doppler radar	ARNS
	15.4- 15.7 GHz	**Surveillance;** PAR/ **Avionics and Airborne Equipment;** Airborne weather radar/ASDE	ARNS/RLS AM(OR)S
SHF or Ka	31.8-33.4 GHz	ASDE/ **Avionics and Airborne Equipment;** Airborne radar	RNS

PART 6: Radio Navigation Systems

6.1 Instrument Landing System-ILS

ITU defines ILS as “a radio navigation system, which provides aircraft with horizontal and vertical guidance just before and during landing and at certain fixed points, indicates the distance to the reference point of landing”. Autopilot systems on some modern aircraft use ILS signals to execute a fully autonomous approach and landing, especially in low visibility settings. ILS comprises of three independent subsystems: i) localizer, (ii) glideslope and iii) marker beacons. The localizer and the glideslope guide the aircraft in the horizontal and vertical plane respectively. The marker beacons act as checkpoints that enable the pilot to determine the aircraft’s distance to the runway. ILS has three operational categories: i) CAT I, ii) CAT II and, iii) CAT III. These operational categories are decided based on ILS installations at the airport and is independent of the receiver on the aircraft. With the advent of GPS and other localization technologies, the marker beacons are less important today and increasingly obsolete. However, the localizer and the glideslope play a major role in an air- craft’s safe landing today and is expected to remain so for many years.

ILS Categories. The main advantage of ILS is that the pilot need not have visuals of the runway during the final approach as the ILS system is intended to guide the aircraft to a safe landing. The ILS categories are classified based on the maximum decision height at which a missed approach must be initiated if the pilot does not have a visual reference to continue the approach. In CAT I the decision height is at 60 m above the ground i.e., if the pilot does not have a visual reference at this height, a missed approach or go around must be initiated. The decision height for CAT III is as low as 15 m above the ground. The demonstrated attacks can cause severe consequences in CAT III systems due to the low decision height. It might potentially be too late to execute a missed approach in case of an attack. The consequences of the attack on CAT I and CAT II systems are less catastrophic. However, they can still cause major air traffic disruptions. Note that CAT I approach is mostly used by smaller flights. Commercial flights typically fly a CAT II or CAT III approach.

6.2 VHF Omni Directional Radio Range-VOR

The VOR system in an aircraft provides directional information while in flight by interpreting the specially coded information transmitted by VOR stations located on the ground. VOR stations transmit over the 108 to 118 MHz frequency spectrum.

The VOR signal transmitted by the station is modulated using two distinct parts. The first part of the VOR signal is amplitude modulated onto a 9.960 kHz sub-carrier at a rate of 30 Hz and in such a way that its phase is not dependent on the bearing angle between the receiver and VOR station. This signal is referred to as the reference signal. The second signal is also modulated at 30 Hz. The phase of this second signal is adjusted such that the difference in phase relative to the reference signal corresponds to the compass bearing of the receiver to the VOR station.

The aircraft's VOR receiver demodulates the transmitted VOR signal comparing the phase difference between the two transmitted signals. This phase difference can then be used to determine the aircraft's compass bearing to the VOR station. An aircraft's position can be determined by observing multiple VOR stations and the compass bearing relative to the VOR stations. Position location utilizing the VOR system can be used to provide confirmation of the location information reported by GPS systems.

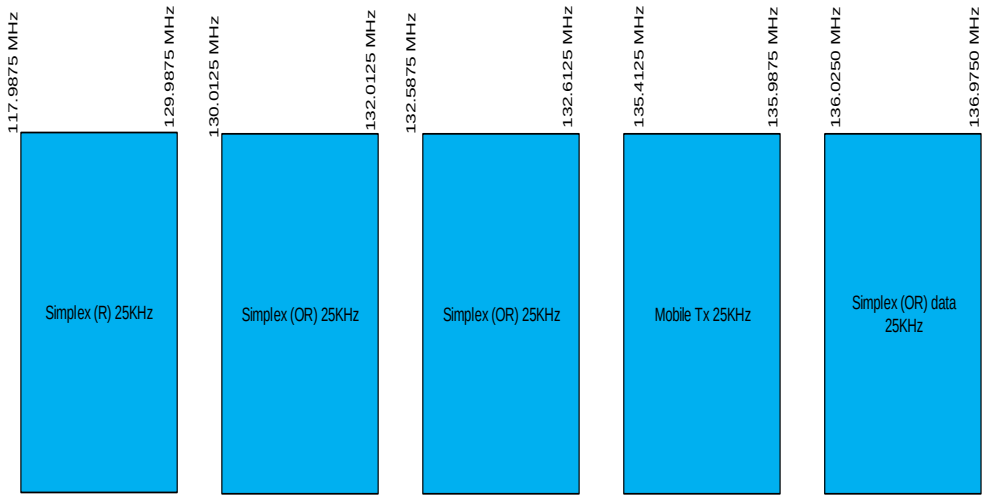
6.3 Automatic Direction Finding-ADF

ADF equipment determines the direction or bearing relative to the aircraft by using a combination of directional and non- directional antennae to sense the direction in which the combined signal is strongest.

This display looks like a compass card with a needle superimposed, except that the card is fixed with the 0-degree position corresponding to the centre line of the aircraft.

Part 7: Aeronautical Radio Frequency Band Plan

7.1 Aeronautical Radio Frequency Band Plan (118-137 MHz)



7.2 The block allotment of the frequency band 118 – 137 MHz

	Block allotment frequencies (MHz)	Worldwide utilization	Remarks
a)	118.000 – 121.450 inclusive	International and National Aeronautical Mobile Services	Specific international allotments will be determined in the light of regional agreement.
b)	121.500	Emergency frequency	In order to provide a guard band for the protection of the aeronautical emergency frequency, the nearest assignable frequencies on either side of 121.500 MHz are 121.450 MHz and 121.550 MHz.
c)	121.550 – 121.9917 inclusive	International and National Aeronautical Mobile Services	Reserved for ground movement, pre- flight checking, air traffic services, clearances, and associated operations.
d)	122.000 – 123.050 inclusive	National Aeronautical Mobile Services	Reserved for national allotments.
e)	123.100	Auxiliary frequency SAR	In order to provide a guard band for the protection of the aeronautical auxiliary frequency, the nearest assignable frequencies on either side of 123.100 MHz are 123.050 MHz and 123.150 MHz.

f)	123.150 – 123.6917 inclusive	National Aeronautical Mobile Services	123.450 MHz which is also used as an air-to-air communications channel (see (g))
g)	123.450	Air-to-air communications	Designated for use as provided under these Regulations
h)	123.700 – 129.6917 inclusive	International and National Aeronautical Mobile Services	Specific international allotments will be determined in light of regional agreement
i)	129.700 – 130.8917 inclusive	National Aeronautical Mobile Services	Reserved for national allotments but may be used in whole or in part, subject to regional agreement.
j)	130.900 – 136.875 inclusive	International and National Aeronautical Mobile Services	Specific international allotments will be determined in light of regional agreement.
k)	136.900 – 136.975 inclusive	International and National Aeronautical Mobile Services	Reserved for VHF

PART 8: Document Administration

8.1 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.

8.2 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.

8.3 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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