TANZANIA COMMUNICATIONS REGULATORY AUTHORITY

RADIO FREQUENCY BAND PLAN FOR DIGITAL SOUND BROADCASTING (DSB)

First Version

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RADIO FREQUENCY BAND PLAN FOR DIGITAL SOUND BROADCASTING (DSB)

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Acronyms and Abbreviations

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

AAC	Advanced Audio Coding
AM	Amplitude Modulation
CELP	Coded Excited Linear Prediction
DAB	Digital Audio Broadcasting
DTTB	Digital Terrestrial Television Broadcasting
DQPSK	Differential Quadrature Phase-Shift Keying
DRM	Digital Radio Mondiale
DSB	Digital Sound Broadcasting
GE06	Geneva 06
HVXC	Harmonic Vector Excitation Coding
IBOC	In-Band On Channel
NFAT	National Frequency Allocation Table
OFDM	Orthogonal Frequency Division Multiplexing
ITU	International Telecommunication Union
TCRA	Tanzania Communications Regulatory Authority
TDMB	Terrestrial Digital Multimedia Broadcasting
VHF	Very High Frequency
MFN	Multiple Frequency Network
T-DAB	Terrestrial Digital Audio Broadcasting

Definition of Terms

National Frequency Allocation Plan	A compilation of frequency allocations to services applicable to Tanzania. It specifies purposes for which various frequency bands may be used in the United Republic of Tanzania.
Digital Audio Broadcasting (DAB)	A digital sound broadcasting that, through the application of multiplexing and compression, combines multiple audio streams onto a relatively narrow band centred on a single broadcast frequency called a DAB ensemble.
Digital Radio Mondiale (DRM30)	A digital sound broadcasting standard designed to work over the bands currently used for AM radio broadcasting particularly shortwave.
Multiplexing	Is a process of combining multiple signals into one signal, over a shared medium.

PART 1: Introduction

The radio frequency spectrum is part of electromagnetic waves propagated in space, serving as a communication medium for wireless systems. The radio frequency spectrum is universally acknowledged as valuable, scarce public resource and thus subject to transparent, predictable and coherent governing policies, legislations and regulations. Given its scarcity, effective and timely management becomes imperative to accommodate both present and forthcoming technological advancements.

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. Among the strategies employed by TCRA to manage this scarce resource is the implementation of the radio frequency band plan.

The radio frequency band plan is in line with the National Frequency Allocation Plan (NFAP), frequency allocation under International Telecommunication Union (ITU) region 1 and most adopted frequency channelization plan as a results of harmonising the spectrum.

PART 2: Scope and Purpose

This document provides radio frequency band plan for operations of the Digital Sound Broadcasting (DSB) systems adopted in the United Republic of Tanzania. The DSB radio frequency spectrum plan intend to facilitate the smooth introduction of the DSB services in the country. The plan provides the required spectrum to be assigned to operators in line with requirements of digital radio network services (public and private) in the country.

The purpose of the plan is to provide assistance to operators and other stakeholders on spectrum-related technical issues relevant to the implementation and use of the frequency bands allocated for DSB in the NFAP in line with ITU Radio Regulations.

This plan is complemented by other ITU-R Recommendations and Reports on DSB that provide additional details on a number of aspects including unwanted emission characteristics for the bands addressed in this plan and radio interface specifications

PART 3: ITU Related Recommendations and Reports on DSB

Report ITU-R BS.2214-5	Planning parameters for terrestrial digital sound broadcasting systems in VHF bands
Recommendation ITU-R BS.1514-2	System for digital sound broadcasting in the broadcasting bands below 30 MHz
Recommendation ITU-R BS.1114-12	Systems for terrestrial digital sound broadcasting to vehicular, portable and fixed receivers in the frequency range 30-3 000 MHz
Report ITU-R BS.2144	Planning parameters and coverage for Digital Radio Mondiale (DRM) broadcasting at frequencies below 30 MHz
Recommendation ITU-R BS.1615-2	"Planning parameters" for digital sound broadcasting at frequencies below 30 MHz

PART 4: Digital Sound Broadcasting

Digital Sound Broadcasting (DSB) is an audio broadcasting technology intended to deliver superior quality sound using digital communications technology. It is a digital signal delivery system capable of delivering sound and data.

A number of digital sound broadcasting technologies have been developed around the world. However, standard such as DAB family (DAB, DAB+, TDMB), Digital Radio Mondiale (DRM30 and DRM+), HD Radio (IBOC) and ISDB-TSB are widely accepted.

The adopted standards for terrestrial Digital Sound Broadcasting (DSB) in the country are Digital Audio Broadcasting plus (DAB+) and Digital Radio Mondiale30 (DRM30). DAB+ System operates on Band III (174-230MHz) while DRM30 uses lower broadcast bands below 30 MHz operating in the 150-285 kHz and 525-1605 kHz spectrum.

4.1 DAB+ System

The DAB+ is an updated version and enhancement of the original DAB system, primarily used for radio broadcasting. DAB+ uses more efficient audio codecs compared to the earlier DAB system, resulting in improved sound quality and more efficient use of the available bandwidth.

For the original DAB, typical bit rates for audio programs ranges between 64 kbps to 256 kbps per program. Different stations might broadcast their content at different bit rates based on their preferences and requirements.

For DAB+, the bit rates per program are generally more efficient compared to traditional DAB due to the use of more advanced audio codecs such as High Efficiency Advance Audio Coding (HE-AAC v2), which provides improved compression without significant loss in audio quality.

Typically, DAB+ stations can broadcast its content at bit rates ranging from approximately 32 kbps to 128 kbps per program. This range allows for acceptable audio quality while maximizing the number of stations that can be transmitted within the available bandwidth.

The number of programs that can be carried per single DAB+ channel, also known as a multiplex, can vary depending on several factors including the available bandwidth, the bit rates allocated to each program, and the compression methods used. However, a typical DAB+ multiplex can carry anywhere from 10 to 30 or more programs simultaneously, depending on the aforementioned factors.

DAB+ makes use of convolutional coded DQPSK OFDM signal to meet the exact requirements of high bit-rate digital broadcasting to mobile, portable and fixed receivers, especially in multipath environments. The system is based on the use of 1536 active carriers with a frequency spacing of 1 kHz. All carriers are transmitted at the same power level. Four DAB frequency blocks fit into a single 7 MHz television channel identified by the letters A, B, C and D, with a 176 kHz guard band between blocks A-B, B-C and C-D. However, a wider guard band of 320 or 336 kHz is assigned between D and A in order to align with a 7 MHz television raster. The T-DAB transmission characteristics are as shown in Table 1 below.

Table 1: DAB Characteristics

Parameters	**DAB Mode**
Number of subcarriers	1536
Sub carrier spacing	1kHz
bandwidth DAB+ frequency block	1.536 MHz
Modulation	4-DPSK OFDM

audio codec	HE-AACv2
data rate (incl. overhead)	2.4 Mbit/s
transmitter distance in SFN	75 km

4.2 DRM 30 System

The DRM 30 system is a versatile DSB system currently available for use in the terrestrial broadcasting bands below 30 MHz. The DRM 30 system employs various audio codecs to encode audio content for broadcasting. These codecs are designed to balance between audio quality and bit rate efficiency, catering to different types of content and transmission conditions, which holds significant importance, particularly in High Frequency (HF) transmissions. Below are the main audio codecs used in DRM 30: -

i. **MPEG-4 AAC:** This codec offers higher audio quality at a bit rate of 14 kbps or higher. It provides excellent fidelity and is suitable for broadcasting high-quality music and other audio content that demands superior sound reproduction.

ii. **MPEG-4 CELP:** Operating at a bit rate ranging between 10 to 12 kbps, the Code Excited Linear Prediction (CELP) codec is suitable for transmitting speech and lower-quality audio content. It offers reasonable quality while utilizing lower bit rates.

iii. **MPEG-4 HVXC:** The Harmonic Vector eXcitation Coding (HVXC) codec operates at bit rates as low as 2 to 4 kbps, making it specifically tailored for speech-only services. It offers intelligible speech reproduction while maintaining low bit rate requirements, suitable for spoken content.

DRM 30 has specifically been designed as a high quality digital replacement for current analogue radio broadcasting in the AM and FM/VHF bands; as such it can be operated with the same channelling and spectrum allocations as the analogue radio. One notable advantage of DRM is its ability to provide expansive coverage as compared to T-DAB.

The efficiency of transmission in DRM 30 systems depends on the following factors: -

i. **Code rates and constellation:** The selection of code rates and constellations plays a critical role in balancing transmission capacity against error performance. Different choices allow for trade-offs between data capacity and the system's ability to handle errors without significant signal degradation.

ii. **OFDM parameter sets:** The selection of the robustness modes (symbol duration, guard interval, carrier spacing, transmission frame length (symbols per frame))

PART 5: DSB Bands and Frequency Arrangements

5.1 DAB Plan for 174-230 MHz

According to the Geneva-06 (GE06) Plan, the Terrestrial Digital Audio Broadcasting (T-DAB) system is primarily designed for large-area coverage operating within the Very High Frequency (VHF) Band III. The Band III, within the VHF spectrum is also designated for various broadcasting services including Digital terrestrial television broadcasting (DTTB). However, in the case of Tanzania, this band is exclusively planned for DAB+ services.

Similar to the traditional FM radio system, DAB+ operates by a Multiple Frequency Network (MFN) where different frequencies are allocated to each transmitter to avoid undue interference between adjacent transmitters. T-DAB was planned for both mobile reception and portable indoor reception.

ITU Region 1, uses the same frequency blocks distribution for T-DAB services in Band III. The Band III forms part of the VHF band which ranges from 30MHz to 300 MHz. The available 56 MHz bandwidth of Band III is divided into eight 7 MHz channels (from channel 5 to channel 12); each 7 MHz channel is also sub-divided into four (4) sub-channels labelled from A through D, with the allocated bandwidth of 1.536 MHz per sub-channel as shown Fig.1. The frequency channelization is shown in table 2. Tanzania DAB+ Channel-Allocation Plan for service area in the VHF Band III as per GE06 Plan are as shown in the table 3.

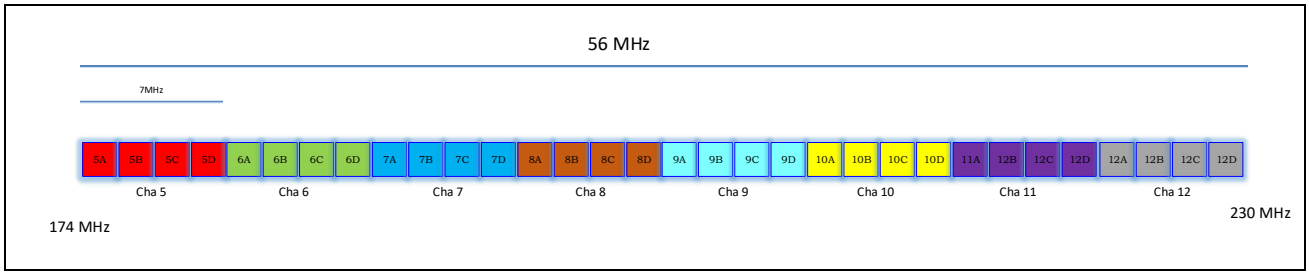

Figure 1: Band III plan for DAB+

Table 2: Frequency channelization and block bandwidth in Band III for T-DAB

T-DAB frequency block	Assigned frequency (MHz)	Frequency block bandwidth (MHz)	Lower guard band (kHz)	Upper guard band (kHz)
5A	174.928	174.160-175.696	–	176
5B	176.640	175.872-177.408	176	176
5C	178.352	177.584-179.120	176	176
5D	180.064	179.296-180.832	176	336
6A	181.936	181.168-182.704	336	176
6B	183.648	182.880-184.416	176	176
6C	185.360	184.592-186.128	176	176
6D	187.072	186.304-187.840	176	320
7A	188.928	188.160-189.696	320	176
7B	190.640	189.872-191.408	176	176
7C	192.352	191.584-193.120	176	176
7D	194.064	193.296-194.832	176	336
8A	195.936	195.168-196.704	336	176
8B	197.648	196.880-198.416	176	176
8C	199.360	198.592-200.128	176	176
8D	201.072	200.304-201.840	176	320
9A	202.928	202.160-203.696	320	176
9B	204.640	203.872-205.408	176	176
9C	206.352	205.584-207.120	176	176
9D	208.064	207.296-208.832	176	336
10A	209.936	209.168-210.704	336	176
10B	211.648	210.880-212.416	176	176
10C	213.360	212.592-214.128	176	176
10D	215.072	214.304-215.840	176	320
11A	216.928	216.160-217.696	320	176
11B	218.640	217.872-219.408	176	176
11C	220.352	219.584-221.120	176	176
11D	222.064	221.296-222.832	176	336
12A	223.936	223.168-224.704	336	176
12B	225.648	224.880-226.416	176	176
12C	227.360	226.592-228.128	176	176
12D	229.072	228.304-229.840	176	–

Table 3: Tanzania DAB+ Channel-Allocation Plan for service area in the VHF Band III as per GE06 Plan

S/NO	Service Area	Channel
1	ARUSHA	11A, 11B, 11C
2	ARUSHA - NGORONGORO	7A
3	DAR ES SALAAM	7A, 7C, 10C, 11C
4	DODOMA	5C, 8C, 11C, 12C
5	DODOMA - KONDOA	7B, 7C, 7D, 8B
6	GEITA	8C, 10D, 12C, 12D
7	IRINGA	10A, 10B, 10C, 11A
8	KATAVI	7B, 7D
9	KATAVI - MPANDA	5A, 5B
10	KAGERA - BUKOBA	11A, 11B, 11C
11	KAGERA - NGARA	7C, 7D
12	KIGOMA	9A, 9C, 9D
13	KIGOMA - KIBONDO	5D
14	KILIMANJARO - MOSHI	5A, 5B, 5C, 7B
15	KILIMANJARO - SAME	7C, 7D
16	LINDI	6C
17	LINDI - KILWA	12A, 12C, 12D
18	MANYARA - BABATI	5A, 5C, 8D
19	MANYARA - KIBAYA	8A
20	MARA - MUSOMA	9D, 12C
21	MARA - MUGUMU	10B, 10D
22	MBEYA	9D, 12C
23	MBEYA - CHUNYA	5C, 12D
24	MBEYA - TUKUYU	5C, 5D, 6A, 12A
25	MOROGORO	8D, 9A, 9B, 12B
26	MOROGORO - MAHENGE	6D
27	MTWARA	5B
28	MTWARA - MASASI	9A, 9B, 9C, 9D
29	MWANZA	5A, 5C, 12A
30	MWANZA - SENGEREMA	5B
31	NJOMBE	5A, 5B, 12B, 12D
32	PWANI - BAGAMOYO	11A, 11B
33	PWANI - KIBAHA	12A, 12C
34	PWANI - UTETE	5A, 5D
35	RUKWA	6C, 10A

S/NO	Service Area	Channel
36	RUKWA - SUMBAWANGA	6A, 10C
37	RUVUMA - SONGEA	6B
38	RUVUMA - TUNDURU	5A, 5B, 5C, 5D
39	SINGIDA	6A, 6B, 6C
40	SINGIDA - MANYONI	5A, 5C
41	SIMIYU - MASWA	5B, 10A, 10C, 11B
42	SHINYANGA	7B, 7D, 11B, 11C
43	SONGWE - MBOZI	5A, 5B, 6B, 12B
44	TABORA	5A, 5C, 5D
45	TABORA - SIKONGE	6D
46	TANGA	5B, 7A, 8C
47	TANGA - HANDENI	12D

5.2 DRM 30 Band Plan

The DRM30 Plan and Channelization is s shown in the table 4 below;

Table 4: DRM Plan

S/NO	Service Area	Frequency Assigned in kHz
1	ARUSHA	1215
2	ARUSHA	1413
3	BABATI	1485
4	BIHARAMULO	1476
5	BUKOBA	837
6	DAR ES SALAAM	531
7	DAR ES SALAAM	657
8	DODOMA	603
9	DODOMA	891
10	DODOMA	1395
11	IFAKARA	1602
12	IRINGA	1584
13	IRINGA	945
14	ITIGI	1602
15	KIBAHA	1035
16	KIBONDO	1485

17	KIGOMA	711
18	KIGOMA	1440
19	KONDOA	1584
20	LIWALE	1584
21	MAFIA	1602
22	MAHENGE	1476
23	MASWA	1584
24	MBEYA	621
25	MBEYA	1467
26	MOROGORO	693
27	MOROGORO	1485
28	MPANDA	1251
29	MTWARA	1188
30	MUSOMA	1260
31	MWANZA	720
32	MWANZA	1377
33	NACHINGWEA	648
34	NJOMBE	1170
35	SAME	1323
36	SHINYANGA	1341
37	SINGIDA	1089
38	SONGEA	990
39	SUMBAWANGA	972
40	TABORA	1008
41	TANGA	1359
42	TUNDURU	1485

PART 6: Document Administration

6.1 Amendment

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

6.2 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. The document will come into use from the official date of its publication.

6.3 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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