

Technical Overview of Frequency Assignment For Radio Broadcasting In Nigeria

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Abstract: In Nigeria, the VHF and UHF frequency bands of the electromagnetic spectrum are mainly occupied by television services, while radio broadcasting is transmitted in the low frequency, medium frequency and high frequency bands. Therefore, it is important to manage the allocated spectrum for these services to ensure that radio stations, cellular network and television broadcast stations do not interfere in signal transmission. The governance of spectrum use on a global basis is a core responsibility of the International Telecommunication Union (ITU) and in particular, its Radio communication Sector (ITU-R). At the national level, the Radio Frequency Spectrum is managed by the following organs of government which include Ministry of Information and Communications (MoIC); National Frequency Management Council (NFMC); Nigerian Communications Commission (NCC) and National Broadcasting Commission (NBC). Frequency assignment and management is less stringent with good planning and monitoring. Radio wave propagation are affected by transmission impairment, if not well planned will result in signal degradations on the system. Hence, this paper reviews the technicalities involved in frequency assignment taking a holistic view at the existing spectrum management.

Keyword: Frequency assignment, ITU, MoIC, NFMC, NCC, NBC, ISM, RF.

I. Introduction

The radio spectrum lies at the lower end of the electromagnetic spectrum, which includes other categories of electromagnetic radiation such as infra-red, optical light and ultra-violet (see Figure 1.1).

Electromagnetic waves are characterised by either:

- (a) Frequency, i.e. the number of sinusoidal oscillations, or “cycles” per second, usually specified in Hertz (Hz) where 1 Hz = 1 cycle per second, or
- (b) Wavelength, i.e. the distance traversed by 1 cycle of an electromagnetic wave in free space (all electromagnetic radiation travels at a constant speed of 300,000 km/sec in free space) [1].

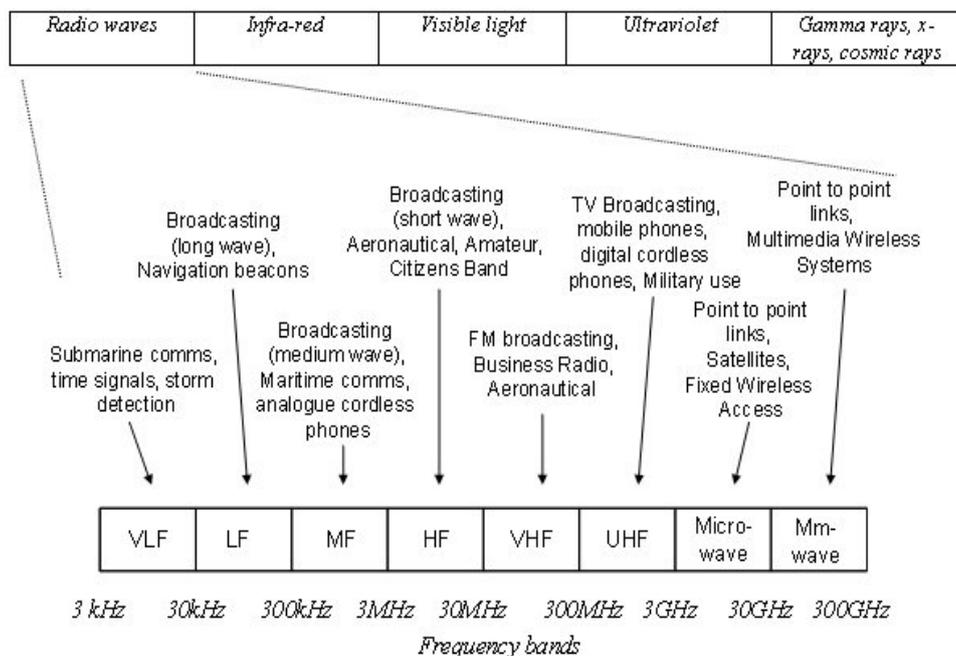


Figure 1.1: The Electromagnetic Spectrum [1]

Frequency assignment is the administration, designation or delegation to an agency or administrator via treaty or law, to specify frequencies, frequency channels or frequency bands, in the electromagnetic spectrum for use in radio communication services, radio stations or ISM applications [2]. For the aim of frequency allocation, the world is categorized into three (3) regions as shown in table 1.1.

Table 1.1: ITU Regions

	Region 1	Region 2	Region 3
Countries	Europe, Africa, the Middle East, west of the Persian Gulf including Iraq, the former Soviet Union and Mongolia.	Americas, Greenland and some of the eastern Pacific Islands.	Most of non-former-Soviet-Union Asia, including Iran and most of Oceania.

Nigeria falls within Region 1. Article 5 of the Radio Regulations deal with these frequency allocations which have been made from 8.3 KHz to 300GHz. It is mandatory for all administrations to adhere to these allocations. The National Frequency Table of Allocations in table 1.2 is a compendium of frequency allocations to services applicable to Nigeria as well as a depiction of frequency usage in Nigeria. This table has been developed and periodically reviewed in conformity with the international regulations governing radio spectrum and the international/ regional agreements acceded to by the Federal Republic of Nigeria in the capacity of the National Frequency Management Council. After each World Radio communication Conference, reviews to the table are made to reflect additions and modifications resulting from these conferences.

This table conveys the nation’s compendium prior to the World Radio communication Conference of 2015. The objective of developing and sustaining a National Table of Frequency Allocation is to promote spectrum discipline, increase efficiency and usage [3].

Table 1.2: The National Frequency Table of Allocations [3]

SEGMENT RANGE: 30-300 MHz				
FREQUENCY BANDS (MHZ)	ITU REGION 1 ALLOCATIONS	NIGERIAN ALLOCATIONS	NIGERIAN UTILIZATION	REMARKS
47-68	BROADCASTING 5.162A 5.163 5.164 5.165 5.169 5.171	BROADCASTING LAND MOBILE 5.164	LAND MOBILE	Cordless systems
68.00-74.80	FIXED MOBILE except aeronautical 5.149 5.174 5.175 5.177 5.179	FIXED MOBILE except aeronautical mobile 5.149	FIXED MOBILE except aeronautical mobile	Cordless systems
74.8-75.2	AERONAUTICAL RADIONAVIGATION 5.180 5.181	AERONAUTICAL RADIONAVIGATION 5.180		Marker beacons(phased out nationwide)
75.2-87.5	FIXED MOBILE except aeronautical mobile 5.175 5.179 5.187	FIXED MOBILE except aeronautical mobile	FIXED MOBILE except aeronautical mobile	Cordless systems
87.5-100	BROADCASTING 5.190	BROADCASTING	BROADCASTING	FM radio broadcasting
100-108	BROADCASTING 5.192 5.194	BROADCASTING	BROADCASTING	FM radio broadcasting
108.00-117.975	AERONAUTICAL RADIONAVIGATION 5.197	AERONAUTICAL RADIONAVIGATION 5.197 5.197A	AERONAUTICAL RADIONAVIGATION	VOR/ILS localizer

II. Preview Of Frequency Allocation/ Assignment / Management

Frequency assignments are based on geographical distribution to promote universal access and service. For telecommunication industries, the country has been divided into tiers of licensing areas, which correspond to the 36 states and the Federal Capital Territory. Licenses and frequency assignments are thus issued on the basis of these licensing areas with spectrum fees varying from one tier to the other. For broadcast frequencies, spectrum fees are classified based on the economic viability of an area and are typically issued as part of the broadcast license. The Nigerian Government considers frequency spectrum as a high-value yet scarce national resource and thus makes it a major source of revenue. Spectrum assignments in Nigeria are handled by three separate regulatory bodies as follows: NCC (for commercial providers & users of telecommunications equipment & services; NBC (for public and private broadcasting organizations); and MoIC (for government bodies and non-commercial users of spectrum).

Kamalu et al., (2012), Electromagnetic spectrum is the frequency and wavelength of electromagnetic radiation. It is a unique natural resource shared by various types of services which is free from depletion but subject to congestion through use. If left unplanned, spectrum congestion can lead to harmful interference and

hinder users from getting the best these services have to offer. Different spectrum bands offer different physical characteristics. Higher frequencies do not carry signals as far and do not penetrate buildings as easily, and lower frequencies have capacity limitations and create more interference.

In Nigeria, the VHF and UHF frequency bands of the electromagnetic spectrum are mainly occupied by television services, while radio broadcasting is transmitted in the low frequency, medium frequency and high frequency bands. Therefore, it is important to manage the allocated spectrum for these services to ensure that radio and television broadcast stations do not interfere in signal transmission since the allocated operating frequencies of these broadcast stations lie very close to each other within a given area of coverage [1].

Innocent et al (2013), the study of broadcasting regulation “has started to creep into the edges of the media studies curriculum.” This wind of change should be welcomed, because it will aid the apprehension of the major forces that shape the communication environment. It has been noted that “literature on media regulation were predominantly produced by legal scholars following Eric Barendt’s comparative study on law”. An appraisal of the statutes of regulation of the Nigerian broadcast industry is pertinent at this period when the whole world is talking about digitization of broadcasting. By 2015, according to the deadline by International Telecommunication Union, ITU, every broadcast station in the world would have switched over from analogue to digital broadcasting. Against this backdrop, the National Broadcasting Commission, NBC, (the regulatory body for broadcasting in Nigeria) set June 2012 as the switchover date for Nigeria. Several issues have arisen from scholars and stakeholders since the announcement. But there are several advantages in the digitization policy; including the expected shoot up in the number of radio broadcast stations and the competitions that will follow [4].

McLean et al (2007), Effective spectrum management can make a big difference to a country’s prosperity, especially as wireless technologies have become the main means of connecting businesses and households to voice, data and media services¹. It is becoming increasingly evident that as developing countries address broader issues of communication and information policy and regulatory reform, wireless services are outpacing wire line connectivity and the spotlight is focusing on current modes of spectrum management. In a globalizing world with rapid technological innovation and increasing demand for radio frequencies, effective spectrum policy should therefore promote the roll-out of services, reduce barriers of entry and promote innovation [5].

All frequency Regulators are generally guided by the National Radio Frequency Management Policy document which outlines the essential issues with respect to frequency assignment, management, monitoring and sanctions/revocations. The main objectives of radio frequency management in Nigeria include:

- i. Promotion of efficient radio communication systems and services through equitable and fair allocation and assignment of spectrum for the benefit of the maximum number of users;
- ii. Spectrum resource planning, management and monitoring in accordance with international agreements;
- iii. Adoption of advanced spectrum allocation and management techniques for the optimal use of spectrum resources;
- iv. Protection of national interests and the coordination of Nigeria’s spectrum policies in bilateral and multi-lateral arrangements; and
- v. Innovation, research and development in new radio communication techniques, spectrum based services and applications [6].

A. License Procedure

Frequency spectrum licences in telecommunications are categorised into short-term permits with a tenure of four months, medium-term permits lasting one year, or long-term licences with a tenure of five, ten or fifteen years. Regular licences range from five to fifteen years. The NCC reserves the right to change the duration, terms and conditions of any frequency spectrum licence. Nearly all frequency spectrum licences are automatically renewable as long as they are being utilised and the licensee is up to date in fee payments.

Broadcast licences have a renewable life span, although, as part of the renewal process, the Commission conducts a public hearing where the licensee’s audience is invited to freely comment on the quality of the operator’s service and the desirability of renewing the licence. The licensee is also required to clear any outstanding financial and administrative obligations to the Commission.

The modes by which the NCC awards licences and assigns frequencies appear to have been based on a combination of commercial value, optimal usage, uniform development across geographies and to some extent, universal access and service. These policy objectives have led to competitive methods of licensing and frequency assignment, including open or selective auctions (either by way of lotteries or «beauty contests»), tenders, and fixed price as determined by the Commission [7].

The table 3.1 shows the spectrum with the potential for increasing internet access.

Table 1.3 shows spectrum with the potential for increasing internet access [7]

Frequencies	Current situation	Potential use
450 MHz	6.25 MHz available, proposed for assignment to commercial operators. It is unknown when the process will be adopted.	Fixed wireless connectivity for the rural market, mobile broadband (4G).
470-860 MHz	Migration to digital broadcasting in 2015 will free up frequencies within this spectrum.	Fixed wireless connectivity for the rural market, mobile broadband (4G).
700 MHz	Migration to digital broadcasting in 2015 will free up frequencies within this spectrum.	Potential application in wireless mobile broadband, mobile broadband (4G).
1.2-1.6 GHz	Migration to digital broadcasting in 2015 will free up frequencies within this spectrum.	Can be used by telecommunication operators and for mobile broadband.
2.4 GHz (Wi-Fi spectrum)	Free for private use. Commercial operators require a license.	Wi-Fi, university/school LAN, public access, Wi MAX, mass market potential.
2.5-2.7 GHz	1900 MHz available, proposed for assignment to commercial operators. It is unknown when the process will be adopted.	GSM mobile, mobile broadband (3G/4G/LTE), WiMAX.
2.7-2.9 GHz	Migration to digital broadcasting in 2015 will free up frequencies within this spectrum.	Can be used by telecommunication operators and for mobile broadband.
3.5 GHz	35 MHz spread spectrum available, proposed for assignment to commercial operators. It is unknown when the process will be adopted.	Rural market, GSM mobile, mobile broadband (3G/4G/LTE), Wi MAX.
3.6-4.2 GHz	Migration to digital broadcasting in 2015 will free up frequencies within this spectrum.	Can be used by telecommunication operators and for mobile broadband.
4.4-5 GHz	Migration to digital broadcasting in 2015 will free up frequencies within this spectrum.	Can be used by telecommunication operators and for mobile broadband.
5 GHz, 5.8 GHz (Wi-Fi spectrum)	Free for private use. Commercial operators require a license.	Wi-Fi, university/school LAN, public access, Wi-MAX, mass market potential
24 GHz	Free for private use. Commercial operators require a license.	Broadband wireless access, mass market potential, public access.
26 GHz	100 MHz proposed for assignment to commercial operators. It is unknown when the process will be adopted.	Broadband wireless access, mass market potential, public access.

B. Frequency Spectrum Regulatory Authorities in Nigeria

The Radio Frequency Spectrum is due to be managed by the following organs of Government below:

- a) National Frequency Management Council (NFMC) is responsible for Planning the national radio frequency spectrum in consultation with the other organs of Government charged with frequency management in accordance with international best practices, Keeping a National Master Register of Frequency assignments, Allocating and coordinating bulk frequency to the organs of government involved with the management of frequency spectrum, Publishing from time to time Frequency Allocation Tables and Frequency Utilization Tables, supervising all the organs of government responsible for the assignment of frequencies including conflict resolution, Promoting research on radio propagation, etc.
- b) Ministry of Information and Communications (MoIC) is the custodian of all frequencies in Nigeria and shall liaise with ITU, sub-regional, regional and international telecommunications organizations for the purpose of representing Nigeria's interest; Serve as the Secretariat of the NFMC. Manage and assign frequencies to government and its agencies, security services and diplomatic missions; Provide assignment data to the NFMC at regular intervals; Manage and co-ordinate internationally assigned frequencies. Carry out monitoring and enforcement procedures in the various frequency bands as may be deemed necessary and reporting such details to the NFMC at regular intervals; Monitor, co-ordinate and keep track of radio signals from space or foreign countries for possible breaches of our national laws and violations of the international telecommunication convention and reporting such breaches or violations to the appropriate organs of ITU.
- c) The Nigerian Communications Commission (NCC) is saddled with the responsibility of Assigning frequencies to non - governmental telecommunications users excluding broadcast frequencies. Performing of enforcement procedures on the various frequencies assigned to ensure compliance with technical standards and administrative procedures. Development and publication of radio frequency regulations and standards for the telecommunications industry; Compiling and updating of a computerised data-base of all radiofrequencies assigned by the Commission; and providing assignment data to the NFMC at regular intervals or on demand.
- d) National Broadcasting Commission (NBC) is charged with Planning, management and monitoring the usage of the frequency spectrum allocated to it; Assignment of broadcast frequencies to commercial, private and government users; Performing of enforcement procedures on all frequencies assigned for broadcast

purposes to ensure compliance with technical standards and administrative procedures. Development and publication of radio frequency regulations and standards for the broadcasting industry, etc. [9]

III. Unlicensed Spectrum

The Nigerian Communications Commission (NCC) has designated the industrial, scientific and medical (ISM) radio band frequencies of 2.4GHz, 5.8GHz and 24GHz, as free for diverse applications following ITU recommendations and global practices. ISM are a group of radio bands or parts of the radio spectrum that are internationally reserved for the use of radio frequency (RF) energy intended for scientific, medical and industrial requirements rather than for communications. Though there are certain technical guidelines which have to be adhered to by users. These conditions include the following:

- a) Applications on ISM frequencies are strictly for private use on a secondary, non-protected, non-interference, and non-exclusive basis. Third party transmissions or commercial services by private networks are strictly forbidden. Providers of commercial services using the ISM band are required to obtain a license.
- b) NCC requires the registration of private networks on ISM frequencies for information purposes.
- c) Equipment must comply with technical limitations on power output, tolerance, modulation and range.

The main objective is to promote rapid expansion of services and in particular to increase use of Internet services, using Wi-Fi technologies. As 2.4 GHz is a shared band, the Commission has issued a guideline to ensure interference free operation by all users of the band and guaranteed grade of services to subscribers. Table 4.1 below shows the frequencies approved for free transmissions on the 2.4GHz frequency band [7].

Table 1.4 : shows ISM Frequencies in Nigeria (NCC) [7]

ISM FREQUENCY (REGION 1)

Frequency band	Frequency Range
67 KHz band	6765 – 6795 KHz
13 MHz band	13.553 – 13.567 MHz
27 MHz band	26.957 – 27.283 MHz
40 MHz band	40.66 – 40.70 MHz
2.4 GHz band	2.400 – 2.5000 GHz

IV. Conclusion

The set down objectives for radio frequency spectrum assignment and efficiency can be achieved through national spectrum planning and the assigning of frequencies on the basis of usage, rather than to particular users, ensuring greater access among broader number of users especially for broadcasting. Regulators are to sanction licensees for unutilized usage and speculative trading or transfer of assigned frequencies.

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