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DETECTION OF REDUNDANT FREQUENCIES IN FM BAND USING COGNITIVE RADIO DEVICE WITHIN CROSS RIVER, AKWA IBOM, AND RIVERS STATES

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Abstract

This research carries out detection of FM Stations, and redundant frequencies within the South-South region comprise of Cross River, Akwa Ibom, and Rivers States. The detection, and identification of the FM Stations was done using an android cell phone, TECNO Hot 6, as an-improvise of a cognitive radio (CR) devise. Some selected towns were visited, using this cell phone; the number of FM stations operating in each state were monitored, and identified. This cell phone has a software defined radio (SDR) application which was used to detect assigned FM frequencies within the area defined by this study. This process was repeated in all the states respectively. The result obtained was recorded as Cross Rive had eight (8), Akwa Ibom nine (9), and Rivers had fourteen (14) FM stations respectively, all the redundant frequencies were also detected, and recorded. It was found that the three states only host thirty-nine FM Stations out 155 in FM Spectrum. This in-depth study revealed the extent to which this FM spectrum has been utilized by Nigerian Communication Commission (NCC), and the unutilized aspect of this spectrum, and made available for proper and future usage within the specified area of study. Therefore, the result presented it could be very useful to NCC in frequency allocation within this area of study.

1.0 Introduction

The radio frequency is a limited natural resource and getting enabled day by day due to growing demand of the wireless communication applications (Akyildiz, I. F., Lee, W-Y., Vuran, M. C. and Mohanty, S. 2008). To operate on a specific frequency, license to that particular frequency is needed. The use of radio spectrum in each country is governed by the corresponding government agencies. In conventional technique each user is assigned a license to operate in a certain frequency band (Akyildiz, I. F., Lee, W-Y., Vuran, M. C. and Mohanty, S. 2008). Most of the time, spectrum remain unused and it is also difficult to find it. In another way, the allocated frequency, is never utilized effectively and varies with time, frequency and geographical location. To overcome the spectrum scarcity and unutilized frequency in the spectrum band, a new communication technique known as cognitive radio (CR) and dynamic spectrum access (DSA) is introduced Lakshmi J. D.

and Rangaiah. L (2019). CR network provides efficient utilization of the radio spectrum and highly reliable communication to users whenever and wherever needed. DSA technology allows unlicensed secondary system to share the spectrum with licensed primary system Popescu, A. (2010). Due to the continuous development of devices and services, our environment is transforming into spectrum demand, radio frequency (RF) spectrum has assigned various bandwidths to various communication bodies that make use of the spectrum Popescu, A. (2010).

The Nigerian Communications Commissions (NCC) is responsible for bandwidth and spectrum regulation in Nigeria (Okorogu V. N., Alumona T. L., Onwuka P.E., and Emenike C. J. 2016). The primary tool of spectrum management by government is a licensing system through bidding. This involves spectrum being apportioned into blocks for specific uses, and assigned licenses for these blocks to specific users or bodies (Khalid, L. 2014). These assigned bandwidths are fixed to the respective bodies (Kusaladharma, S. and Tellambura, C. 2017). Hence, with the continuous development of new inventions it also, brings the problems as in communication field, spectrum scarcity, which is now becoming a very major problem as man invents applications every day (Mondal, R. K. 2018). Each application require spectrum to operate, but with the limited amount of spectrum availability, cognitive radio is needed to eliminate the spectrum scarcity problem (Odufuwa F. 2010). Major reasons for spectrum scarcity are inefficient and ineffective utilization of the spectrum available, (Polson J. 2004). Hence spectrum is divided into two types of users; primary spectrum users (PSU) and secondary spectrum user (SSU), PS is a spectrum that is paid for, that means you need a license to use while SS is a spectrum that is free you don't need a license. 11One of the solutions in spectrum scarcity is to identify the spectrum holes. Spectrum holes are those that are created when primary users are not using the allotted spectrum to them at that particular time,

2.0 Methodology

This research work used Tecno hot 6 as an adaptive cognitive radio device, because the device was equipped with software defined radio application that could be used to detect occupied and used frequencies as well as redundant frequencies. Figure 3.1 above shows clearly how this device was deployed in gathering data for this research work in the field. The seven South – South State capitals and other commercials towns were visited at the cause gathering data for this research work. In each State Capital and other important Towns considered on-air FM Stations were searched with SDR device and all the FM Stations detected were recorded. The Towns and Cities considered in this research work include; Port Harcourt in River State; State; Ikom and Calabar in Cross River State; as well as Eket, and Uyo in Akwa Ibom State This software defined radio (SDR)

3.0 Method and Process of Detecting the FM Stations

The method and process of identifying the existing FM station within the State considered in this research was as presented in the subsections as follows; An android phone, Tecno Hot 6 was used as an improvise

of a cognitive radio CR which was used to identify FM broadcast Station existing in each state. Each state capital was visited, and this device was used to tune through the FM band which identified all allocated and usable FM frequencies within each state. This process was repeated in all the choice locations in each state, and the results recorded.

The first state visited is River State, and has fourteen (14) FM Stations situated in the State Capital Port Harcourt only. Akwa Ibom State, was the second state and Towns used were Eket, and Uyo. Also, in Cross River State, two towns were visited, they were Ikom and Calabar. The results of FM Station detected from the three states and five Towns are as recorded in Table 1.

4.0 Results

The results of this research work are presented in tables 1 to 3.

Table 1.: Shows all the allocated and occupied frequencies within the three States

STATE	LOCATION	S/N	STATION ID	FREQ.
Akwa Ibom	Uyo	1	AKBC	90.5
	Uyo	2	PASSION	94.5
	Uyo	3	COMFORT	95.1
	Uyo	4	UNIUYO	100.7
	Uyo	5	PLANET	104.5
	Eket	6	HERITAGE	104.9
	Uyo	7	PARADISE	105.9
	Uyo	8	XL FM	106.9
	Uyo	9	GOSPEL REVOLUTION	107.5
Cross River	Ikom	1	CRBC	89.7
	Calabar	2	SPARKLING	92.3
		3	FAD	93.1
		4	HIT	95.9
		5	CORRECT	97.3

		6	CANAAN	99.5
		7	CRBC	105.5
Rivers	Port Harcourt	1	UNIQUE	88.5
		2	GARDEN CITY	89.9
		3	CLASSIC	91.1
		4	WAVE FM	91.7
		5	NIGERIA IFO	92.3
		6	NAIJA	92.7
		7	RHYME	93.7
		8	WAZOBIA	94.1
		9	TODAY	95.1
		10	COOL	95.5
		11	FAMILY LOVE	97.7
		12	TREASURE	98.5
		13	RADIO RIVERS	99.1
		14	WISH	99.5

This table 1 shows clearly all the allocated frequencies detected and arranged state by State. It also, shows the States, Towns where these FM Stations are located, FM Station IDs, their frequency of operation and the number of FM Stations detected per State. While Rivers Station has the highest number of FM Station of seventeen (14), Akwa Ibom, and Cross River has (9), and (7) respectively.

Table 2: Shows FM Stations Operating with the Same Frequency within the States

S/N	FREQ.	ASSIGNED STATION	STATE	LOCATION
1	92.3	Sparkling FM	Cross River	Calabar

		Nigeria IFO	Rivers	Port Harcourt
2	92.6	CRBC	Cross River	Calabar
		Naija	Rivers	Port Harcourt
3	99.5	Wish	Rivers	Port Harcourt
		Canaan	Cross River	Calabar

Table 2 was constructed to show how multi – stations operate with the same frequency. In many cases, up to two different FM Station operates with similar frequency. The location and states of operation of these stations are also indicated and showed in this table 3. The first shared frequency, 92.3MHz is shared with Sparkling FM Calabar and Nigeria IFO, Port Harcourt. The second shared frequency, 92.6MHz is shared with CRBC FM Calabar, Naija FM, Port Harcourt. The third shared frequency is 99.5MHz. this shared Wish FM and Caanan FM of Port Harcourt and Calabar respectively.

In this table 2, all unassigned FM frequencies within the South-South zone were displayed for ease of identification throughout the FM band.

All the 161 frequencies contained in Table 2 are yet to be assigned to prospectus users from FM band. So, these unused frequencies serve as holes for cognitive radio operators as well as both private and Governments to subscribe to for information dissemination within FM band.

Table 3: Shows a Class Boundary of the FM frequency band, number of Allocated and Unallocated Frequencies in each class boundary

S/N	CLASS BOUNDARY	NOT ALLOCATED FREQU	ALLOCATED FREQUENCY
1	87.00 – 87.90	0	0
2	88.00 – 88.90	8	2
3	89 .00 – 89.90	7	3
4	90.00 – 90.90	8	2
5	91.00 – 91.90	8	2
6	92.00 – 92.90	7	3
7	93.00 - 93.90	7	4

8	94.00 – 94.90	5	5
9	95.00 – 95.90	6	4
10	96.00 – 96.90	7	3
11	97.00 – 97.90	7	3
12	98.00 – 98.90	8	2
13	99.00 – 98.90	6	4
14	100.00 – 100.90	6	4
15	101.00 – 101.90	8	2
16	102.00 – 102.90	9	1
17	103.00 – 103.90	8	2
18	104.00 – 104.90	8	2
19	105.00 – 105.90	8	2
	Total	**130**	**50**

The entire FM band was grouped into 22 class boundaries of equal size of ten (10) different frequencies as shown on table 3 In each of the class boundaries, the number of allocated and non–allocated frequencies are shown. The table was made up class boundary, unallocated frequencies and allocated frequencies. From table 4, the total number of both unallocated and allocated frequencies could easily be determined. The table showed that 130 frequencies (FM channels are still unassigned to subscribers. While only 50 frequencies (FM channels) are effectively used within the States

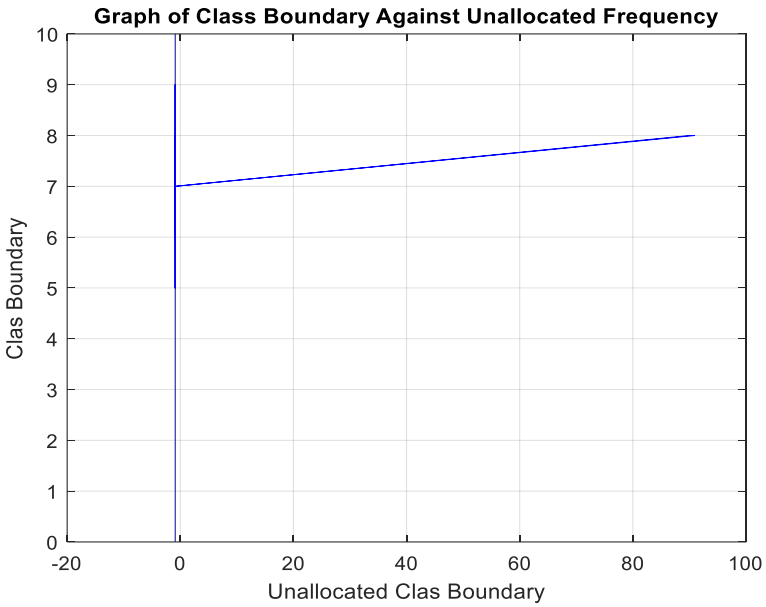

Figure 2.1 Class Boundary and unallocated Frequency

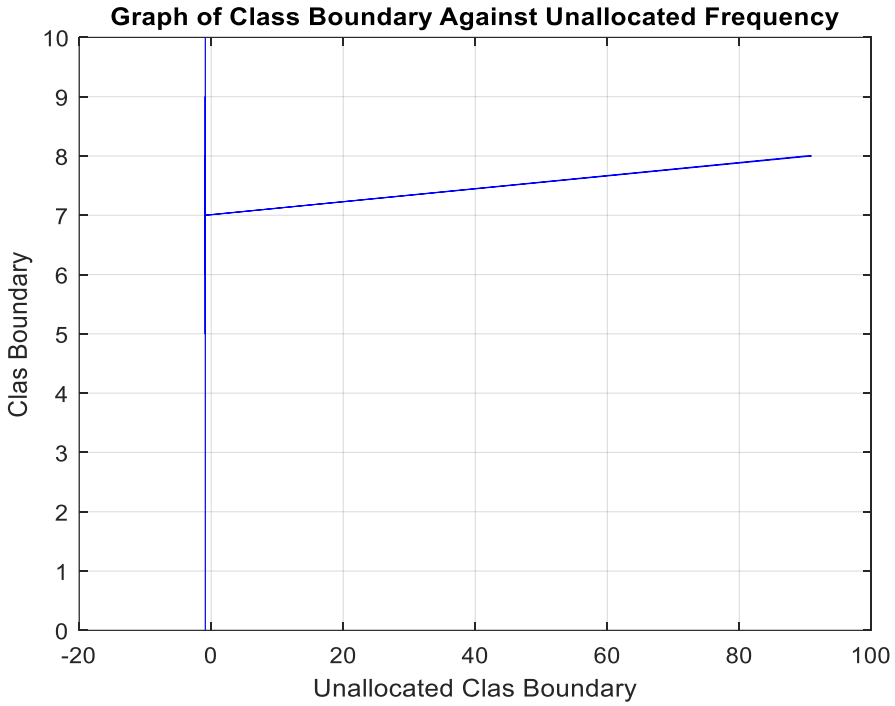

Figure 2.2 Class Boundary and unallocated Frequency

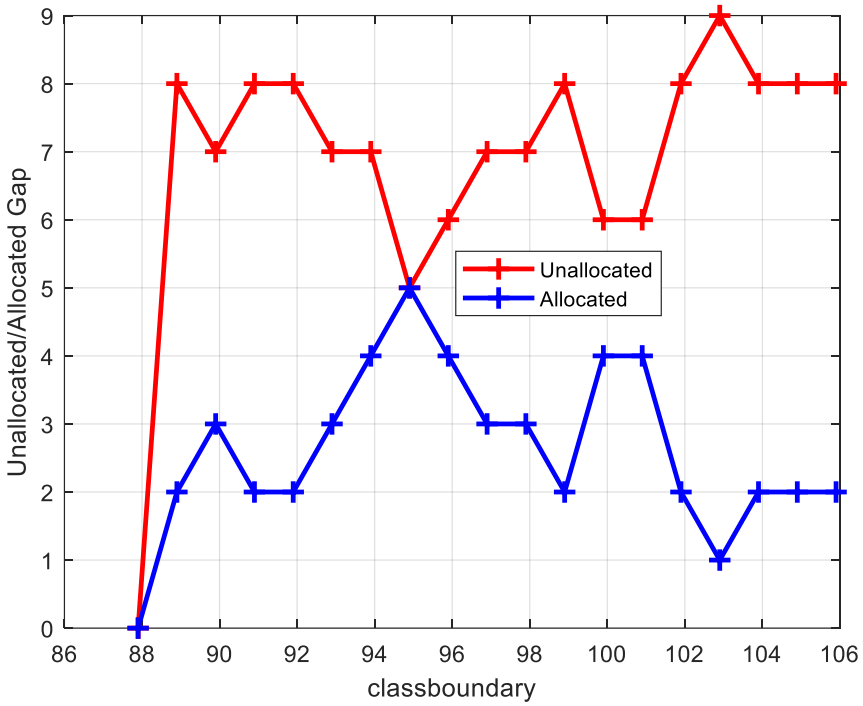

Figure 2.3 Class Boundary and unallocated/allocated Frequencies

5.0 Discussion

Table 1 showed clearly all the allocated frequencies detected and arranged state by state. This table also showed the States, Towns where these FM Stations are located, FM Station IDs, their frequency of operation, and the number of FM Stations detected per State. While Rivers Station has the highest number of FM Station of seventeen (14)., others like Akwa Ibom have nine (9), and Cross River has eight (7).

In many cases, up to two different FM Station operates with similar frequency. The location and states of operation of these stations are also indicated and showed in this table 2. The first shared frequency, 92.3MHz is shared with Sparkling FM Calabar and Nigeria IFO, Port Harcourt. The second shared frequency, 92.6MHz is shared with CRBC FM Calabar, and Naija FM, Port Harcourt. The third shared frequency is 99.5MHz and the Stations involve are Wish FM and Caanan FM of Port Harcourt and Calabar respectively.

It was further deduced that FM stations sharing the same frequencies were not located within the same State of broadcasting but separated from each other with reasonable distance of hundreds of km apart (frequency reused).

From table 3, the total numbers of both unallocated and allocated frequencies could easily be determined. The table showed that 130 frequencies (FM channels are still unassigned to subscribers. While only 50 frequencies (FM channels) are effectively used within the South – South region. The research shows a total of 31 FM channels are

assigned/ utilized within the three States under consideration.

6.0 Findings

The researchers found that

a. three States on occupied 31 frequencies**.**
b. Some Stations shared common frequency operation due to frequency reused
c. There is gross under utilization of frequencies in the FM band within the South-South region of Nigeria.

7.0 Conclusion

This thesis was adequately researched within the South–South Zone of Nigeria. The research found that so many usable frequencies in FM band were still left unallocated to subscribers therefore left abandoned. The researcher has also made known to both Nigerian Broadcasting Commission NBC and Nigerian Communication Commission NCC the number of unutilized frequencies within the Zone under consideration. It now beholds on the prospectus frequency user and both the NBC and NCC to adequately utilize the result provided in this research to monitor and subsequently allocate the available frequencies for management and utilization for the benefit of all.

8.0 Recommendation

Considering that today's modern communication has made it very possible to globalize the world and antennas played very critical role in the globalization process, therefore the following recommendation is made based on this research. This research has provided and addressed the problems the number of assigned and effectively occupied frequencies; unassigned frequencies and the location of the stations using these frequencies. Therefore, this research work is highly recommended to both NBC and NCC for future allocation of frequencies to desiring private organizations and Government broadcast stations. The solutions to the problem of management and monitoring of the FM frequency have to a greater extent solved by this research work, therefore, this work is highly recommended.

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