

Radio Frequency Spectrum Observatory Report and Management for Enhancement of 5G Cognitive Radio Networks in South East Nigeria

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Radio Frequency Spectrum Observatory Report and Management for Enhancement of 5G Cognitive Radio Networks in South East Nigeria.

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Abstract

The provisions of wireless resources are obviously increasing in demand globally on daily bases as a result of undoubting opportunities and communication breakthrough they afford mankind; which consequently led to swift increase in the number of users and diverse communication options. This study analyzes radio frequency resource and its management for the five states of south east Nigeria and develops the geolocation data-base-web where secondary users can query the availability of the free bandwidth at any point in time without causing any network mishaps to the primary users. The bands of interest are that of very high frequency and ultra-high frequency bands. The first task undertaken was an outdoor measurement campaign for 48 hours using a threshold of -90 dB to decide the presence of licensed users else the band is termed free for opportunistic utilization. Empirical statistical evaluations were used to analyze the measurements' outcome and the results showed that on the average, 37.5%, 49.2.5%, and 13.2 %, 36.6 %, 45.2 % and 18.1%, 40%, 41.9% and 18.2 %, 38..1%, 47.1% and 14.8 %, and 35.7%, 48.4 % and 16 % of the bands captured were un-occupied, not-fully occupied and fully-occupied for Abia, Anambra, Ebonyi, Enugu and Imo states respectively. The specific occupancy for each of the states whether rural or urban was also captured in table 2. The results also indicate that there are opportunities for dynamic spectrum access and harvesting for radio frequency resource management in 5G network and wireless networks at large.

Keywords: Very-high and ultra-high radio frequency, radio frequency occupancy, geolocation data-base, and South East Nigeria.

1 Introduction

The globalization of the world is continuously having a leap and primarily enabled and sustained through wireless communication services. Internet services are part of wireless communication that have become part of human life whose provisions make life easy and fast going. Government on her own is doing everything possible to sustain wellness of its citizens by providing policies that eradicate digital divide and exclusion, the sustainable development goal (SDG) 9. which aims at building resilient infrastructure, promoting inclusive and sustainable industrialization and fostering attests to this crucial intension innovation [1] and [2], (2023). This internet access is greatly deployed and best enjoyed on wireless bases as it is reliable and cost effective when compared with the wireline communication. It is the vastly used method of communication at the present times because it is easy to install and gives high speed data transfer. It also provides mobility to the users, enabling them to use wireless medium at any given time and place which curbs limitations and complexities associated with wired network. Wireless communication uses radio frequency spectrum; a natural resource as the integral medium for its propagation, spectrums of a limited bandwidths are assigned to different modes of service providers for their exclusive uses in order to avoid encroachment from one to another.

However, there is limitation in use of these exclusive allocated bandwidths as observations made from several researchers have that while some networks are heavily congested, some are being underutilized and even stay ideal across times and geographical regions [3] and [4]. Therefore, there exists a need to develop techniques for optimizing available spectrum across allocated bands of spectrum.

Measures have been introduced before now to optimize the available bandwidth of the spectrum; they are time and frequency hopping techniques. These techniques are able to perform and contribute in increasing the efficiency of system; however, they pose resistance to interference and eavesdropping, and equally not so effective in utilization of the whole bandwidth assigned to the users. Consequently, these are drawbacks that limit their deployment as there is enormous hunger for spectrum resources' wide ranges of provisions and opportunities. A possible route out of this global challenge is the emergence of cognitive radio technology (CRT) which is dynamic in its operation and ensures spectrum resources utilization in opportunistic manner [5]. Utilizing spectrum resources in opportunistic manner as promised by CRT requires a previous knowledge of channel's occupancy of primary users by the secondary users, this ensures that hand-off delay and possible interference are avoided. So, to achieve this awareness, spectrum observation (sensing) is a must task to be undertaken as it is very integral to deployment of CRT and particularly spectrum management. Observations made from the practices of cognitive

radio technology have shown that regardless of the spectrum sensing technique used by the cognitive users to access the opportunistic spectrum, interference and other channel impairments have become reoccurring experiences in the network. This research work is therefore designed to investigate the spectrum resource allocation for TV, radio and wireless service providers bands in all states of south east Nigeria; it provides detailed spectrum scan status for very high frequency (VHF) and ultra-high frequency (UHF) radio spectrum bands that cover these bands of interest. A geolocal data web was also designed where information about the scanned environments were stored for access by the secondary users for dynamic spectrum utilization and awareness of interested researchers in this discipline.

1.1 Paper Organization

The paper is thus organized as follows; Section 1 has introduction, Section 2 elaborates related works reviewed and research gaps that necessitated this work, materials used were described in section 3, threshold decision, measurement location, analysis of the spectral occupancy measurement and development of the web-based TV white space geo-location database system as parts of method were considered in section 4. The spectrum occupancy statistical and graphical results alongside their discussion were captured in section 5 while section 6 has contribution and conclusion.

2 Review of Related Works

The works of [6] conducted a spectrum occupancy measurement in cellular frequency band that covers the range of 700-2700 MHz for one week at 10dB above the noise floor. RF explorer 6G combo spectrum analyzer connected to dongle laptop and installed with MATLAB was used to carry out the measurement. Their results showed that an average occupancy of all services was at 16.06%, while 50% of the locations' occupancies was below 20% for the LTE and below 33% for GSM 900 and UMTS2100.

[7] carried out a comparative study on the spectrum observatory for the improvement of spectrum management in cognitive radio networks in urban and rural areas. Their work was an outdoor observation done in January and February 2020 that surveyed second, third and fourth-generation mobile networks and digital video broadcast-terrestrial frequency bands. Their work analyzed the radio frequency span of 20-800 MHz in a distance of 30 km distance and discovered the frequency bands that can be harvested for integration of new wireless communication and cognitive radio system. Their results showed an occupancy of lower than 30.27% and 8.43% for the captured locations.

Authors of [8] conducted quantitative estimation of ultra-high frequency band in six states of south west Nigeria using the protection, the pollution view point and FCC rule. Their work covered TV white spaces in the coverage area of the TV broadcasting station and utilized the location of the tower, transmission power of the TV transmitter, operating frequency and height of the antenna as parameters for estimating the available TVWS. The results from the estimation show that the pollution view point approach guaranteed enough protection from the primary users and prevent interference from the secondary users. Their findings also revealed that there were abundant TVWS in the states for the deployment of TVWS devices.

The work of [9] developed a web-based geolocation data base for the identification of television white space in Nnobi Anambra state, south east Nigeria. Their work captured the radio spectrum range from 470-789MHz using an RF explorer with a threshold of -110dBm to decide the presence or absence of licensed users. A span of 20MHz was used to enhance sensitivity of the spectrum measured, and the frequency resolution for the experiments was set to 178.6 KHz on the RF Explorer window client. Their measurement was done for fifteen minutes for the period of one week in Nnobi village and the result indicates that more than 70% of the frequencies in the UHF band were left unused implying their potential for white space harvesting.

[10] did a comparative evaluation of spectrum occupancy of broadcasting bands in urban, sub-urban and rural environments in three locations of Calabar, Cross-Rivers state Nigeria. The measurements were taken for three hours each day between October 2018 and May 2019 in each location to ensure the possible daily broadcasting pattern of stations and the maximum held signal strength were captured. Further measurement was done in Uyo in September 2021 to compare its results with Calabar urban's results. Their results show that ultra-high frequency band percentage utilizations for the three locations were 98%, 76% and 33% with available cumulative bandwidths of 8MHz, 96MHz, and 264MHz respectively

A web-based geolocation database for television white space in Ngwo Enugu state, south east Nigeria was designed and developed in [11], Their work captured the radio spectrum range from 470-789MHz using an RF explorer with a threshold of -94.5dBm to decide the presence or absence of licensed users; the channel is classified occupied when the perceived signal strength is above the threshold otherwise it is termed free for TV white space harvesting. Their measurement was done for fifteen minutes for the period of one week and in restricted in Ngwo village. Their result indicates that more than 65% of the frequencies in the UHF band was left unused, thereby making it a place for potential white space harvesting.

A spectrum occupancy prediction model for cognitive radio system was developed in [12]. In his work, a machine learning model for spectrum occupancy was developed to manage the delay that led to inefficient utilization of available spectrum. Power spectrum density data was collected for twenty-four hours in Minna, Niger state and Federal Capital Territory, Abuja, Nigeria with three measurement sites in each location within the VHF band (30-300 MHz). A back-propagation neural network (BPNN) model was developed to predict the spectrum occupancy using time-series data which was converted into a feature vector and captured as time instances of the occupancy of all the frequency sub-bands. Twenty-four different input parameters with only one output which capture hourly spectrum occupancy were used to predict the spectral occupancy. The results for Minna dataset, in band 1 (30-47 MHz), reveal a highest actual spectral occupancy of 40.59% with a prediction accuracy of 99.06% while band 7 (137.05-144 MHz) has a lowest occupancy of 25.24% and a prediction accuracy of 99.31%. The corresponding results for the Abuja dataset, in band 1 (30-47 MHz), show a highest actual spectral occupancy of 39.11% with a prediction accuracy of 98.59% while band 11 (230.05-267 MHz) has a lowest occupancy of 22.13% with a prediction accuracy of 99.40%.

[13] developed an enhanced spectrum allocation algorithm for secondary users in cognitive networks, the enhanced algorithm was based on artificial bee colony algorithm used for predicting and sensing the channel of primary users. The algorithm first predicted the channel allocated to primary users, after which sensing of the channel which reduced the false alarm probability and increased overall throughput of the network. The proposed algorithm overcame the drawbacks of modified traditional methodologies which were used only for sensing a channel and showed 11.8% additional efficiency as compared to binary artificial bee colony algorithm.

An evaluation of spectrum occupancy in West African television bands to understand the practical opportunities for DSA-based connectivity in [14]. The authors conducted measurements in urban and rural areas of Nigeria, Ghana, and Sierra Leone; analyzing the temporal patterns of TV channel usage and their implications for secondary access. The results revealed large portions of underutilized spectrum, particularly in rural areas, confirming that TV White Spaces remain a viable medium for broadband expansion in the region. They also tested database-assisted access, where secondary devices query a central server for available frequencies, and found that this method can effectively prevent interference with primary broadcasters. The study provided real-world evidence supporting the potential of TVWS and reinforced the importance of context-specific regulation for efficient spectrum management

2.1 Research Gap

Radio frequency spectrum and specifically very-high and ultra-high frequency bands used for TV transmission and cellular networks have not received enough attention in spectrum observatory works in south-east Nigeria. This assertion is made based on the fact that there is no specific work that focused on VHF and UHF bands in all the states of south-east Nigeria despite the enormous attractive features of these bands. Most studies were centered on UHF and measurement carried within short periods and on restricted locations of the states, these are a few research gaps that were addressed in this research.

3 Materials

An RF spectrum analyzer was used to scan the radio frequency environment of the various measurement locations. It has two antennas mounted on its two ports: the SMA 1 and SMA2 which are responsible for low input/output and high input/output spectrum analyzer and signal generator modes. It displays the full frequency spectrum, carrier and modulated shapes, and activities of spread spectrum. It equally shows the bandwidth to monitor collision and frequency deviation from tone. Universal serial bus (USB) cable was another device used; it connects the RF spectrum analyzer to the laptop and ensures there is an enabled connection between spectrum analyzer and the laptop. An HP Elite Book 840 G3 model laptop was used; it connects the RF spectrum analyzer via USB cable. It is used to capture and record the pictures and videos of the measurements taken, and ensures their broader and quality display for graphic purposes. To be able to do all these, the laptop was preinstalled with an RF explorer windows client which enables compatibility between the RF explorer and the laptop's window used. It is installed in the laptop and automatically gets connected to the RF explorer once connected together with a USB cable, simply put, it ensures the whole set-up meets up with its purpose, A nearby source of power supply was made available to maintain a functional set-up for the period of the measurement. Figure 1(a) shows the set-up materials used for the measurement while figure 1(b) presents the RF explorer-laptop inter phase outlook.

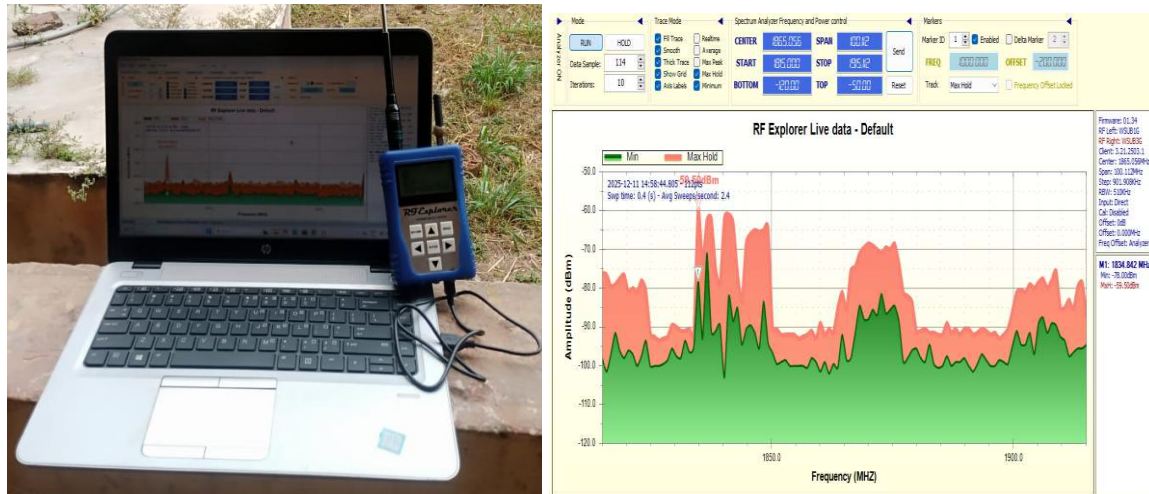


Figure 1a: The set-up materials for the measurement. Figure 1b: The RF explorer-laptop inter phase outlook

4 Method

4.1 Threshold Decision

A very close observations of measurements taken at various locations indicate that channels' activity was always noticed at values greater than and equal to minus ninety decibel miliwatt (≥ -90 dBm) of the received signal strength of the RF spectrum analyzer and usually 10dBm above the noise floor. This decision is also based on International Telecommunication Union (ITU) recommendation.

4.2 Measurement Locations

Spectral occupancy measurement within the frequency range of 150 MHz to 2700 MHz with a span of 100 MHz was carried out for 48 hours using an RF explorer. Two types of locations which are urban and rural areas were considered in this study to determine the density of users and their usage of spectrum resource in these environments. The urban areas are Umuahia, Akwa, Enugu, Abakaliki and Owerri while the rural areas are Isuochi, Umunze, Four corners, Afikpo and Okigwe. A careful choice of a measurement location is essential for a good spectrum measurement campaign as locations chosen have a very great impact on the spectrum occupancy measurement. A site for spectrum measurement will demand:

- 1 Transmitters around the measurement location are minimal to avoid intermodulation and saturation challenges.

2 Minimal impulsive noise due to vehicular movements, electrical machines and any other noise that is dominant in an environment like noises from social activities which can increase the signals received. Bearing in mind these conditions, measurements were taken in these locations listed in table 1.

Table 1: The measurement states, regions, locations and their geographical positions.

States	Regions' type	Locations	Geographical Positions
Abia	Urban 1	Slot system Umuahia	5.533429,7.491579
	Urban 2	Federal Medical Centre Umuahia	5.5224608,7.4910685
	Rural	Obuohia Ndiawa Isuochi	6.2367185,7.163264
Anambra	Urban 1	Nnamdi Azikiwe ASSU secretariat Akwa	6.2485557,7.1213762
	Urban 2	D-New WOZOBIA guest house a Amawbia	6.2367185,7.163264
	Rural	Maranatha communication Nigeria limited, Umunze	5.9774877,7.2296729
Ebonyi:	Urban 1	28 Onwe road, Abakaliki	6.3130785,8.1002921
	Rural	Egesco guest house Ndibe beach, Afikpo	5.8833429,7.9333437
Enugu	Urban	No 65 Owerri Road, Asata.	6.4472567,7.4977829
	Rural	Chisom guest house, four corners	6.0952529,7.4954456
Imo	Urban	Ama-wire by Imo state University	5.5137439,7.0451941
	Rural	Laommies Suites, Okigwe	5.8223774,7.3453332

4.3 Analysis of the spectral occupancy measurement.

The spectrum occupancy for each frequency of the channel in each location was calculated in order to ascertain percentage occupancy of each channel for the period measurements. Duty cycle which is the percentage of time a

frequency band or channel is occupied over a given period was used to evaluate how often signals are perceived during a sample period of scanning.

$$\text{It is given as duty cycle (DC) (\%)} = \frac{\text{Occupied Period (OcP)(hours)}}{\text{Total Observation period (hours)}} \times \frac{100}{1} \quad (1)$$

Another estimate considered is the Spectrum Resource Occupancy (SRO), it is given as

$$\frac{\text{Number of occupied channels (NCO)}}{\text{Total number of channel measured (TNCM)}} \times \frac{100}{1} \quad (2)$$

From the spectrum occupancy measurements carried out, these nomenclature and abbreviation were made to help classify the values and status of the measurements of the various locations.

So, we have total number of channels measured (TNCM), number of unoccupied channels (NUC), number of channels not fully occupied (NCNFO), number of channels fully occupied (NCFO) and total number of occupied channels TNOC (both NCNFO and NCFO). From these, further relationships were derived for classification.

$$\text{Percentage of number of channels not fully occupied (\% NCNFO)} = \frac{\text{NCNFO}}{\text{TNCM}} \times \frac{100}{1} \quad (3)$$

$$\text{Percentage of number of channels fully occupied (\% NCFO)} = \frac{\text{NCFO}}{\text{TNCM}} \times \frac{100}{1} \quad (4)$$

$$\text{Percentage of number of unoccupied channels (\% NUC)} = \frac{\text{NUC}}{\text{TNCM}} \times \frac{100}{1} \quad (5)$$

4.4 Development of the Web-based TV white Space Geo-Location Database System

A geo-location database web system for storing, processing, and querying television white space (TVWS) spectrum across South-Eastern Nigeria was developed. It serves as a functional prototype that translates analytical components into deployable implementation. The objective was to develop a platform capable of demonstrating database driven spectrum access rather than a full-scale regulatory system. It is accessible at

<https://tvws-geolocation-app.vercel.app/>

The system was developed using a modular client-server architecture consisting of 3 layers:

1. 1 The frontend interface: this was implemented using react native to provide cross-platform accessibility across web and mobile platforms. It allows manual or GPS-based coordinate input visualization of available TVWS channels, and administrative monitoring and data entry.
2. 2 The backend development and computational logic: this was implemented using FastAPI, a Python-based web framework selected for its performance and ease of API development. It validates user/device geolocation queries, application of simplified protection criteria, and structured JSON response generation.

3. 3 Database structure and data management: The MySQL was used as the relational database management system for structured storage of measured spectrum occupancy records, geospatial classifications and historical query logs. The schema was designed to support efficient retrieval of location-dependent spectrum information while maintaining structural simplicity consistent with the proof-of-concept scope.
- 4 4 Operational workflow: this follows a simplified geo-location database query process as follows:
 - A user or white Space Device submits a location-based request
 - The backend retrieves nearby incumbent broadcast data.
 - Protection criteria are evaluated using separation distance and received power threshold conditions
 - The system returns permissible channels and associated transmit power limits

This workflow mirrors the functional principles of certified TVWS database systems.

4.5 User Interface Design and Front-End Interaction: The frontend of the TV White Space (TVWS) geolocation database system was developed using typescript and react. They were chosen to provide a fast, interactive, responsive and user-friendly interface, this interface enables users to access the systems functionalities like authentication, spectrum querying and data measurement. The interface consists of:

- 1 Login and authentication pages
- 2 Query interfaces
- 3 . Administrative dashboards
- 4 Data upload forms
- 5 . Dynamic result display sections

Dropdown menus and input fields were implemented to allow users to query TVWS data based on parameters such as state, location, and time. The interface was designed to ensure that there is ease of navigation, fast response, and improved user experience.

4.6 Frontend–Backend Interaction: Communications between the frontend and backend follows a client-server architecture. The react frontend is the client interface while the backend is handled by a FastAPI, a python dependency. Interaction between both components is achieved through RESTful APIs using HTTP requests and

responses. When a user submits a request through the frontend interface, the following steps are followed for interaction and execution.

- The request is sent to the FastAPI backend.
- The backend processes the request.
- Relevant data is retrieved from the MongoDB database.
- The processed result is returned to the frontend in JSON format.
- The frontend dynamically displays the result to the user.

To ensure a secured interactions between the user-facing application and its server, JSON Web Token (JWT) authentication was incorporated. Following a successful sign-in, the server generates an access token which is used to authorize all subsequent requests, granting access based on the user's specific roles and permissions. Administrative users are able to submit TV White Space (TVWS) measurement data directly through the application's interface. The incoming data undergoes thorough validation on the backend prior to its storage in the MongoDB database, thereby safeguarding its accuracy and consistency.

The user interface communicates asynchronously with the backend, allowing for dynamic content updates without requiring a full-page refresh. This significantly improves the system's responsiveness and overall operational efficiency.

5 Results and Discussion

Table 2 shows the distribution of the number of channels measured, and the various spectral occupancy distribution for the locations in the five states. It contains TNCM, NUC, %NUC, NCNFO, %NCNFO, NCFO and %NCFO for the five states captured during measurement.

Table 2: various spectral occupancy distributions for the locations in the five states.

States	Locations	TNCM	NUC	%NUC	NCNFO	%NCNFO	NCFO	% NCFO
Abia	Umuahia 1	246	83	33.7	123	50	40	16.2
	Umuaahia 2	246	88	35.7	123	50	35	14.2

	Ndiawa	246	106	43.1	117	47.5	23	9.3
	Average values	246	92	37.5	121	49.2	33	13.2
Anambra	Unizik	246	97	39.4	99	40.2	50	20.3
	Akwa	246	132	53.7	96	39	18	7.3
	Umunze	246	41	16.7	139	56.5	66	26.8
	Average values	246	90	36.6	111	45.2	45	18.1
Ebonyi	Abakaliki (1)	246	94	38.3	106	43.1	46	18.7
	Abakaliki (2)	246	67	27.2	139	56.5	40	16.3
	Afikpo	246	133	54.1	65	26	48	19.5
	Average values	246	98	40.0	103	41.9	45	18.2
Enugu	4 Conners (1)	246	102	41.5	110	44.7	34	13.8
	4 Conners (2)	246	119	48.4	95	38.6	32	13
	Owerri rd.(1)	246	60	24.4	143	58.1	43	17.5
	Average values	246	94	38.1	116	47.1	36	14.8
Imo	Owerri (1)	246	74	30.1	128	52	44	17.9
	Owerri (2)	246	73	29.7	127	51.6	46	18.7
	Okigwe	246	116	47.2	102	41.5	28	11.4
	Average values	246	88	35.7	119	48.4	39	16

About 246 channels at a span of 10 MHz were measured in each state, it can be observed from table 2 that on the average, **37.5%**, 49.2.5%, and 13.2 %, 36.6 %, 45.2 % and 18.1%, 40%, 41.9% and 18.2 %, 38.1%, 47.1% and 14.8 %, and 35.7%, 48.4 % and 16 % of the spectrum were un-occupied, not-fully occupied and fully-occupied for Abia, Anambra, Ebonyi, Enugu and Imo states respectively. The figure 2a presents the bar chart representation of the spectrum occupancy at the various measurement states while figure 2b represents the lines with markers

indicating the trends of occupancy over the period of measurement. The vertical margins of the graphs represent the duty cycle in percentage while the horizontal margins represent the various states being captured during measurement.

Additionally, table 2 also presents the exact spectral occupancy for each of the locations across the five states, while graphical figures 3a and 3b, figures 4a and 4b, figures 5a and 5b, figures 6a and 6b, and figures 7a and 7b present the bar charts and line markers representation of the spectrum occupancy at specific locations for Abia, Anambra, Ebonyi, Enugu and Imo states respectively as extracted from table 2.

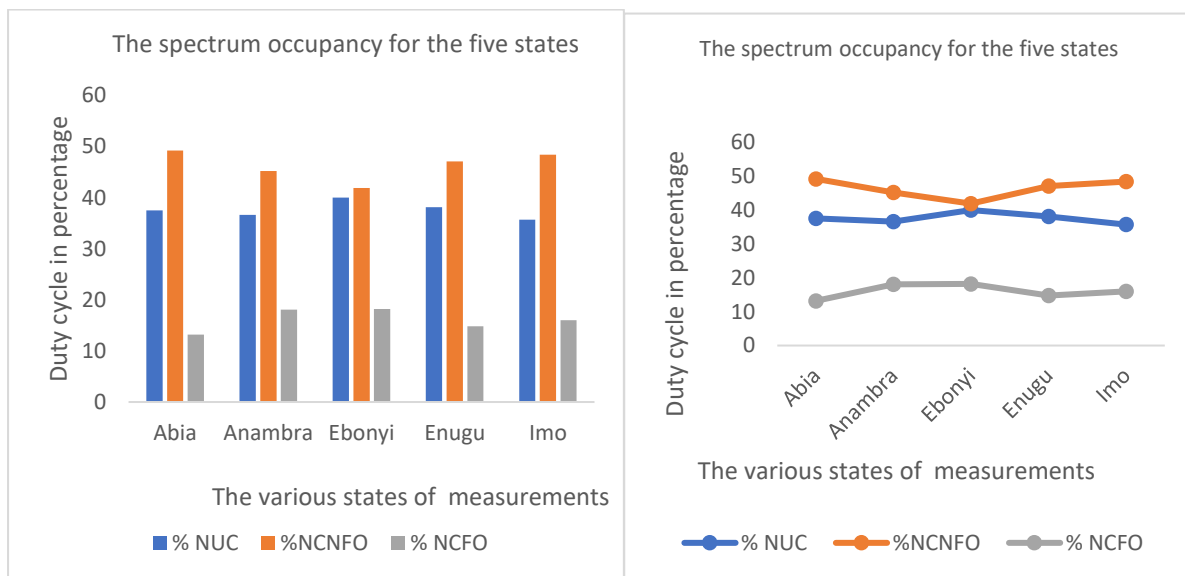


Figure 2a

Figure 2b

Figure 2a: The bar chart representation of the spectrum occupancy in the five states

Figure 2b: The lines with markers indicating the trends of occupancy.

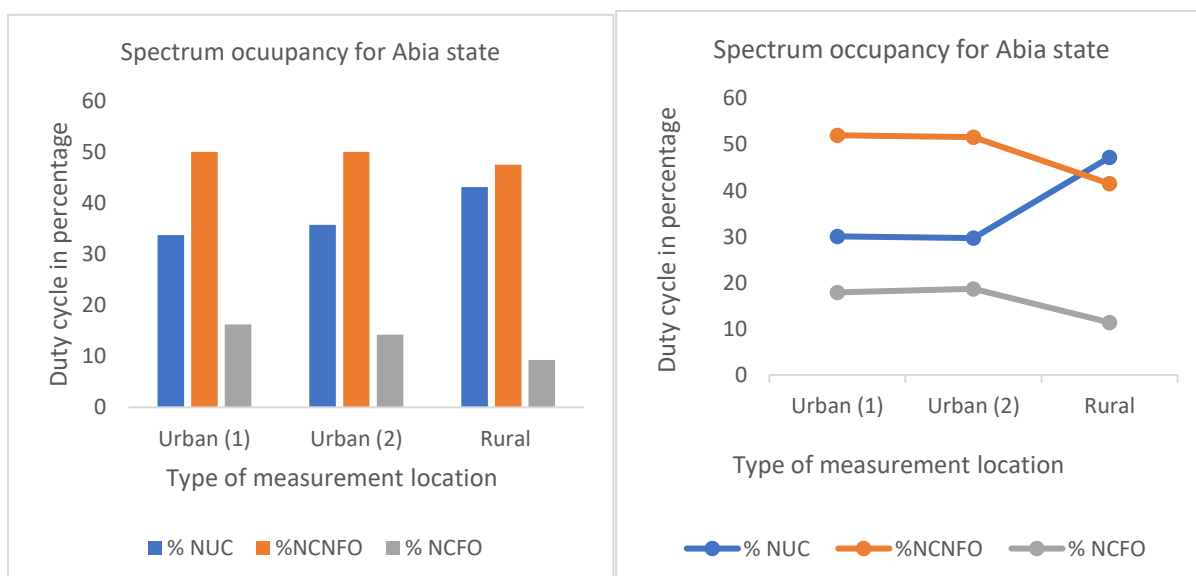


Figure 3a

Figure 3b

Figure 3a: The bar chart representation of the spectrum occupancy in Abia state

Figure 3b: The lines with markers indicating the trends of occupancy in Abia state

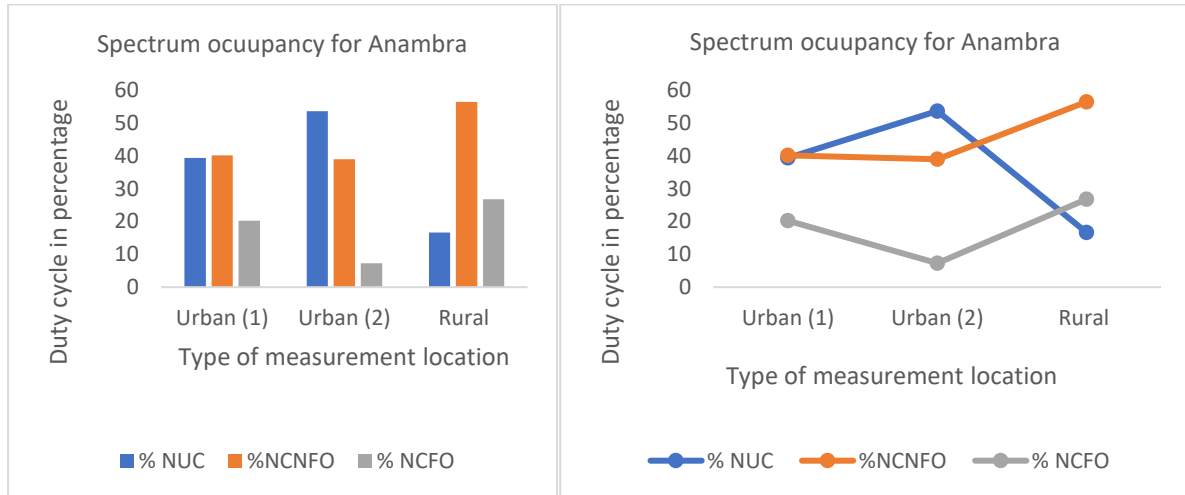


Figure 4a

Figure 4b

Figure 4a: The bar chart representation of the spectrum occupancy in Anambra state

Figure 4b: The lines with markers indicating the trends of occupancy in Anambra state

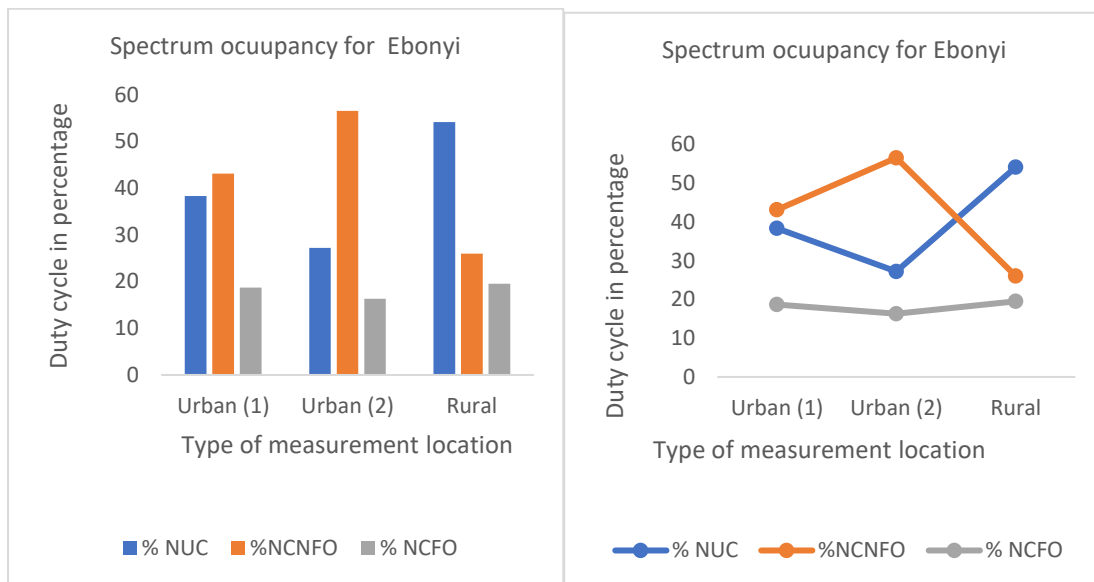


Figure 5a

Figure 5b

Figure 5a: The bar chart representation of the spectrum occupancy in Ebonyi state

Figure 5b: The lines with markers indicating the trends of occupancy in Ebonyi state

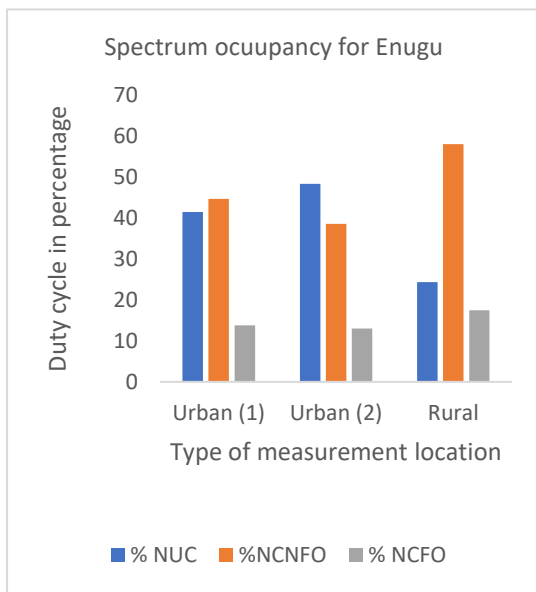


Figure 6a

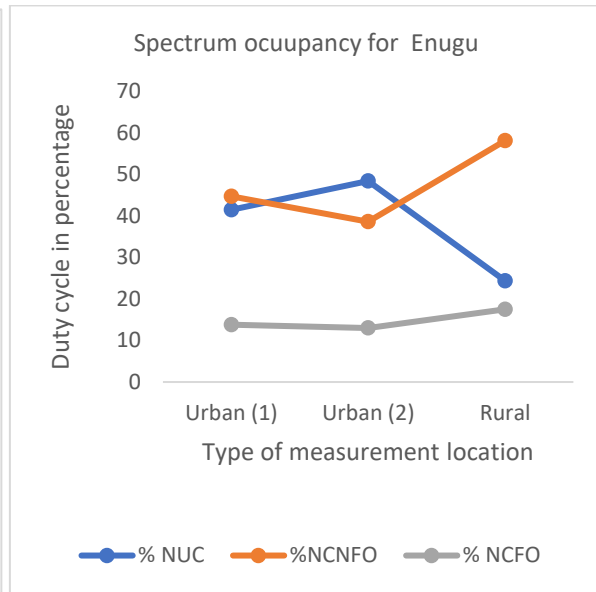


Figure 6b

Figure 6a: The bar chart representation of the spectrum occupancy in Enugu state

Figure 6b: The lines with markers indicating the trends of occupancy in Enugu state

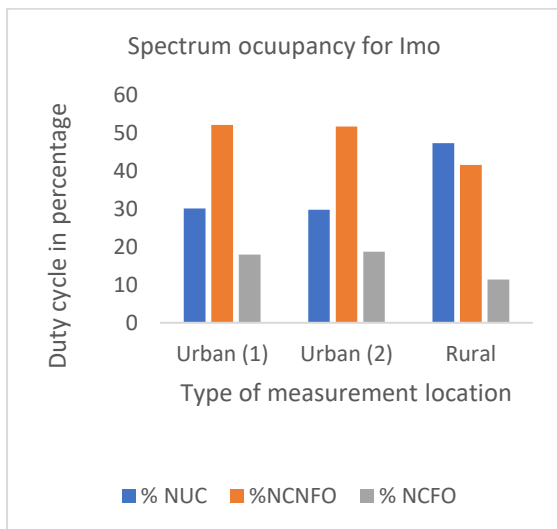


Figure 7a

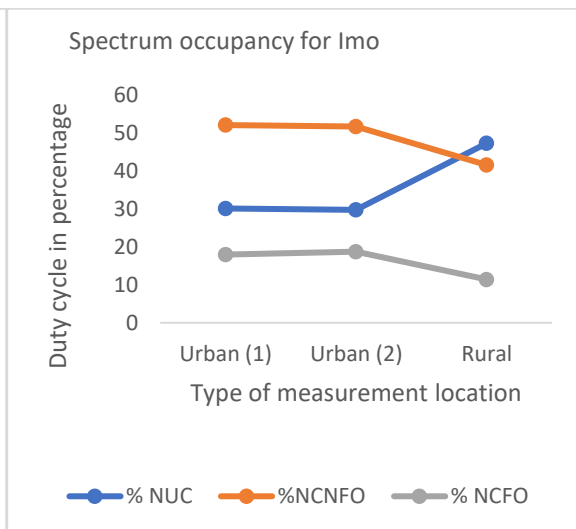


Figure 7b

Figure 7a: The bar chart representation of the spectrum occupancy in Ebonyi state

Figure 7b: The lines with markers indicating the trends of occupancy in Ebonyi state

6.1 Contribution

This research work provides detailed spectrum measurement statistics for every single channel within the range of very high and ultra-high radio frequency spectrum for the five states in south eastern region of Nigeria. First

was the measurement campaign which highlights the importance of a spectrum observatory in a spectrum management system, this was necessary to ensure that exact status of the bands of interests was captured correctly. Secondly, the study ensured that the spectrum occupancy activities of primary users in urban and rural geographic regions of these states were extracted correctly, helping in characterization of these environments and in taking decision on the opportunistic utilization of the available white spaces in these areas, comparative analysis of the results from various locations was also achieved in the process. Thirdly, the research was necessary in building a real geolocational database web that contains an updated spectrum occupancy status; this database helps in solving diverse cognitive radio issues like spectrum sensing, prediction, allocation, sharing and interference management. All these contributions were necessary as they provide the most recent and detailed spectrum occupancy survey of bands of TV stations and wireless communication networks in rural and urban regions of five in south eastern states of Nigeria.

6.2 Conclusion

Radio frequency observatory for very-high and ultra-high frequency bands have been studied for 48 hours for the five states of south eastern states of Nigeria covering about 246 channels. A threshold value of $\lambda = -90$ dBm was used in deciding the presence of primary user above and below which the band was termed free and can be utilized by the secondary users. A geolocational data-base was developed where the secondary users query the data base via internet to analyze and make decisions on which bands of the license users are available for opportunistic utilization at any given point in time. The measurement results showed that on the average, 37.5%, 49.2.5%, and 13.2 %, 36.6 %, 45.2 % and 18.1%, 40%, 41.9% and 18.2 %, 38.1%, 47.1% and 14.8 %, and 35.7%, 48.4 % and 16 % of the spectrum were un-occupied, not-fully occupied and fully-occupied for Abia, Anambra, Ebonyi, Enugu and Imo states respectively. The specific occupancy for each of the states whether rural or urban was also captured in the work. The empirical characterization of the results show that there are significant opportunity for dynamic spectrum access for future hope of the rising users and resource management in 5G network and wireless networks at large.

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