International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 2 Feb 2022, pp: 1157-1161 www.ijaem.net ISSN: 2395-5252

Development of Database Accessibility For Frequency Scheduling of TV White Spaces (TVWS) Broadband Connectivity in Rural Areas Using Dynamic Spectrum.

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Submitted: 10-02-2022 Revised: 22-02-2022 Accepted: 25-02-2022

ABSTRACT
This paper focuses on the creation of a data base database on modeling and frequency of TVWS broadband connectivity in the rural area deploying spectrum access technique. A database was created using an android Application where the frequencies required can be accessed on request. An outdoor propagation model was developed for Enugu rural area of Ugbawka where the path loss exponent result gave 2.15dB. Measurements were carried out to know the extent at which Indoor broadband can be enhanced using Wi-Fi in TVWS. Setting the modulation scheme to adaptive and manual at separate times, the SNR's Downlink (DL) and Uplink (UL) values were measured. Also varying the 16 QAM, QPSK and BPSK modulation modes between the DL and UL, at ½ and ¾ convolution rates at the six locations, each exhibited some pattern subject to the modulation mix.TVWS Optimization Quadrature Amplitude Algorithm, (TOQA), which showed that throughput performed better by giving 60Mbps and 70 Mbps at SNR of 5dB while the conventional algorithm gave 30Mbps and 25 Mbps at same SNR value. A 34.0% improvement was achieved when the dynamic access technique was implemented on the TVWS network.

Keywords: Dynamic Spectrum, Simulink, TV White Space, Quadrature Amplitude Algorithm, Asymmetric Digital Subscriber, Bandwidth

I. INTRODUCTION

The world at large has continued to witness huge demand for voice, data and video related services. This despite the current deployed infrastructural facilities in many countries including Nigeria.It gained widespread attention in the 1990s as a Dial-up Internet. Dial-up Internet requires basically, a phone line and modem device to access the internet at a data transfer rate of 56Kbps (Warner, 2018). This little connection speed made it time-consuming to download files and not feasible to stream music or video. In addition to its slow speeds, people were unable to make phone calls and browse the internet at the same time. As the total number of internet users around the world continued to grow, the public began to demand faster internet connections that could transmit more data. The response in the early 2000s was broadband technology that breathed new life into the internet. Broadband internet connection is high-speed access that allows a large volume of data to be transmitted at a data transfer speed greater than 256Kbps using an Asymmetric Digital Subscriber Line (ADSL).

➢ Real-Time Applications of TVWS

The limit of the real-time applications of TVWSs can only be our imagination. According to Khan et al., (2018), quite a number of deployment scenarios/applications have been conceived for communication systems based on TVWS. Many communication industries have already piloted projects and proof of concepts to show-case the effectiveness of TVWS-based communication. The Main driver for the deployment of TVWS is the characteristic radio wave in the UHF TV band, and its ability to penetrate deep inside buildings. Some of the promising applications are:

Rural Broadband: This is the major application of TVWSs that the researcher is very much interested in. Researches and conclusions from multiple literatures cited above clarifies that the rural areas could benefit, to a great extent, from the

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deployment of TVWS owing to the sheer nature of the TV band waves having propagation characteristics to reach tens of kilometers.

It can therefore, be stated that in some rural areas, minimum levels of signals can be detected which could access sparingly, voice calls in some locations and a total blackout in the other. In the area of Internet connectivity; Network Latency was observed to be a big challenge. Network latency refers to the time taken for a packet data to travel from a sender to a receiver verse versa. Latency may also involve transmission delays, exhibiting properties of the physical medium, and processing delays such as passing through proxy servers or making network hops on the internet. Generally, the performance and network speed of a network are usually expressed as bandwidth. Hence the average person is more familiar with the term, bandwidth, because manufacturers use that as a metric for advertisement and latency matters to the end users.Distinguishing the complications between Latency, Throughput and Bandwidth; by drawing an analogy with a pipe; the **Bandwidth** determines how narrow or wide the pipe is; the narrower it is, the less data it is able to pushthrough and verse-versa. While Latencyrefers to time taken to transfer data, **Throughput** refers to the total number of data that can be transferred overtime.

Low network latency can be caused by a lot of factors, some of which includestransmission mediumlike Wide Area Network (WAN) or fiber optic cables.All these have limitations and can affect latency due to their nature. WAN latency occurs when the network is busy dealing with traffic to the extent of delaying other requests as the hardware can't handle them all at maximum speeds. An error or other problem with the hardware can increase the time it takes for the hardware to read the data, which is another reason for latency.

3.1 Methodology

3.2 Creation of Database for TV White Spaces

The Database creation was carried out in two stages. The first was to collate Data while the second step was the Computer Programming, using data in Excel Spreadsheets and Android software programming tools.

(a) Data collation.

This first step taken was the measurements conducted through drive test.The measurements taken involved the recording of the Transmitters Received Signal Strength (RSS) and other transmitter parameters, like the transmitted and received power. Using the set up in figure 1, the RF Explorer repeatedly scanned the spectrum from 240 to 960 MHz for 24 hours. However, RF explorer is designed to be configured manually, with a maximum scanning range of 100 MHz. Using RF Explorer Spectrum Analyzer showed that on any channel occupied by a Primary User, the threshold level in absence of any transmission is -107dbm. Figures 2 and 3 respectively show signal strength display of the routs and Rf Explorer Live Data Debug This was confirmed through repeated measurements on Enugu State Broadcasting Service (ESBS) frequency that transmit on 703.25 MHz. Keeping sufficient cushion for low power transmissions, we chose -107 dBm as the noise threshold for the measurements. Appendix 7 shows the table of the data collected and stored in an Excel spread sheet. Meanwhile, the coordinates of the areas measured are as displayed in the table 1 below.

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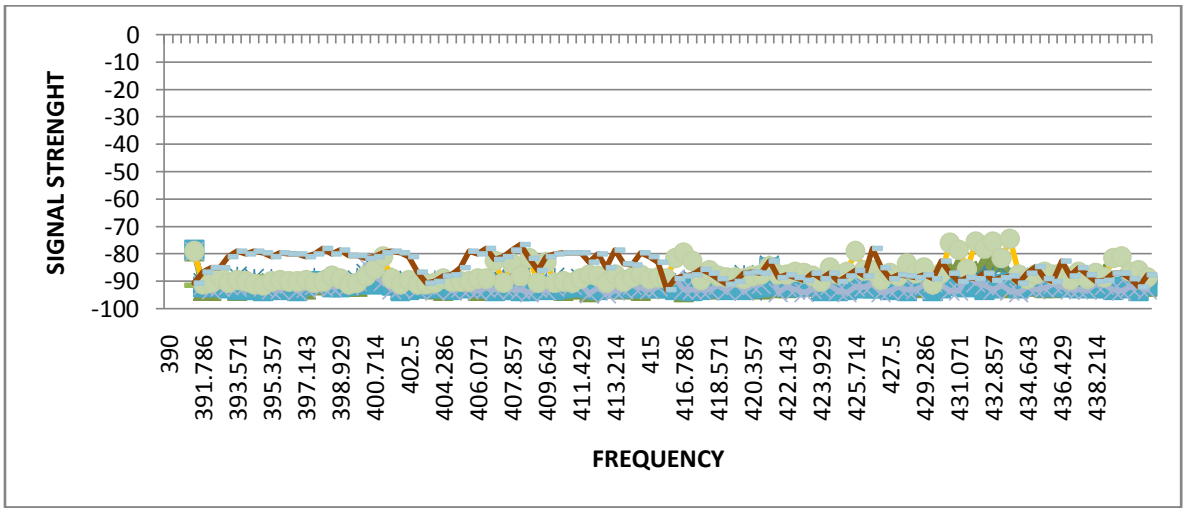
1Figure:1 Set Up for Frequency scanning.

1Table 1: The coordinates of locations where measurements were carried out

Location	Longitude	Latitude
Okpara Square	7.519779°E	6.439927°N
Ozalla/Udi Road by Four corners	7.464213°E	6.322740°N
Four corners by Old road	7.486038°E	6.314934°N
ESUT Agbani	7.524847°E	6.310197°N
ESUT Enugu Faculty of Enginrn	7.511045°E	6.431746°N
Ogui Road by Zik's Stadium	7.496372°E	6.442805°N
Ngwo/Okpokoro/Nineth Mile	7.4071824°E	6.435976°N
Udi/Amokwe Town	7.396007°E	6.322866°N
Ugbawka Renaissance University	7.35543°E	6.33394°N



2Figure 2: Signal Strength Display through the Drive Routes

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3Figure 3.: RF Explorer Live Data Debug

The measurement results for Renaissance University as a typical rural chosen location, show that bands for terrestrial TV broadcast are free. According to National Frequency Management Council of Nigeria (NFMCN), among the bands observed are 240MHz - 265.4MHz, 305.1MHz and 306.9MHz are used for fixed mobile services. Bands from 310MHz - 430.1MHz which are used for STL Two-way radio (PMR)/ fixed mobile, Bands 451.1MHz, 469.9MHz, 470.8MHz and 470.3MHz are for STL: Private CDMA Networks Bands from 510.2MHz to 519.7MHz where signal was presence are used for Analog TV, DTT and DVB-TV. There is no transmission from band 520MHz to 740MHz. Appendix 1 shows the Table of Frequency allocation by National Frequency Management Council of Nigeria (NFMCN). Apart from 510.2MHz – 519.7MHz bands, the whole of the spectrum between 470MHz- 740MHz has power level below -107dBm.

II. CONCLUSION

In this paper, the various details on the major diffferent between the wireless broadband technology for Television white spaces and traditional wireless technology systems were currently used. It was observed from the analysis that a well designed database has the abaility of accepting more new database entries from observation which could be used by a geolocation database procedures to provide opportunistic access to broadband internet connections.

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