



## Spectrum Occupancy Measurement in the VHF Band- Results and Evaluation in the Context of Cognitive Radio

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### ABSTRACT

In this paper the results of spectrum occupancy survey in the context of Cognitive Radio was presented. In Cognitive Radio, secondary unlicensed users are allowed to opportunistically use the primary licensed users' bands with the understanding that there will be no interference i.e Secondary Users (SU) quits at the arrival of Primary Users (PU). A 24-hour measurement survey was carried out at the centre of Minna metropolis in Niger State, Nigeria covering a frequency range of VHF (30-300MHz). Aaronia HF 6065 V4 spectrum analyzer was used for data collection. Results show that the band allocated for Aeronautical Navigation has the highest spectral occupancy of 39.83% followed by the FM band with occupancy of 12.90% while the frequency band meant for Aeronautical Mobile and Space Operation has occupancy of 4.73% and TV Broadcasting 0.09%. The average occupancy of the VHF band is 14.39%.

Keywords: *Cognitive Radio, FM, Primary Users, Secondary Users, VHF*

## 1 INTRODUCTION

The rise in the demand for wireless devices and wireless communication technology has resulted to the scarcity of the finite radio spectrum. Several wireless services and applications like satellite radio broadband, Wi-Fi internet connections and Bluetooth devices have contributed to the heavy demand of the spectrum. Several regulatory bodies worldwide including the Federal Communications Commission (FCC) of the United States of America (USA) have discovered that lots of frequency bands in the radio frequency spectrum is currently under-utilized. Therefore, the implication is that most spectrum that are allocated are not fully utilized (Barau *et al.*, 2013). This has led to inefficient use of this natural resource (Weiss and Jondral 2004). In the current policy, unlicensed users are disallowed from accessing the spectrum even when they are not utilised by the primary users (Saladhine *et al.*, 2017). Cognitive Radio is envisioned to solve the problem of spectrum scarcity by gaining an understanding of the dynamism of the spectrum occupancy of the frequency band (Barnes *et al.*, 2013; Barnes and Maharaj, 2011).

According to Mitola and Maguire (1999) Cognitive Radio is a radio that senses the environment and adapt its operating parameters to changes in the environment. The essence of Cognitive Radio is to assess the free frequency bands so as to improve on the usage of spectrum opportunistically. It has been generally accepted as a standard solution to spectrum scarcity and under-utilization due to the ineffective way of spectrum allocation to

Primary User (PU). To effectively deploy Cognitive Radio, there is the need to have correct and accurate understanding of the allocated spectrum.

Several spectrum occupancy measurement campaigns have been conducted all over the world (Juarez *et al.*, 2016 and Wiles *et al.*, 2016). The study reveals heavy underutilization of spectrum. Few of the campaigns focused on some specific frequency bands while others focused on power received in dBm or percentage of spectrum utilization such as duty cycle (Lima and Mello 2013). Spectrum measurement campaigns is important so that spectrum occupancy samples on pre-selected frequency bands can be obtained such as in cellular bands or TV bands (Eltom *et al.*, 2018).

However, there is still a general lack of the understanding of the spectrum occupancy in Africa and in particular in Nigeria. According to Kliks *et al.*, (2013), spectrum occupancy measurement information for a particular location is not applicable for other locations. Therefore, this work presents results of an outdoor spectrum occupancy measurement in Minna metropolis, Niger State, Nigeria with focus on the Very High Frequency (VHF) band of 30-300MHz).

## 2 METHODOLOGY

The description of the measurement location and the equipment used are described in the following sub-sections.