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# Preliminary Performance Assessment of TV White Spaces Technology for Broadband Communication in Malawi

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**Abstract**

Recently, the use of TV White Spaces for broadband communication has raised interest. White Spaces refer to regions of radio spectrum that are not used all the time in a specific geographical location. This paper presents the preliminary performance assessment of a TV White Spaces deployment in Malawi. The method used involved coverage simulations at the TV White Spaces frequencies, deployment of the network, monitoring and performance analysis. The preliminary results report usable coverage distance up to 7.5 km which has allowed that remote students access the content of the university library and interact with the university faculty. The results thus show that the TV White Spaces technology can be used for broadband connectivity in rural and undeserved areas even when the WiFi and broadcasting spectrum is already utilized. A typical application that supports remote access of e-library resources from a rural Secondary School was developed using DSpace architecture over the White Spaces infrastructure is discussed.


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## 1. Introduction

The growing demand for wireless data transmission imposes the search for alternatives to the current spectrum exploitation schemes. In the long term, dynamic spectrum access seems to be the only viable solution, once the technical details for its implementation are solved. In the near term, the use of currently vacant spectrum allocated to TV broadcast is poised to alleviate the spectrum crunch while opening the path for dynamic spectrum access [1].

An evaluation of the performance of well-defined secondary systems in realistic scenarios will eventually help to gauge the usability prospects for TVWS-driven technologies and potentially guide subsequent regulatory rule-making. In Malawi, the partnership team between the regulator (referred to as the Authority in the TVWS regulations) and the University of Malawi-Chancellor College has developed the TVWS rules and regulations, investor side business model and a performance analysis of the network in the mid of December 2013. The deployment of the pilot was completed in September in partnership with the Abdus Salam International Centre for Theoretical Physics (ICTP) from Trieste, Italy. The goals for the Malawi TVWS Pilot are similar to that of the Cambridge Trial [2] that is, to help industry understand the capability of TV white spaces to serve a wide range of applications, through key factors such as the coverage and performance that can be achieved.

The authors herein have previously published on the findings of a TVWS spectrum measurement initiative in Malawi and Zambia. In [3] they introduced an open hardware device that geo-tags spectrum measurements and saves the results on a micro SD card. The device can also be used to record the use of spectrum over long periods of time. An assessment study on TV white spaces in Malawi using affordable tools was presented in [4]. In the current paper however, we focus on the performance of the deployed network since appropriate performance indicators of White Space Devices (WSDs) are badly needed [5].

The rest of this paper is organized as follows. Section II is the description of the deployed TVWS network and the proposed monitoring platform. Network performance results are presented in Section III. A typical application using DSpace over the TVWS infrastructure is presented in Section IV. Conclusions are drawn in Section V.

## 2. Network Setup and Proposed Monitoring Platform

The Malawi TVWS network topology has a typical star configuration, with the base station as hub and the CPEs as clients. The base station is located in a 40 m tower that was erected by the Chancellor College of the University of Malawi for the installation of an FM broadcasting station, and both the FM broadcasting and WSD antennas are located in the same mast and operate without interference. Both transmitters are housed inside the building adjacent to the tower and are connected to their respective antennas by low loss coaxial cables. The same tower also houses a 5 GHz point to point wireless link to the Internet Service Provider that offers the connectivity to the outside world. A picture of the mast with the FM antennas on top and the TVWS omnidirectional antenna below is shown in Figure 1.

Fig. 1. The mast with FM and TVWS antennas.