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TV White Spaces Technical rules for Africa to enable efficient Spectrum Management

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PRESENTATION OUTLINE

- Introduction
- Related Works
- Database Algorithm
- Interference Mitigation Strategy
- Conclusion

QUOTATION

"Stories are the secret reservoir of values: change the stories individuals or nations live by and tell themselves, and you change the individuals or nations".

From "A Way of Being Free" Ben Okri

- TVWS might be the new world story -

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INTRODUCTION

- Broadband Internet access has proved to be a key vital element of modern life and a crucial enabling factor for the global, information-age economy.

- TV White Spaces is one of the promising solutions for extending broadband connectivity to underserved areas

- Regulators around the world are currently formulating rules and regulations that will facilitate deployment and access of TV White Spaces network

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INTRODUCTION….Cont

- Recent FCC rules permitting unlicensed use on a secondary basis of the TVWS promise a whole new set of possible applications
- In an effort to ensure that these applications have been implemented, there is a need for creation and adoption of industry standards
- FCC adopts a minimum distance between secondary user and TV service area to guarantee that the interference margin is not exceeded by secondary users.
- The transmission power for fixed secondary users is fixed to 4W which is a conservative setting.

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RELATED WORKS

- The Suggested Technical Rules and Regulations of DSA for the use of TVWS contemplate that available frequencies and maximum transmit power for a WSD at a given location may be determined based on a geolocation and database method

- Database(s) designated by the regulator will provide this information based on the positional information from a master WSD, the height of the transmitting antenna (for fixed master devices), and use by licensed incumbents in or near the geographic area of operation of the WSD.

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RELATED WORKS….Cont

- The rules suggest that a database will supply a list of available frequencies and associated permitted transmit powers to WSDs
- In general the DSA suggests that;

1. WSDs are permitted to operate on a licence-exempt basis subject to the interference protection requirements set forth in these rules.

2. WSDs may operate in the broadcast television frequency bands, as well as any other frequency bands designated by the Regulator.

3. WSDs shall only operate on available frequencies determined in accordance with the interference avoidance mechanisms

4. Client WSDs shall only operate on available frequencies determined by the database and provided via a master WSD

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RELATED WORKS….Cont

- Proposed interference mitigation approach using a cloud infrastructure for dynamic spectrum networks using spectrum resource as a service (SRaaS) will be discussed

- Mfupe et al. propose “A Cloud Infrastructure for Dynamic Spectrum Networks Using Spectrum Resource as a Service (SRaaS)”

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RELATED WORKS….Cont

- They envisage that future wireless dynamic spectrum networks (FWDSNs) will integrate techniques for rapid identification and sharing of radio frequency spectrum resources by means of radio techniques

- Based on this vision, they propose a cloud framework for spectrum resource as a service (SRaaS) in the application layer, based on a national geo-location spectrum database (GLSDB) developed for South Africa.

- The SRaaS framework has the potential to unlock the future wireless dynamic spectrum networks firstly as the best short-term solution for minimizing any harmful interference in such network architectures as the TVWS

RELATED WORKS….Cont

- Secondly SRaaS can be used as a toolbox by regulators in the development of efficient dynamic spectrum regulations at a national level
- Thirdly, such regulations could be enforced and monitored through an SRaaS environment.
- The authors further argue that multi-tenancy and schema sharing techniques are utilized at the inter-regional level to allow the cross-border harmonization of RF spectrum regulation.
- To clarify the design and functionality of the proposed database, the authors should have drawn the schema of their proposed database and discuss the algorithms used in the back end.

RELATED WORKS….Cont

The USA Federal Communications Commission (FCC) made a ruling on TVWS to:

- Provide for both fixed and personal/portable devices to operate in the TV white spaces on an unlicensed basis
- Devices must include a geolocation capability and capability to access a database of protected radio services
- Devices provide their location to their database, which returns a list of channels on which they may operate (channel lists are specific to the location of the device)

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RELATED WORKS….Cont

Additional provisions to mitigate Interference Risk

- Fixed devices must register their locations in the database
- Fixed and personal/portable devices must provide identifying info to the database
- Devices cannot transmit without checking database and must recheck periodically
- All devices must include adaptable power control to use the minimum necessary power

As a follow up to the above highlighted rules, FCC Authorizes Nationwide use of TVWS

DATABASE ALGORITHM

- According to DSA, the input to a geolocation database will be positional information from a master WSD, a classification code or other information characterizing a device's emissions performance, the height of the transmitting antenna for fixed master devices and use by licensed incumbents in or near the geographic area of emissions masks.
- If available, this information should be supplied to the database.
- If not, the device can provide its emissions performance to the database in another form.

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DATABASE ALGORITHM…Cont

- If a device is sophisticated enough to modify its emissions profile dynamically, then regulators can consider an approach in which the database provides a maximum power level per channel and then the device ensures – based on its emissions profile – that it falls below the ceiling provided by the database.
- There is need to define the various entities and their relationships with regard to frequency and signal strength calculations.
- Interference from White Space Devices (WSDs) is controlled by limiting their radiated power.

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INTERFERENCE MITIGATION

- Since TVWS devices make opportunistic use of frequency voids that are unoccupied by primary users, they should not interfere with the existing licensee at all times and at all locations

- Several studies have presented various mechanisms for preventing interference with the primary user and these studies have primarily focused on the use of spectrum sensing techniques and geo-location database access or a combination of the two

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INTERFERENCE MITIGATION…Cont

- While the Federal Communication Commission in the USA has imposed a White Space Device (WSD) transmit power limitation as another way of protecting the incumbent, some studies have also proposed various ways of managing interference between WSDs

- Other Authors have proposed an intelligent TVWS management system that will control allocation of available channels to the secondary users in a manner that will allow maximum spectrum utilization.

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CONCLUSION

- Some rules and regulations dictating the use of white spaces, particulary the TVWS have been presented from the various perspectives namely, FCC, CSIR, and DSA
- A proposed set of rules and regulations that in part use portions of the related works by DSA, FCC and CSIR has been drafted for use in Malawi.
- An overview of these drafted regulations has been presented and awaits review and comments from stake holders in the Malawian industry, after which the regulations shall be gazetted for official use.

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Shaping the Future- Key actions needed

If you want to go quickly, go alone ….if you want to go far, go together." **African Proverb.**

When the webs of a spider join, they can even trap a lion"

Ethiopian Proverb.

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THE END

Thank you very much for your attention

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