Studies on the Use of TVWS in South Africa

Recommendations and learnings from the Cape Town trial

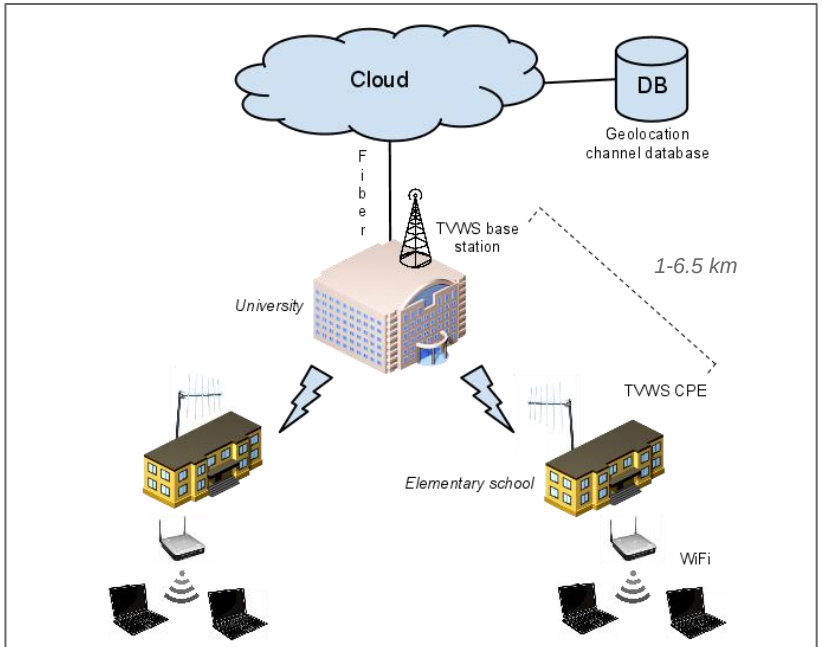
Google

Contents

1. Cape Town trial objectives and network overview

Trial objectives:

- Demonstrate that TVWS technology can be used to deliver affordable broadband services without interfering with TV reception
- Provide information to the Minister and Department of Communications regarding the use of TVWS to meet policy objectives relating to universal service and access and efficient spectrum management
- Assist ICASA in developing a regulatory framework authorising the use of TVWS
- Increase awareness of the potential for TVWS use in South Africa & across the African continent



- 3 sector Carlson Wireless base station
- 10 schools with ~6000 students
- 2.5 mbps per school
- Ranges up to ~6.5km

2. Technical studies confirmed that the technology works

Study	Methodology	Observation
Determine white space availability	Predicted white space availability using Google's database and confirmed with spectral scans	8 available channels were selected for the trial
Validate equipment for operation	Measured out-of-band emissions in lab	Equipment operated as expected and has an appropriate spectrum mask (99.9% of power is contained within 6.48 MHz +- 0.03 MHz)
Estimate TV protection ratios	Measured perceived interference on analogue TVs in lab	Protection ratios devised for for N+1 and N-1 channels
Confirm that TV protection is consistent with the database	Set up 24 hour monitoring spectrum analyzer at base station looking for changes in spectral emissions	Base station operation consistent with database
Demonstrate non-interference to TV receivers	• Measured out-of-band emissions around schools and base station • Crowd-sourced interference reporting from radio groups and TV viewers	• No interference measured/detected • Developed parameters for adjacent channel operation • No interference reported

3. Technical recommendations and propagation modeling

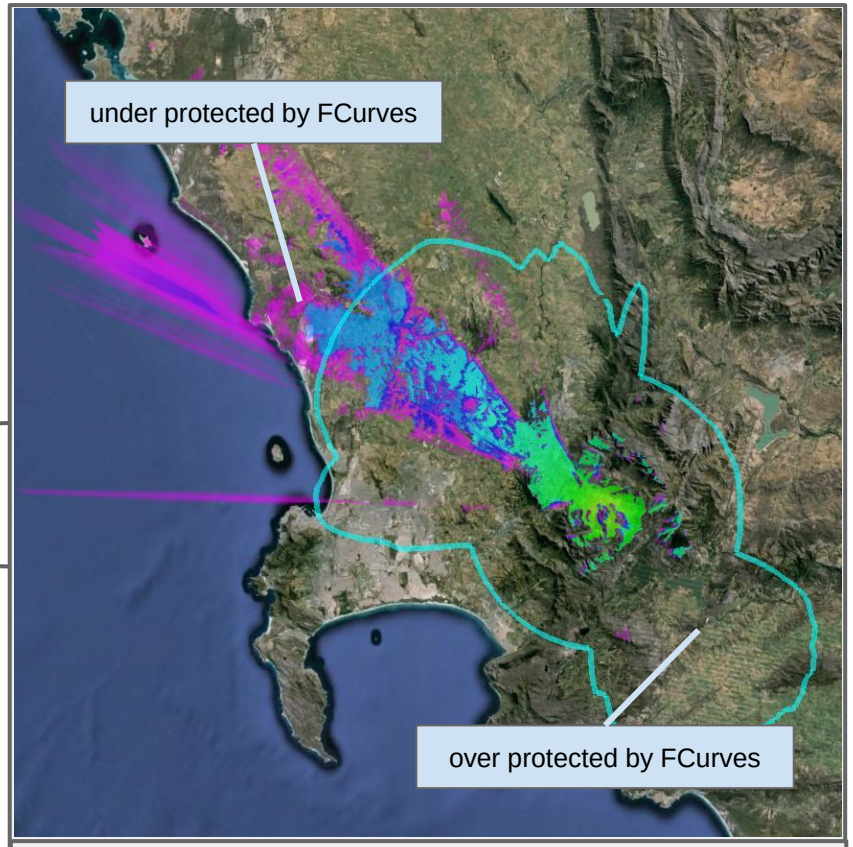
We have observed that for any analogue with sufficiently strong signal:

- WSD can be operated on the adjacent channel on its right-hand side without causing interference
- WSD may be operated on the adjacent channel on its left-hand side without causing interference, subject to the transmission power of the WSD being reduced

On the basis of the above observations, we recommend that a geo-location database be used for TVWS networks:

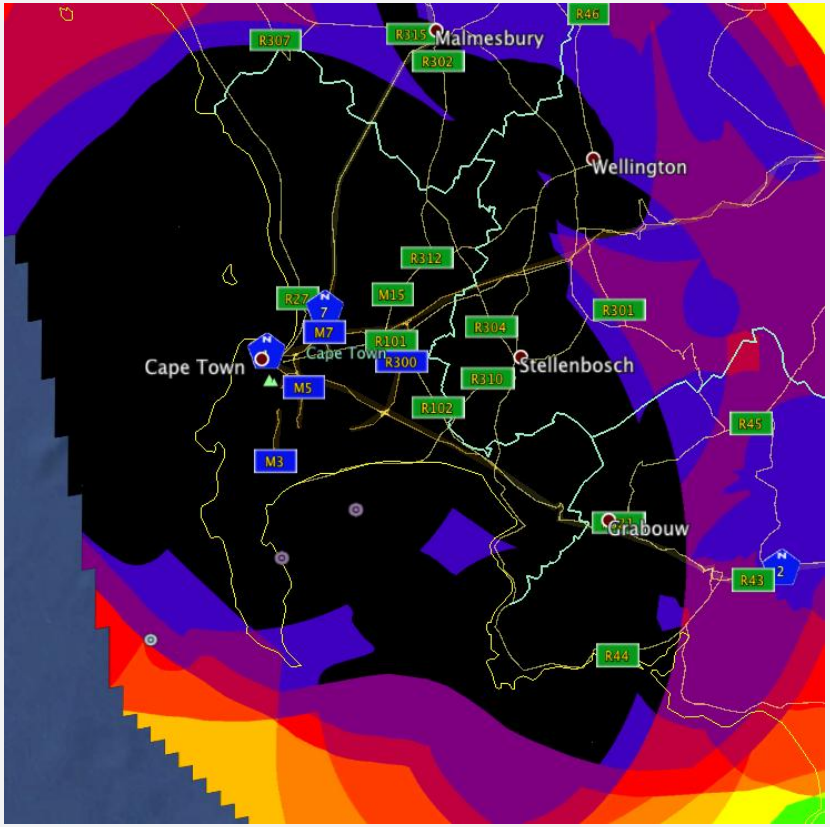
- Propagation modeled using Longley-Rice to protect TV transmitters
- The database must be able to estimate protection ratios for each of the adjacent channels
- Provide transmission power levels to the WSDs for each of the available channels

We further recommend that a study to determine protection ratios for digital TV channels be undertaken before the digital analogue dual illumination commences.

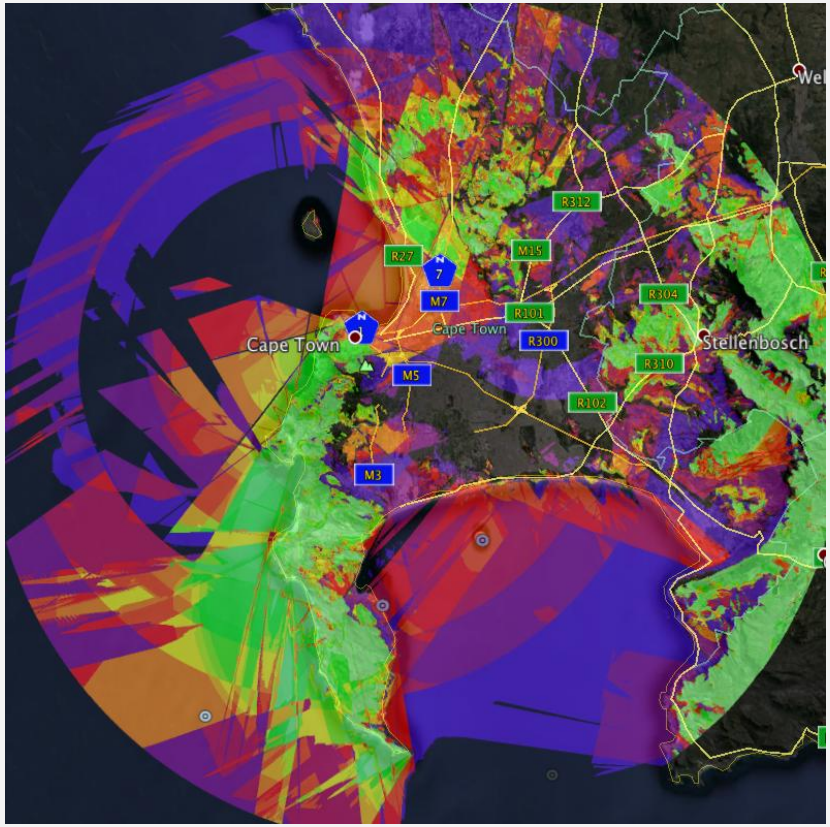


- FCurves (blue circle) does not account for terrain variation
- Longley-Rice (heat map) provides better protection & allows for variable device power

Propagation models compared in Cape Town



FCurves



Longley-Rice

4. Policy recommendations

Policy Goal	Recommendations
Improve Internet access	• Recognize that TVWS technology & database-enabled spectrum access can deliver wireless broadband to end users, especially in hard-to-serve areas, and address increasing demands on spectrum use
Promote efficient use of spectrum	• Recognize that TVWS devices can co-exist with established services • Recognize the value of spectrum sharing and promote its use as part of a progressive approach to managing spectrum more efficiently • Determine protection requirements that are sufficient to avoid harmful interference while allowing maximum usage
Support a competitive ecosystem to spur innovation	• Consider multiple TVWS device profiles for fixed and mobile devices for indoor and outdoor use • Recognize that TVWS spectrum access through a database can evolve to accommodate changes in technology, market requirements or regulatory mandates. • Encourage the development of multiple databases and promote competition to drive down costs and spur innovation
Scale technology globally	• Promote an internationally harmonized approach to TVWS device characteristics and certification to take advantage of economies of scale • Consider a regional approach to license-exempt managed access spectrum & conformance regimes for the equipment • Promote the development of TVWS equipment standards

5. Discussion points

Key issues and questions

for resolution prior to the finalisation of a regulatory framework governing TVWS. Each section provides contextual information and a list of proposed questions for public discussion relating to:

- The benefits of TVWS
- The basis on which TVWS usage should be allowed
- White space databases & spectrum sensing
- Provision of information regarding incumbent operations
- Management of white spaces databases
- Types of white space devices;
- Operational parameters (power output, available channels, out-of-band emissions, propagation model for interference calculations)
- Impact on radio astronomy;
- International rules applicable to devices
- General considerations

6. TVWS in SADC & Africa

- Communications Regulators' Associations of Southern Africa (CRASA), Botswana 6 August 2013
- West African Spectrum Group Meeting, Dakar, Senegal 30-31 May 2013
- ATU: First African Spectrum Working Group Meeting Nairobi 12-15 November 2013
- Other trials:
  - Malawi: trial connecting hospitals and schools in the south
  - Kenya: trial network using TVWS technology and solar-powered base stations to deliver broadband access and create new opportunities for commerce, education, health care and delivery of government services. Focus on commercial feasibility of TVWS technology in delivering low-cost broadband in communities without access to both broadband and reliable electricity
  - Tanzania: pilot focusing on deploying broadband in an urban setting, delivering an integrated device, service and connectivity solution to university students

7. Model rules

Outline for model rules documentation:

1. Permissible Frequencies of Operation
2. Protection of Licensed Incumbent Services
3. Geolocation and Database Access
4. Database Algorithm
5. Database Administrator
6. Spectrum Sensing in the Broadcast TV Frequency Bands
7. Technical Requirements for WSDs Operating in the TV Broadcast Bands

8. Next Steps - Initiating the rulemaking process

- Trial results constitute sufficient basis for initiation of required regulatory process
- Unambiguous outcome that no interference caused to primary users
- Suggestion that ICASA proceed to develop a Discussion Document and publish for comment as soon as possible
- Policy framework as set out in National Radio Frequency Spectrum Policy 2010 supports spectrum sharing and innovation with further support likely early 2014 through the National Broadband Policy and spectrum-related policy directives
- ICASA Strategic Plan 2014-18: Strategic Outcome-Oriented Goal 3 (Promote efficient use of spectrum resources) includes
  - Framework for the use of “white space” and cognitive radio technologies to be published by 31 March 2015
  - Achievable if regulatory processes initiated now