WS Geo-location Spectrum Databases

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4th Summit on Community Networks in Africa
University of Dodoma, Tanzania, 30 October '19

our future through science

How we Make Impact

Technology licensing and start-up creation

Access to infrastructure, skills; tech incubation

Innovation in support of industries in decline

Improvement of industry competitiveness

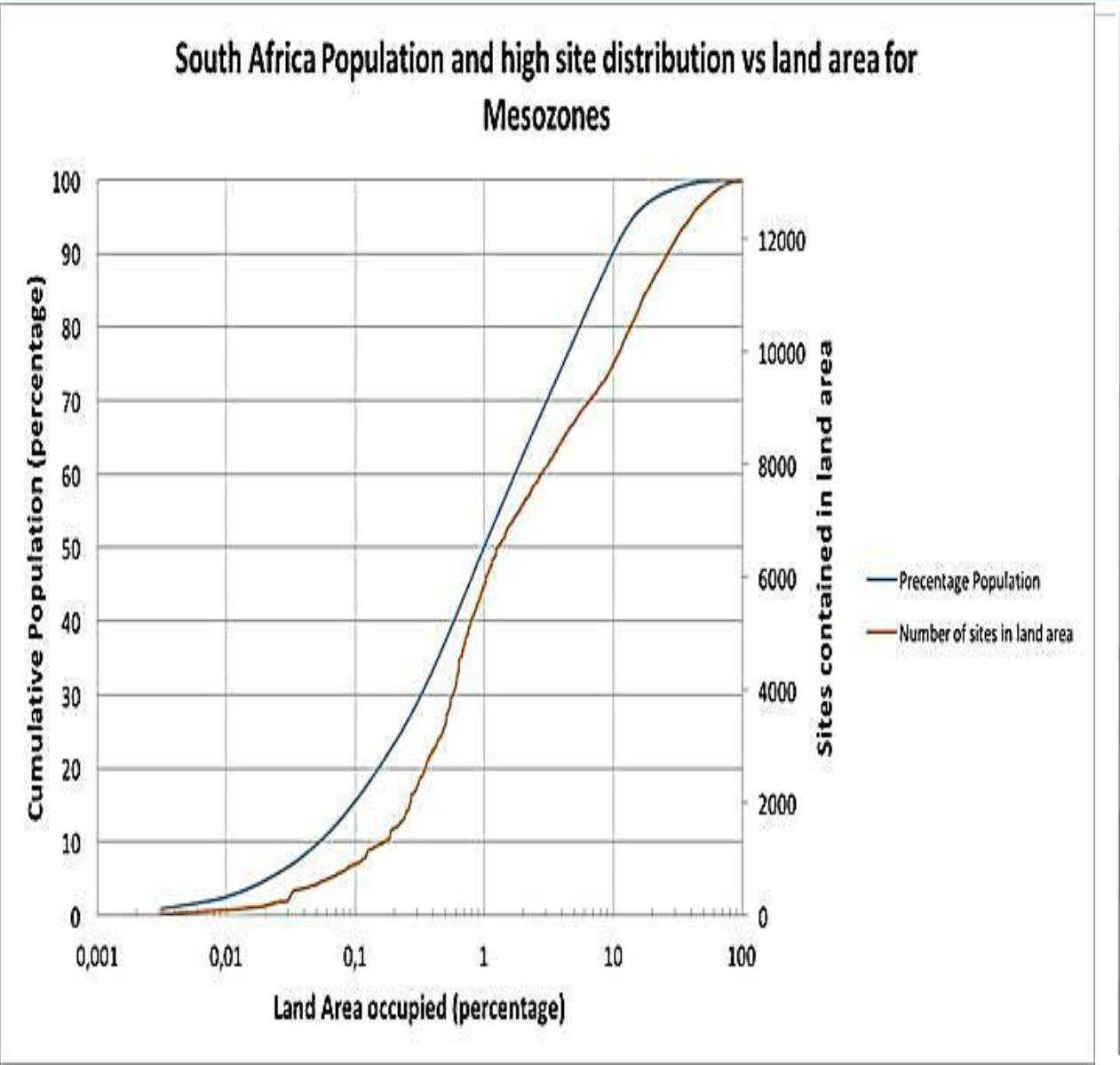
New industry creation

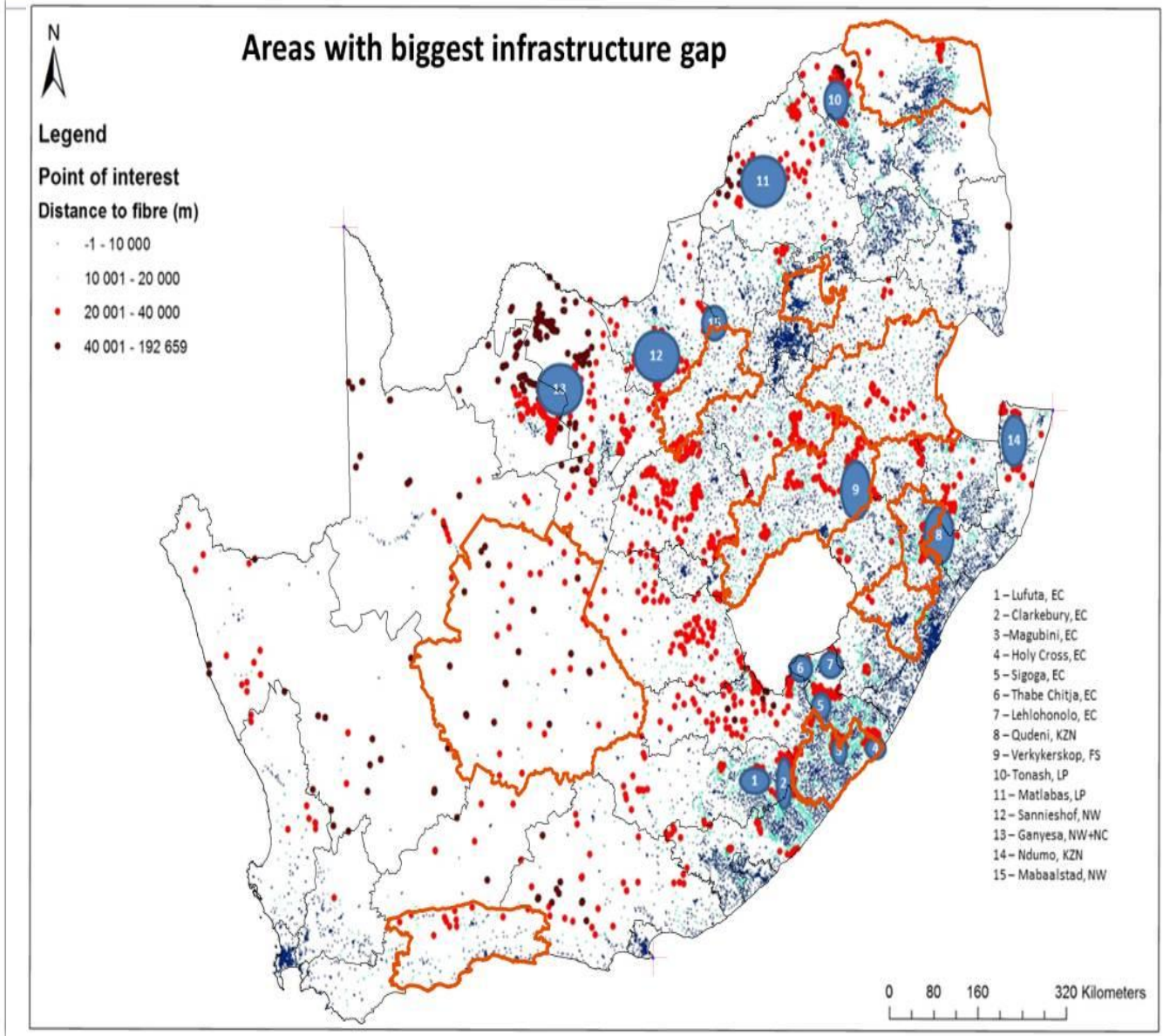
Technology localisation and supplier development

Community-based enterprise creation

What we wish to achieve; a consolidated, strengthened offering representing a value proposition that is relevant to the competitiveness of the South African economy

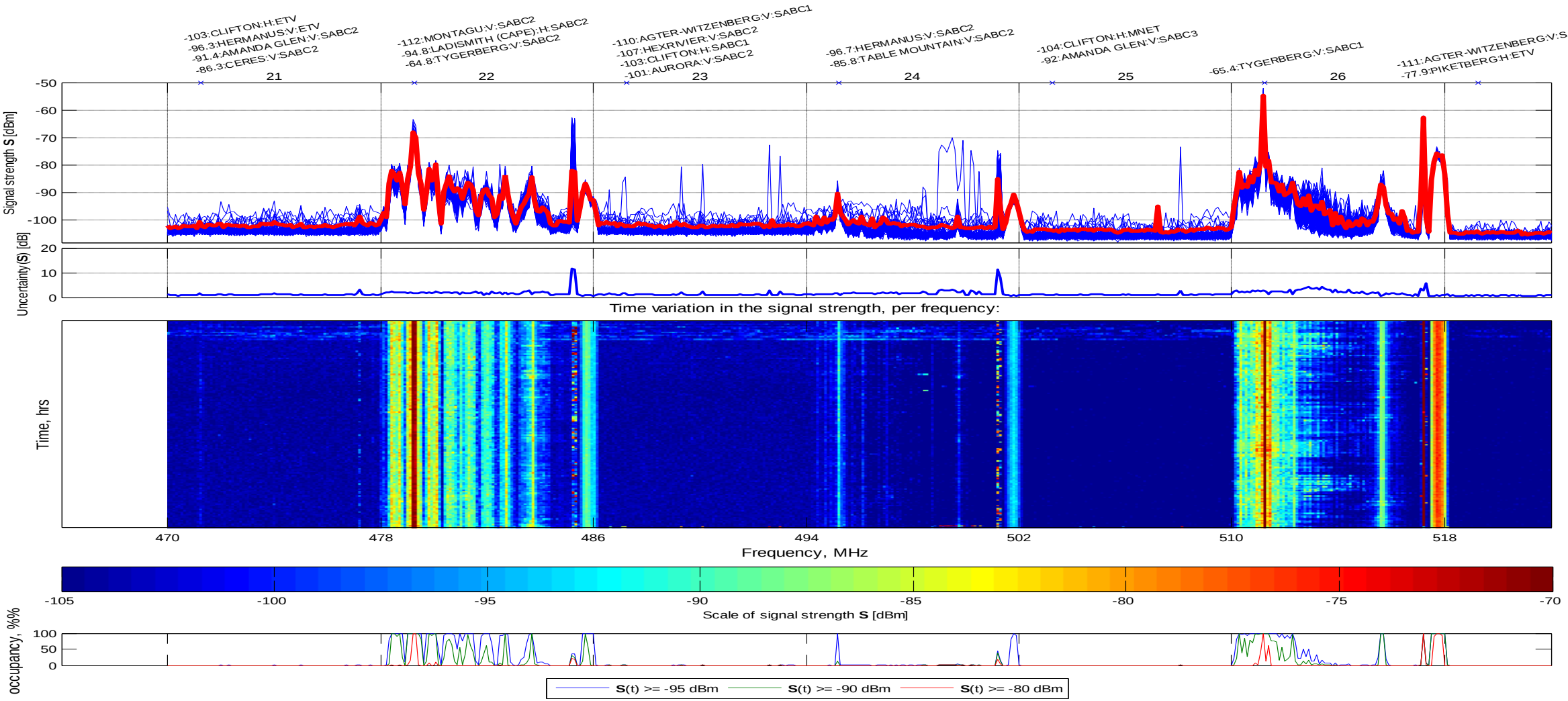
Motivation: Dynamic Spectrum Sharing (1/3)





Motivation: Dynamic Spectrum Sharing (2/3)

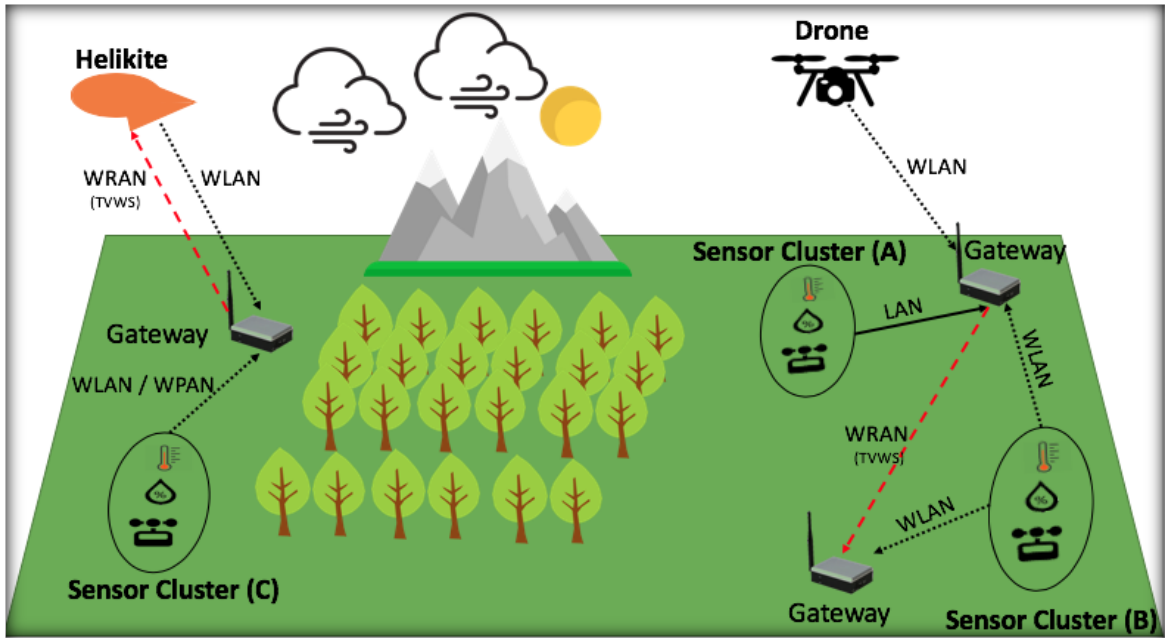
White spaces: TV Channels 21,23,25,27

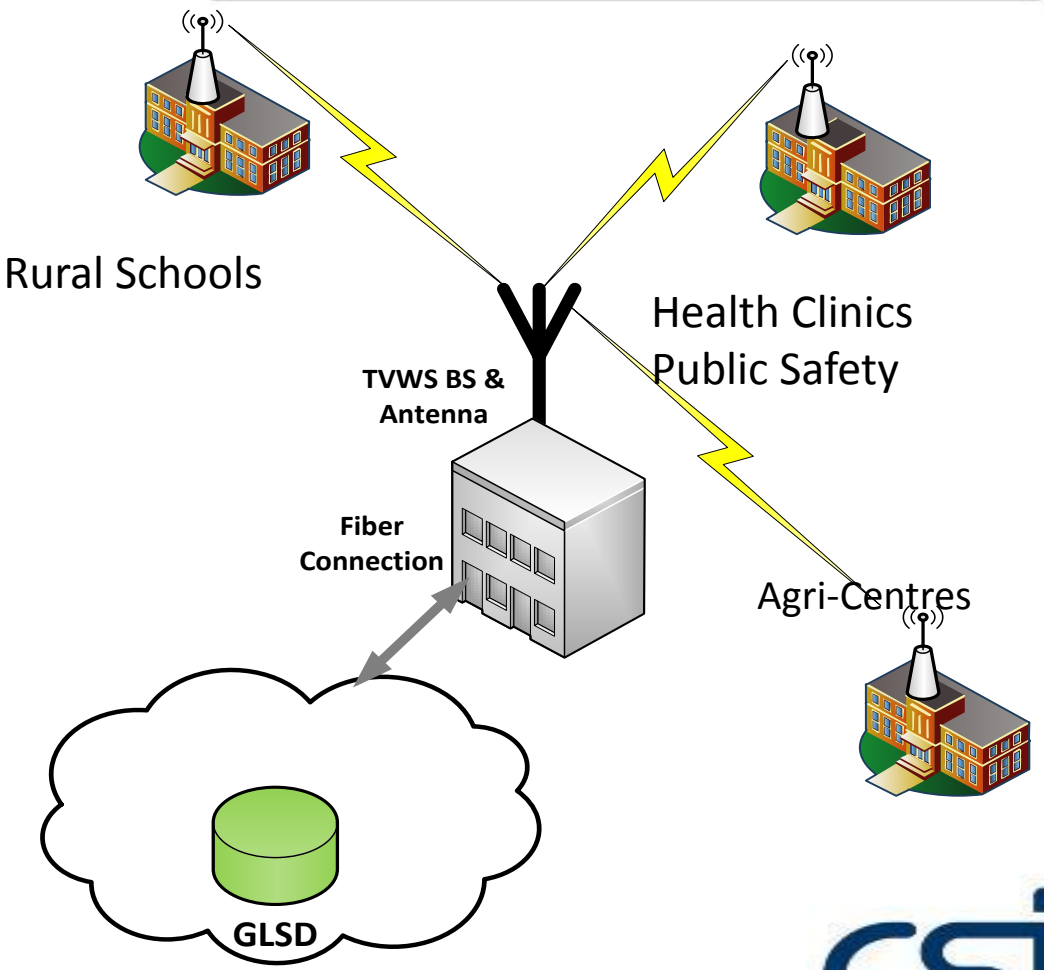


Motivation: Dynamic Spectrum Sharing (3/3)

Use cases - Sustainable Development Goals:

- E-health
- E-commerce
- Agri-centres/smart farming
- Public safety
- Smart villages





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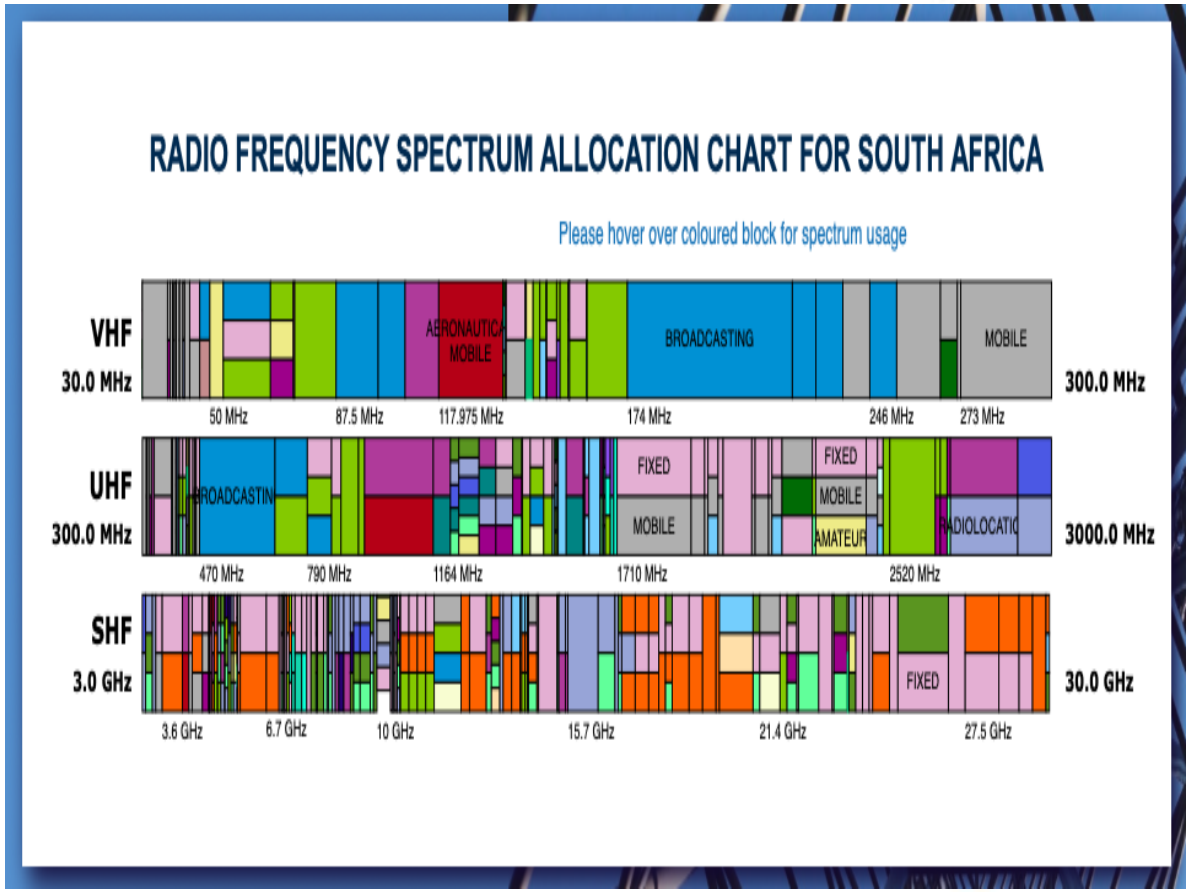
Timeline of the TVWS Framework Development

2012	2013	2014	2015	2016	2017	2018	2019
First TVWS Technology Trial in Western Cape (CSIR, Google & others)	CSIR Develops a Prototype GLSD to be used for TVWS Research and Technology Trials	Second TVWS Technology Trial in Limpopo (CSIR, Microsoft & others)	ICASA Publishes Discussion Paper	CSIR's GLSD Qualified by Ofcom to Provide TVWS Services in the UK	Position Paper On Dynamic And Opportunistic Spectrum Management	1. TVWS Regulations published 2. ICASA issues a Tender to Develop, host and manage ICASA Reference GLSD (R-GLSD)	1. ICASA R-GLSD Commissioned 2. Interim S-GLSD Developed and Hosted by CSIR 3. Pre-commercial TVWS Trials Commences 4. ICASA Develops Qualification Framework for S-GLSD Providers 5. (In Progress)

8 Years in the Making!

Supporting Policy, Regulations, Recomms & Standards

- National Broadband Policy (SA CONNECT), 2013
- Radio Frequency Spectrum Regulations (RFSR) of 2011, as Amended
- National Radio Frequency Plan (NRFP) of 2018
- Terrestrial Broadcast Frequency Plan (TBFP) of 2013
- Type Approval Regulations of 2013
- Astronomy Geographic Advantage (AGA) Act No. 21 of 2017
- ITU-R RA.769-2
- SARAS, 2011
- ITU-R P.1812
- ITU-R P.452
- ITU-R P.1411
- ITU-R P.1546
- ITU GEO6
- ETSI EN 301 598
- IETF PAWS RFC 7545



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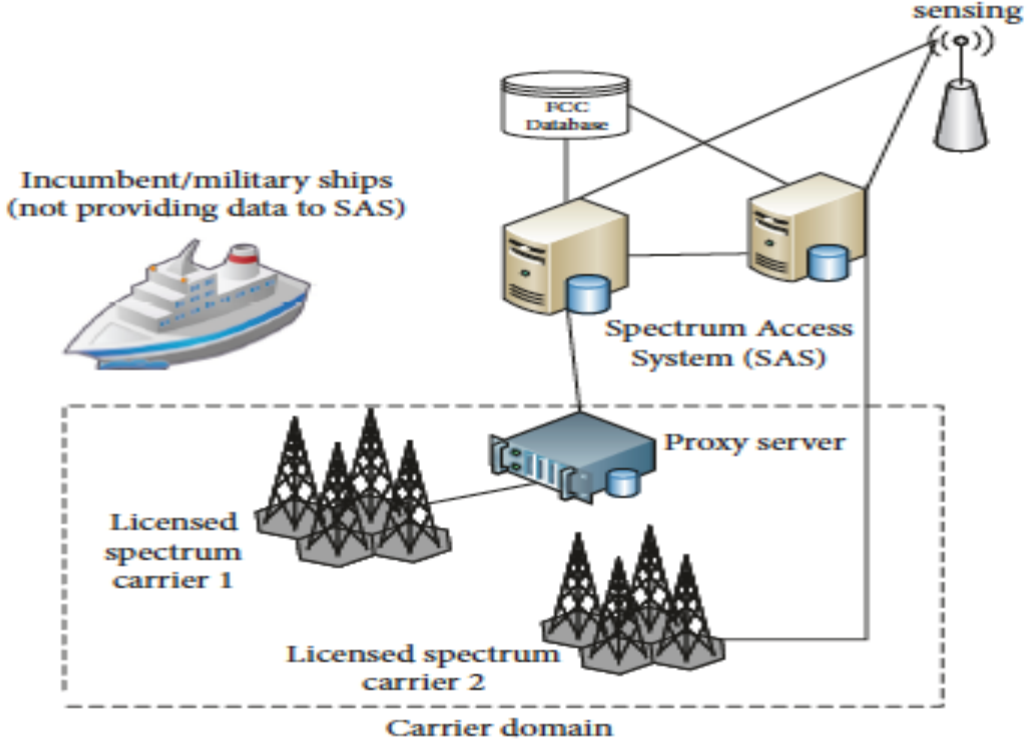
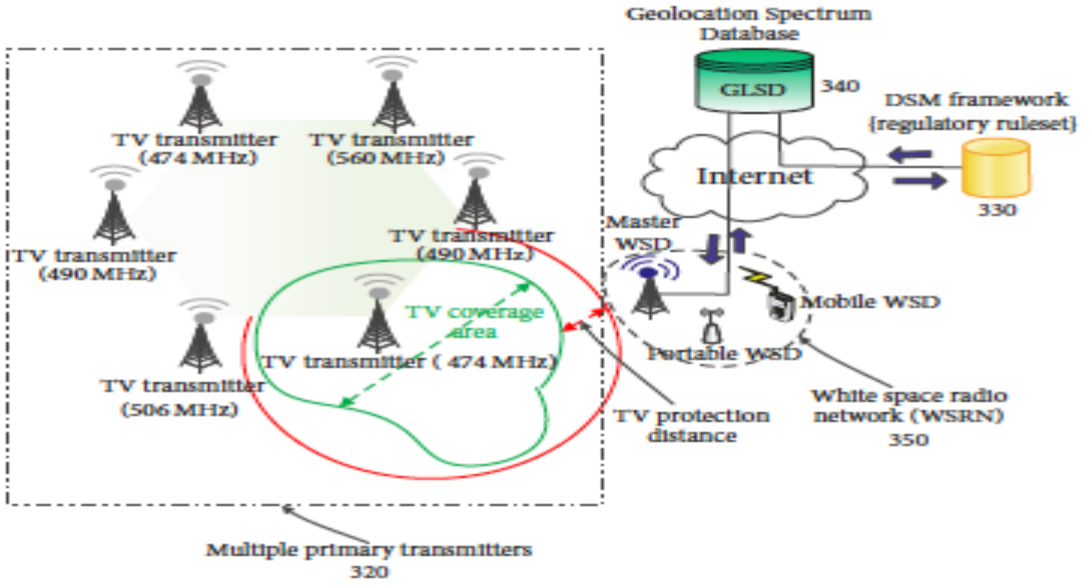
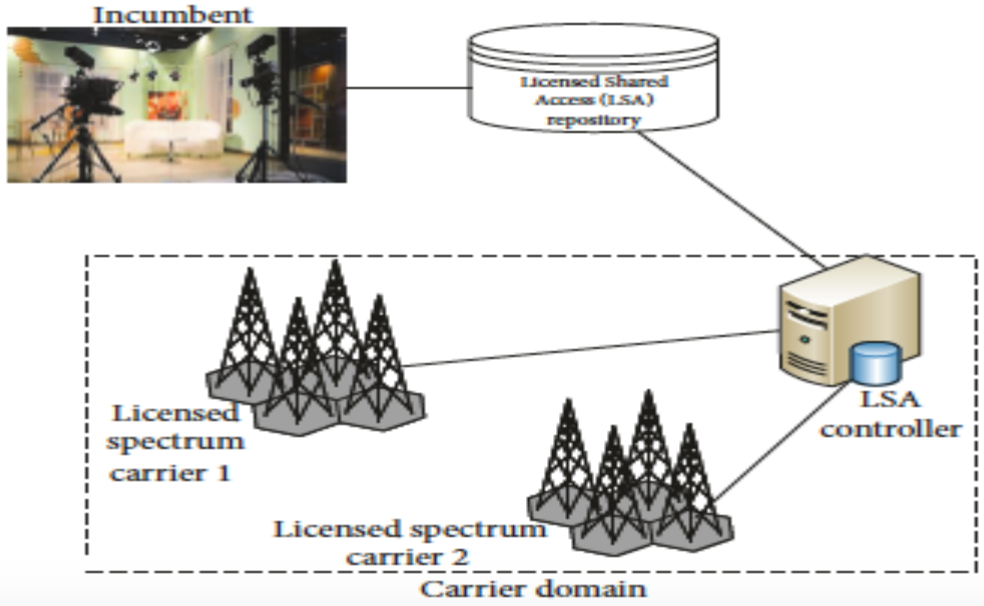
Geo-location Spectrum Databases



(a) The Spectrum Access System (SAS) model

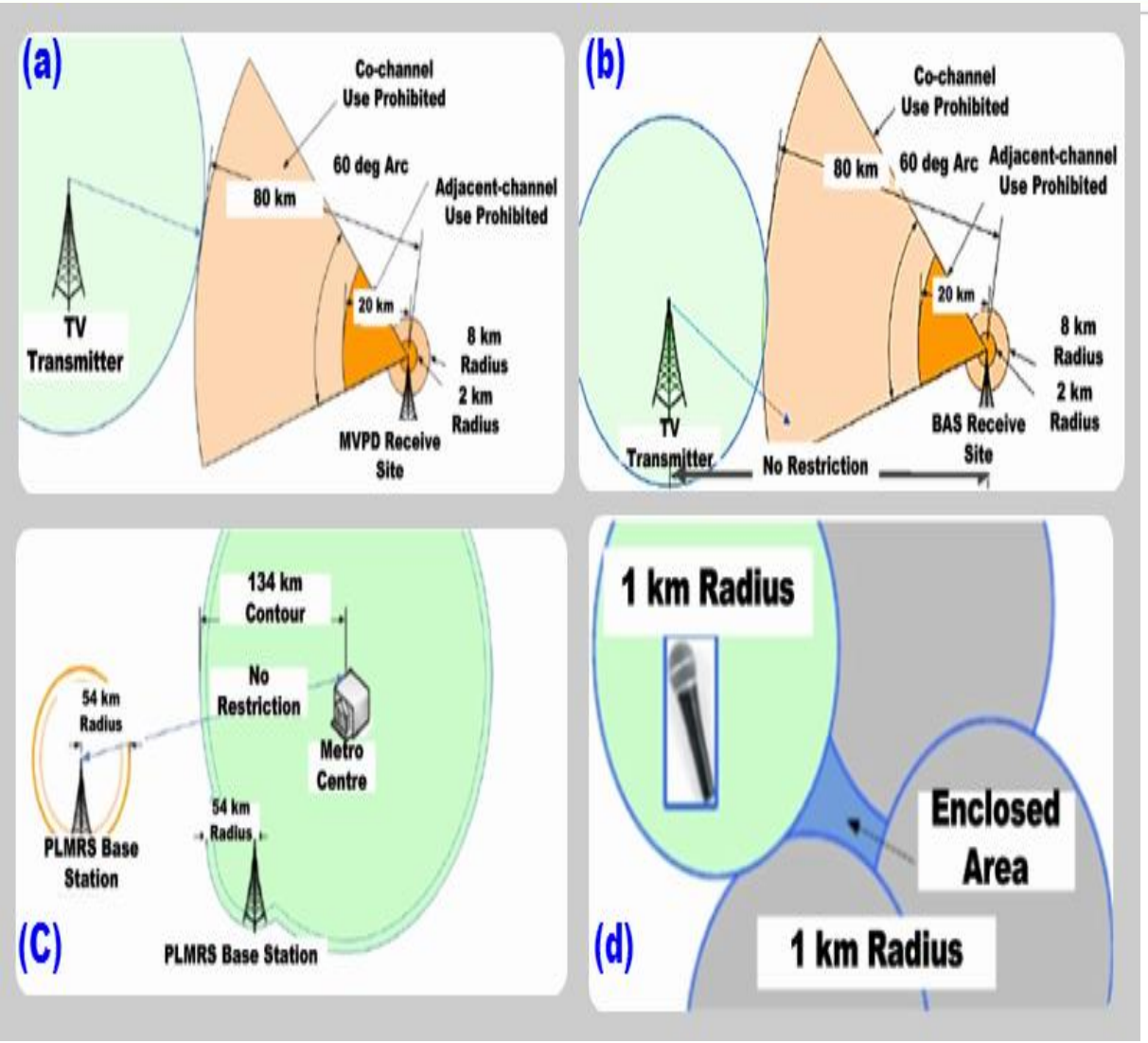


(b) The TV White Spaces (TVWS) model

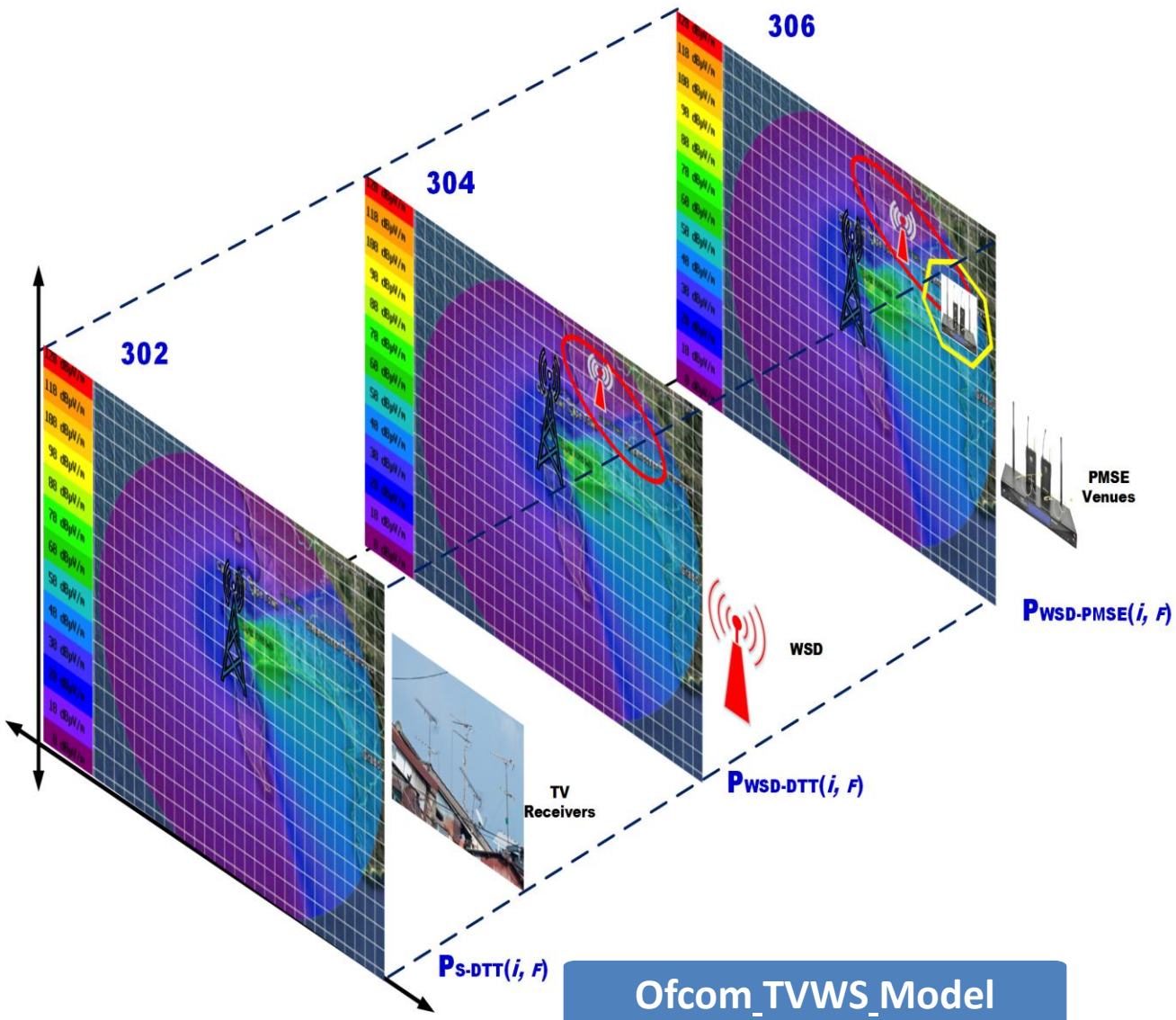


(c) The Licensed Shared Access (LSA) model

TVWS Technical Model (1/3)

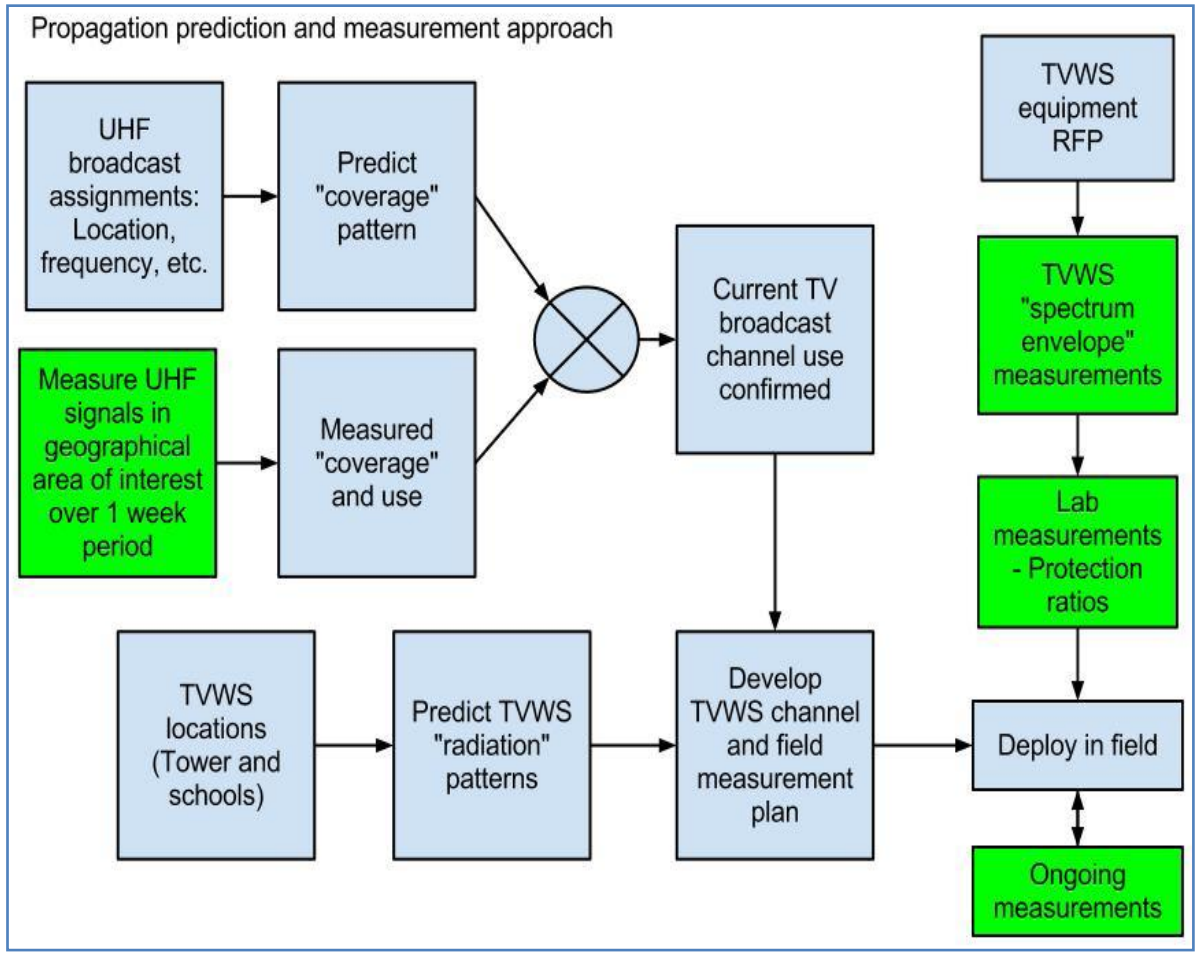


FCC TVWS Model



Ofcom_TVWS_Model

TVWS Technical Model - RSA (2/3)



- ICASA entered into a research collaboration with CSIR to develop the TVWS technical model
- CSIR developed the prototype South Africa GLSD for TVWS use during technology trials and research purposes
- Relied on well researched, tested, **international best practices**, and standardised propagation prediction models
- Applied the model and cross-validated with measured coverage in TVWS trials in Western Cape and Limpopo in South Africa
- Correctness of results verified by ICASA and broadcasters
- The technical model was used to develop the R-GLSD and S-GLSD compliant to the TVWS Regulations of 2018

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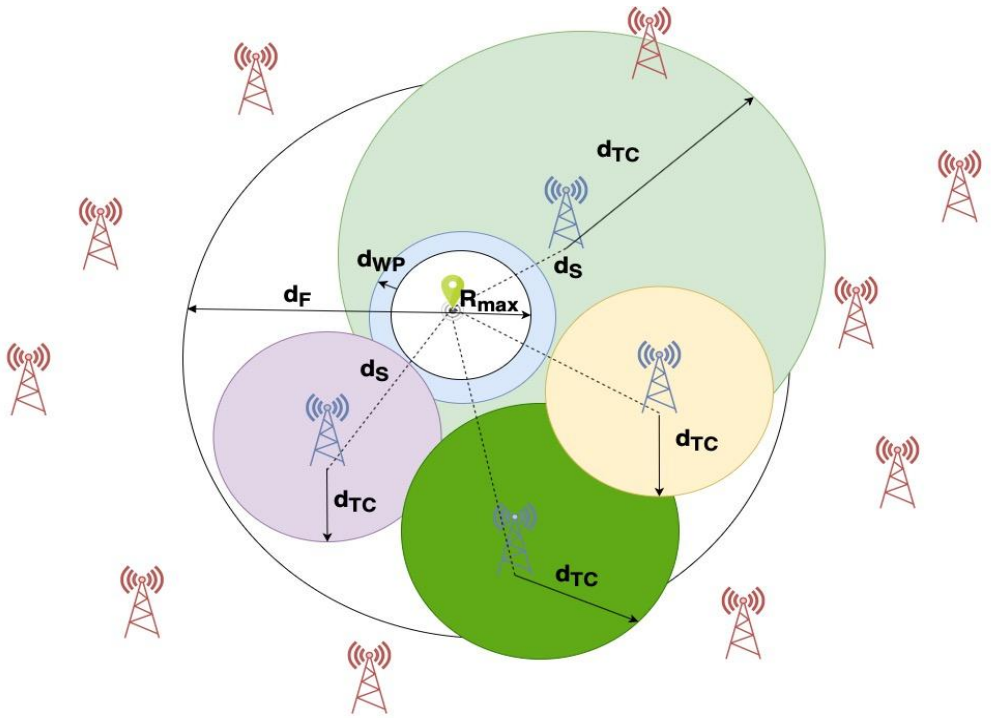
TVWS Technical Model - RSA (3/3)



Consider TV Broadcasting Transmitters that are located within the filtration distance from the WSD, and their coverage overlap with that of the WSD:

- **TV Broadcast Transmitter Coverage Distance (d_{TC})**
- **WSD Coverage Distance (d_{WC})**
- **Separation Distance between WSD and TV Broadcast Transmitter (d_S)**
- **Distance due to WSD Location Uncertainty (d_F)**
- **Minimum Separation Distance between WSD and TV receiver (d_{WP})**

Shortcut Filtration Process: $d_S - d_{TC} <= (d_{WC} + d_{WP})$

A CNIR Approach:

- $C_{TV} = \{21, 22, 23, \dots, 48\}$ // Consider all Broadcast TV Channels 470 MHz – 694 MHz, Excluding 606 – 614 MHz
- $f_{TV} \in F_{TV}$ // Perform a Snapshot Analysis on the TV Coverage Areas that May Intersect with or Enclosed by that of the WSD

S.T.

- $F_{TV} \subseteq C_{TV}$ // A Subset of all Channels, Excluding 606 – 614 MHz

Regulations on the use of TVWS of 2018 - RSA (1/2)

INDEPENDENT COMMUNICATIONS AUTHORITY OF SOUTH AFRICA

NOTICE 147 OF 2018

ELECTRONIC COMMUNICATIONS ACT 2005, (ACT NO. 36 OF 2005)

REGULATIONS ON THE USE OF TELEVISION WHITE SPACES

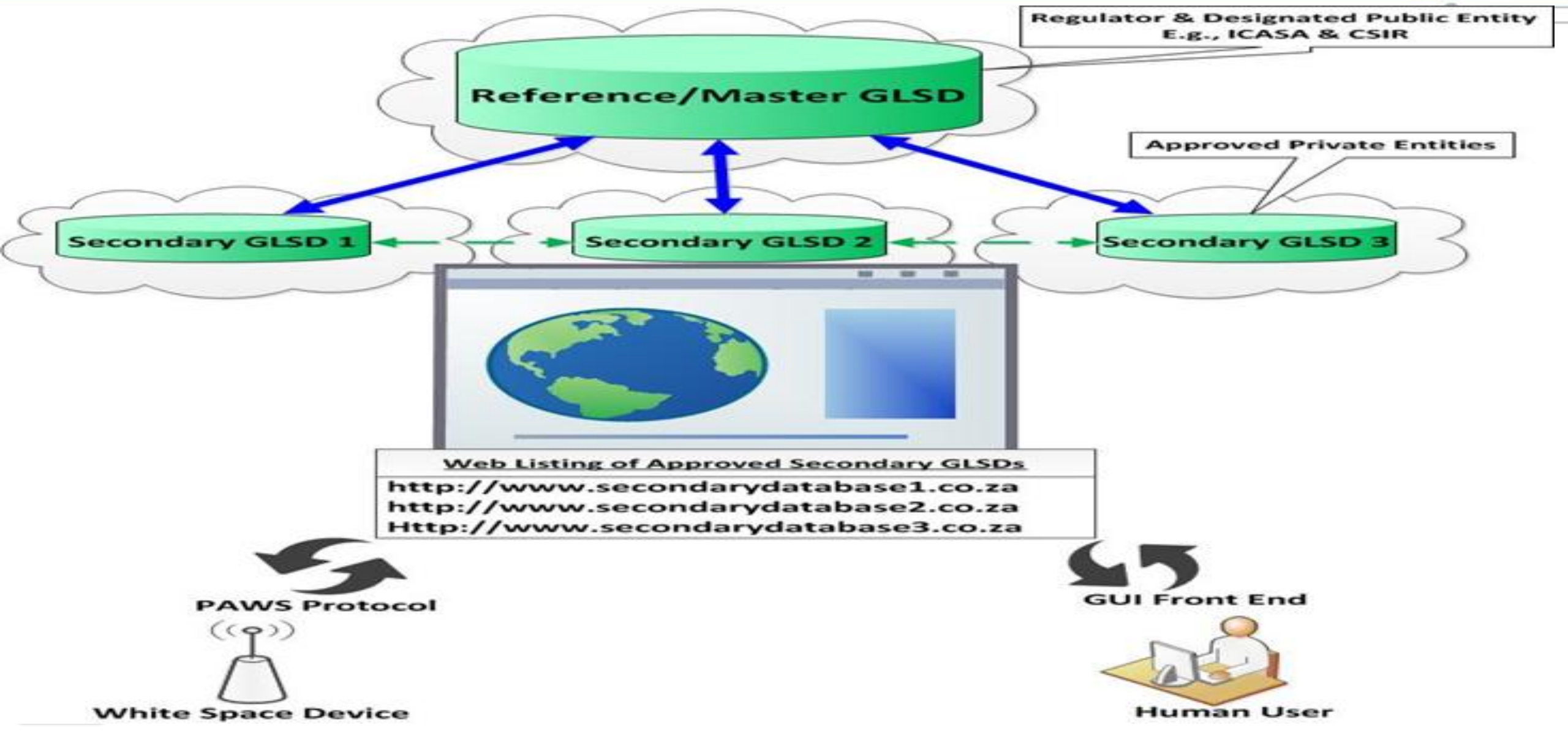
The Independent Communications Authority of South Africa ("the Authority'), in terms of section 4 read with section 32 (1) and 33 of the Electronic Communications Act (Act No. 36 of 2005), hereby prescribe the Regulations on the use of Television White Spaces.

TVWS Frequency Range: 470 MHz to 694MHz Excluding the Radio Astronomy sub-band (606-614MHz), a.k.a Channel 38

Highlights:

- Reg 3: Characteristics of WSDs
- Reg 4: WSD Authorisation (i.e., Type Approval)
- Reg 5: Avoidance of Harmful Interference
- Reg 8: Location Specific EIRPS (i.e., Urban/Rural Classifications)
- Reg 10: S-GLSD Access
- Reg 16: Responsibility of R-GLSD & S-GLSD Operators.
- sub sec (2): Qualification of S-GLSD Providers
- sub sec (4): S-GLSD Service Fees

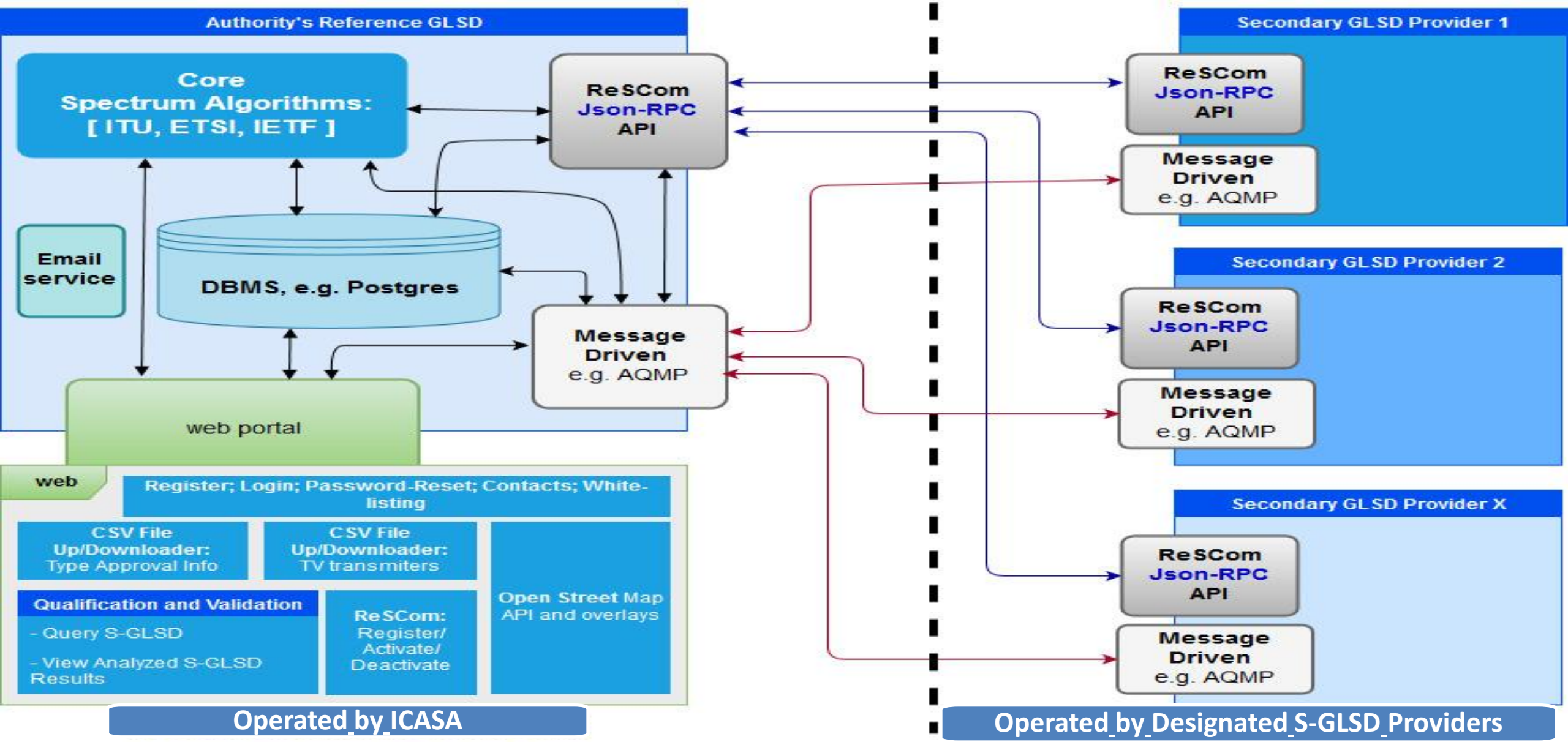
Regulations on the use of TVWS of 2018 - RSA (2/2)



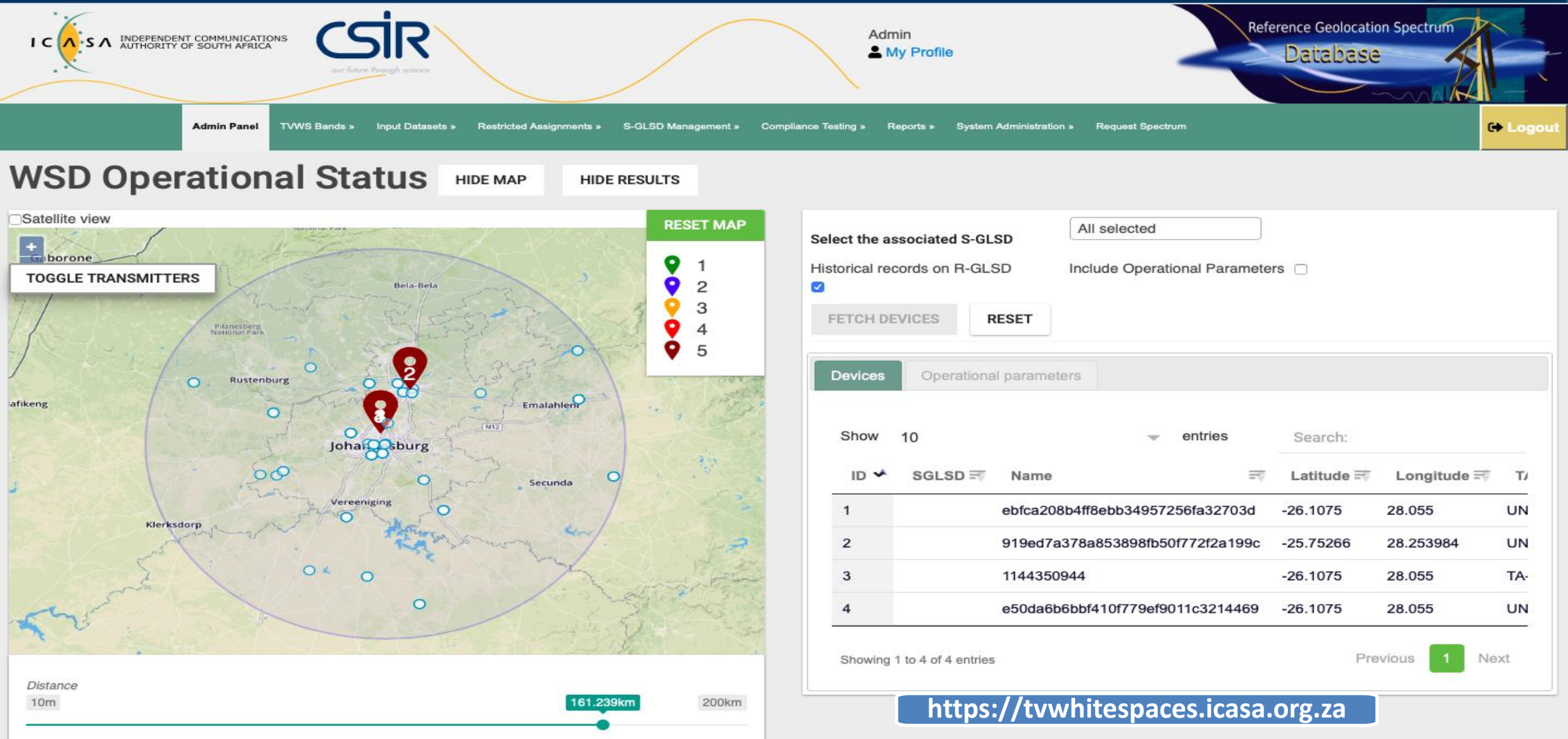
Reference Geo-location Spectrum Database (R-GLSD) (1/3)

"Operated by the Regulator, the R-GLSD performs baseline calculations for the countrywide TVWS availability maps and generates Operational Parameters for WSDs, for setting regulatory limits"

Reference Geo-location Spectrum Database (R-GLSD) (2/3)



Reference Geo-location Spectrum Database (R-GLSD) (3/3)



https://tvwhitespaces.icasa.org.za

Secondary Geolocation Spectrum Database (S-GLSD) (1/3)

"A GLSD operated by certified GLSD operators designated by the Authority to provide GLSD services to network operators"

Secondary Geo-location Spectrum Database (S-GLSD) (2/3)

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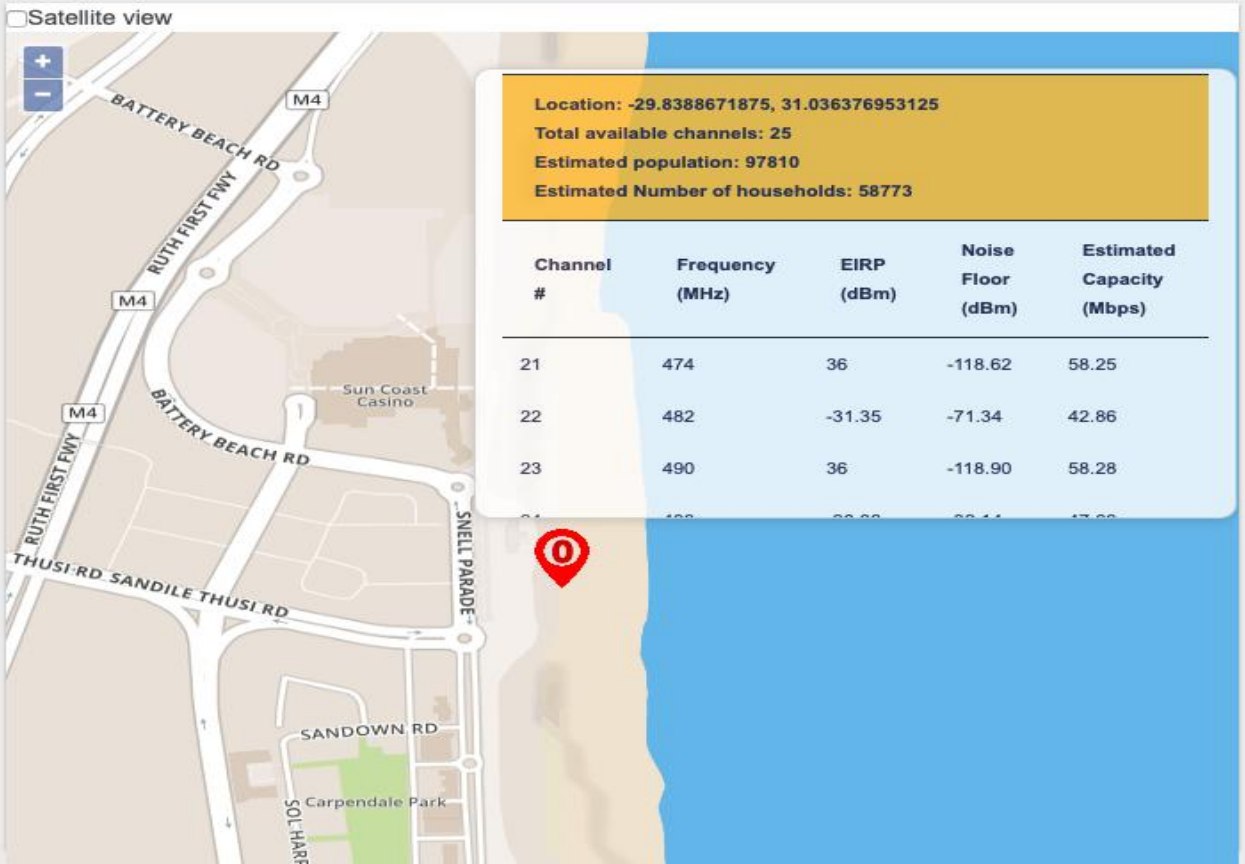
Admin
My Profile

Secondary Geolocation Spectrum Database

Admin Panel | Spectrum Query » | Input Datasets » | System Reports » | Network Operator » | System Administration » | PAWS Configurations » | Restricted Assignments » | Planning Tool | Logout

Request Spectrum

HIDE MAP | HIDE RESULTS



Location: -29.8388671875, 31.036376953125
Total available channels: 25
Estimated population: 97810
Estimated Number of households: 58773

Channel #	Frequency (MHz)	EIRP (dBm)	Noise Floor (dBm)	Estimated Capacity (Mbps)
21	474	36	-118.62	58.25
22	482	-31.35	-71.34	42.86
23	490	36	-118.90	58.28

RE-SUBMIT | ADD-NEW-POINTS | RESET

Latitude | Longitude | Add point

INPUTS

Channels

	21	22	23	24	25	26	27	28	29	30
-8b43-805a2942bf5d	36	-31.35	36	-20.83	36	10.91	36	-20.83	36	11.17

Showing 1 to 1 of 1 entries

Previous | 1 | Next

Legend
Available Spectrum
Unavailable Spectrum

https://whitespaces.csir.co.za

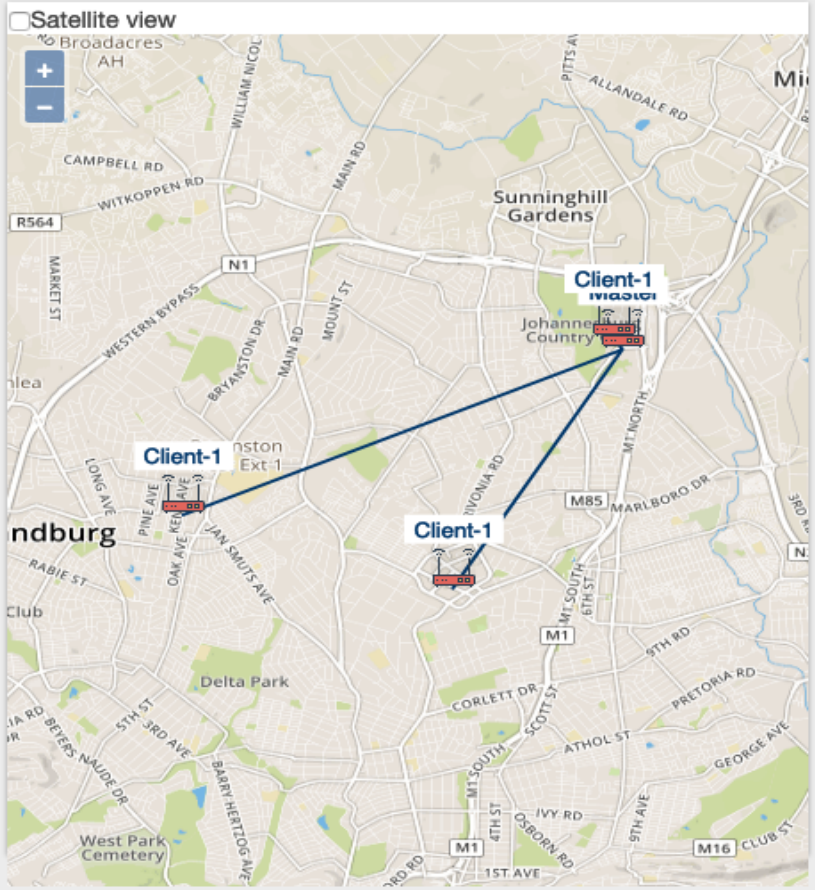
Secondary Geo-location Spectrum Database (S-GLSD) (3/3)

https://whitespaces.meraka.csir.co.za/loggedin/maps/network/planning/tool

Admin Panel | Spectrum Query » | Input Datasets » | System Reports » | Network Operator » | System Administration » | PAWS Configurations » | Restricted Assignments » | Planning Tool | Logout

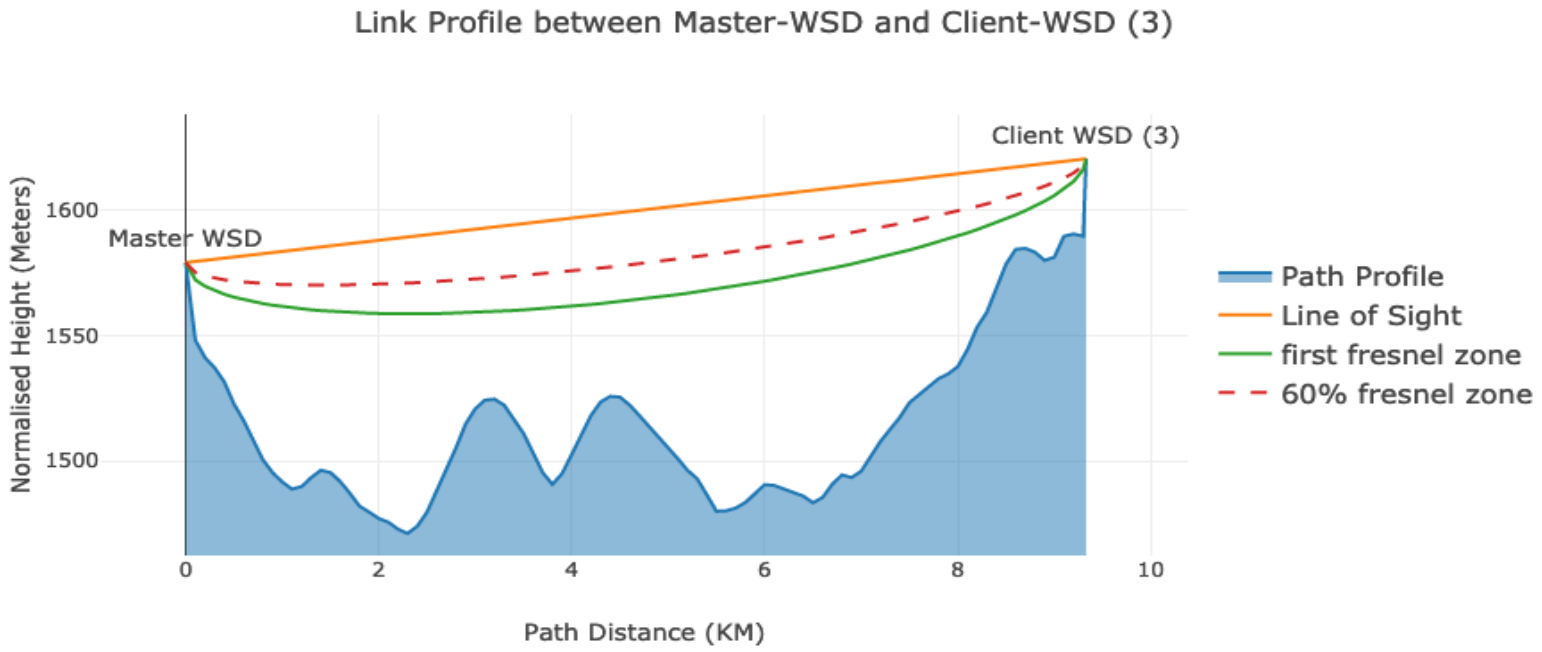
Network Planning

HIDE MAP | HIDE RESULTS

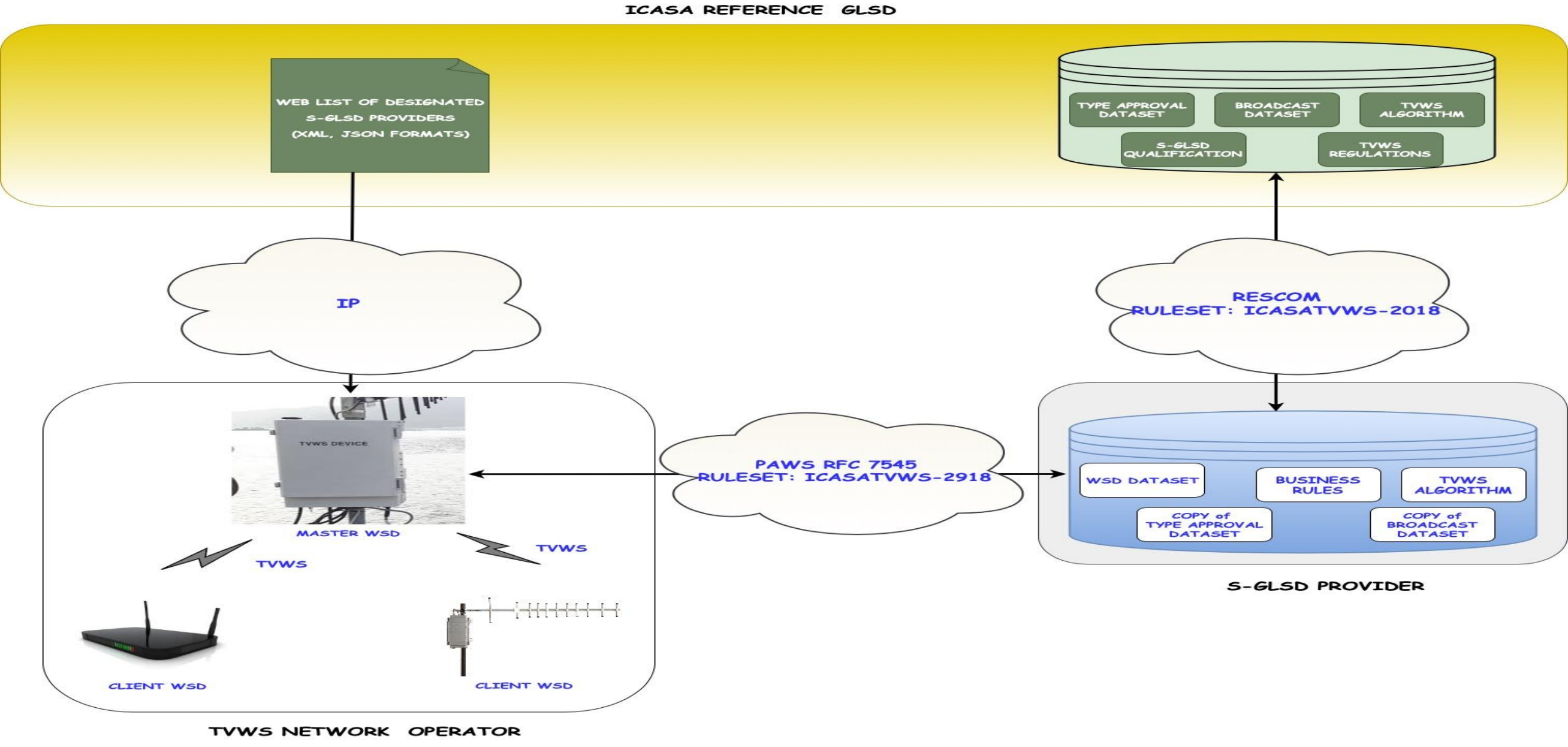


60% fresnel zone is clear from obstacles.

60% fresnel zone is clear from obstacles.



Recap: The South African TVWS Ecosystem



WSD Type Approval

Two-Stage Procedure:

1: EMC Conformance Assessment

- Done through an Accredited Test Lab (ATL)

(e.g., ETSI EN 301 598 compliant certificates)

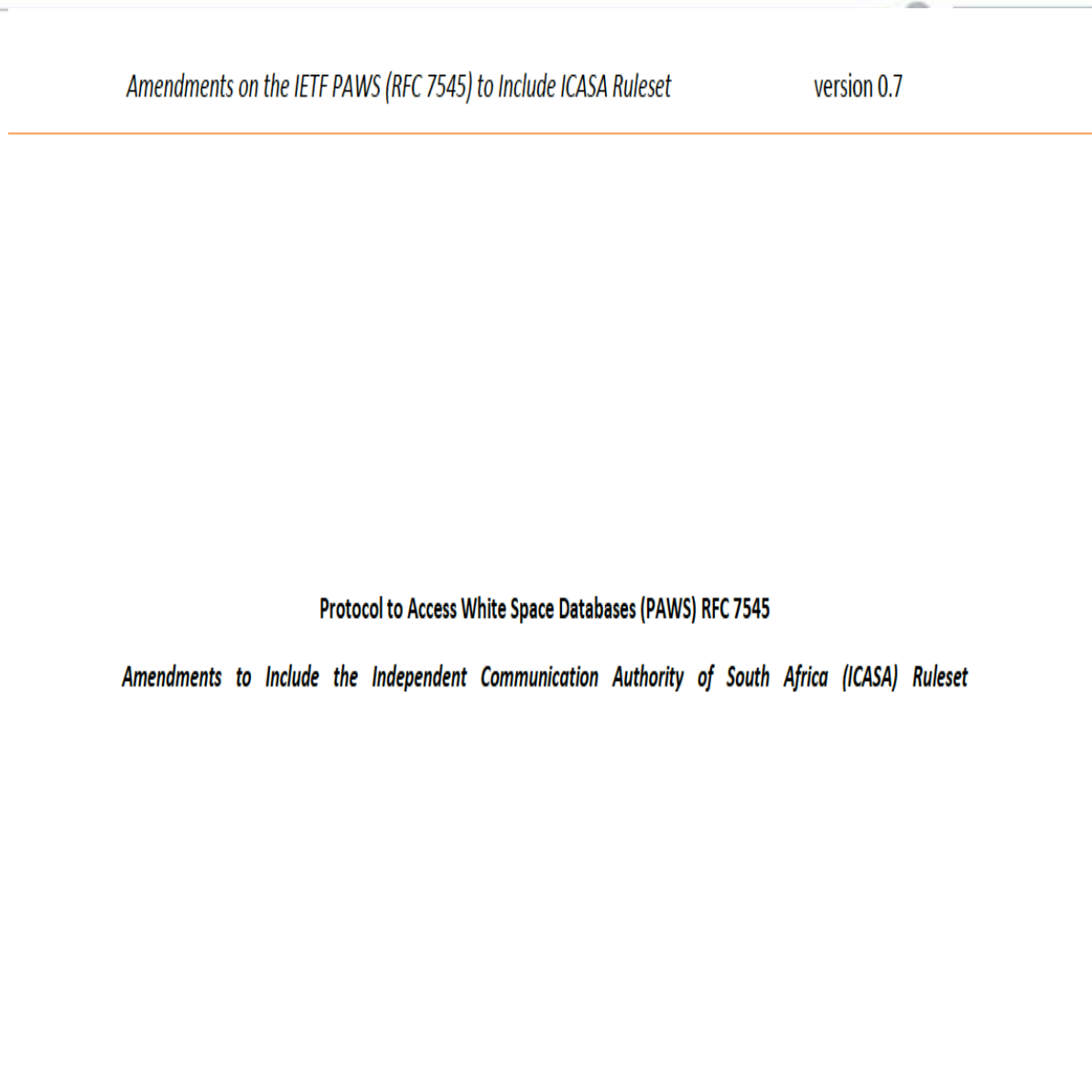
2: S-GLSD Connectivity Conformance Assessment

- Done through an Approved S-GLSD Provider

- Ref. Reg 4: WSD Authorisation

- Ref. Reg 10: S-GLSD Access

(i.e., PAWS Ruleset: ICASATVWS-2018)



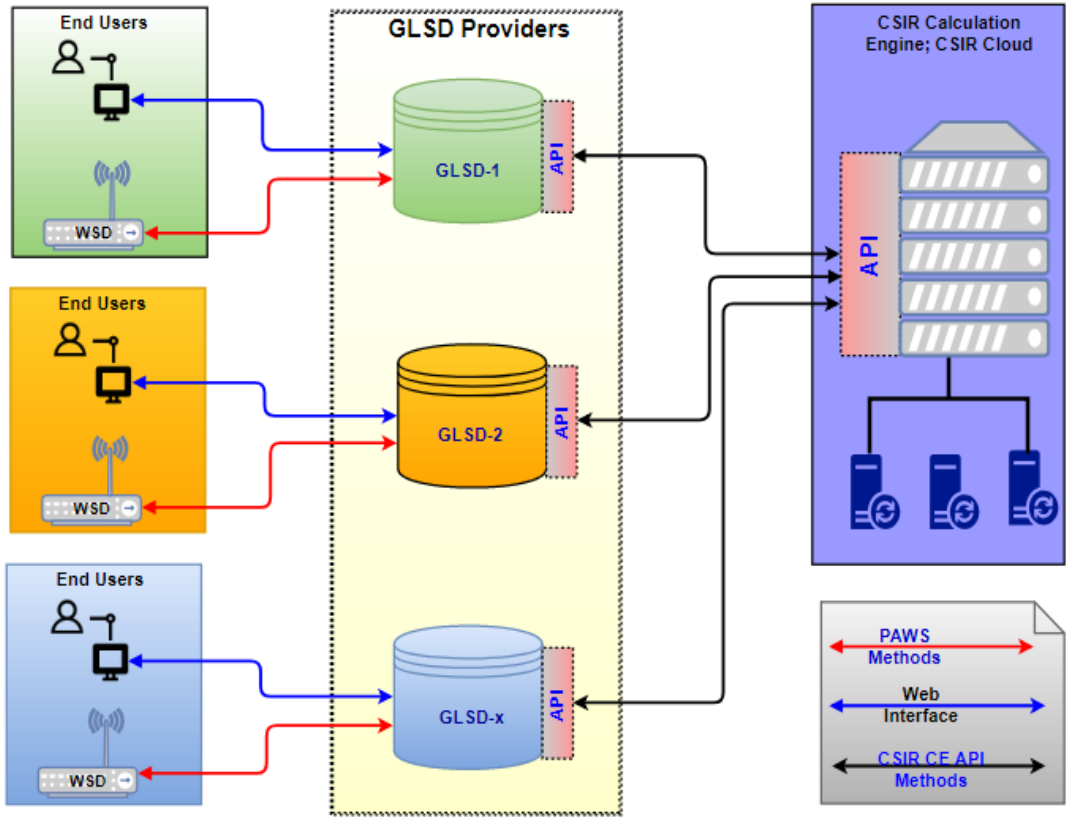
Amendments on the IETF PAWS (RFC 7545) to Include ICASA Ruleset version 0.7

Protocol to Access White Space Databases (PAWS) RFC 7545

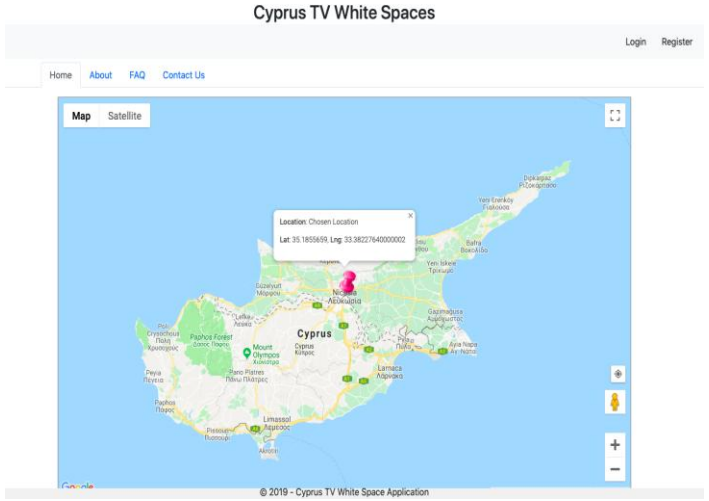
Amendments to Include the Independent Communication Authority of South Africa (ICASA) Ruleset

Supporting TVWS Networks Globally through an Open API

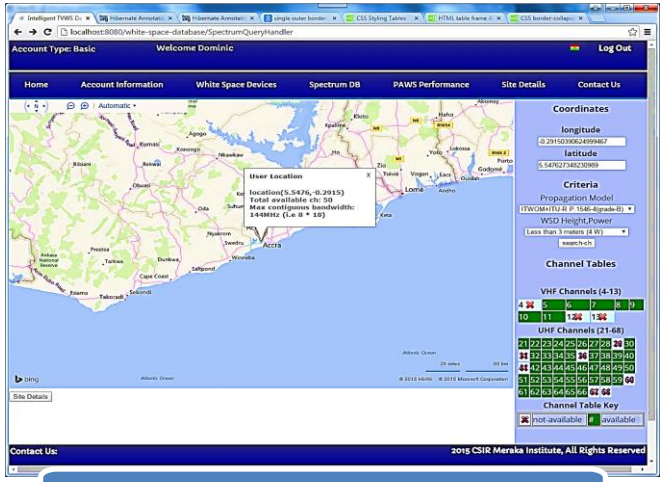
CSIR's CE is used in South Africa & has been supporting pilots in other countries through API



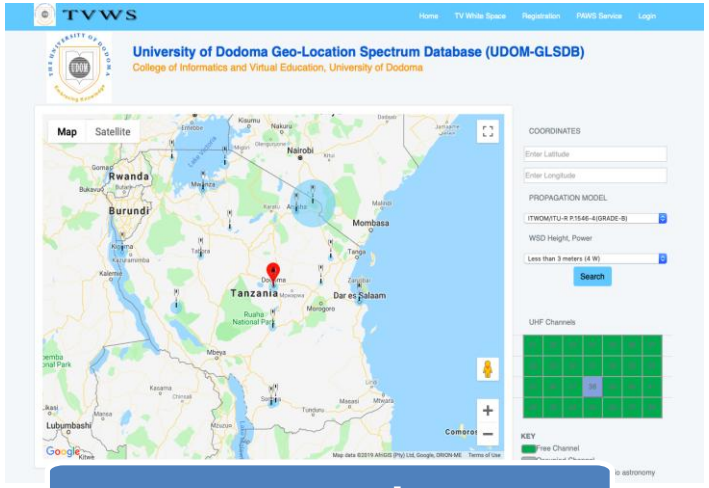
Qualified to operate in UK since 2016



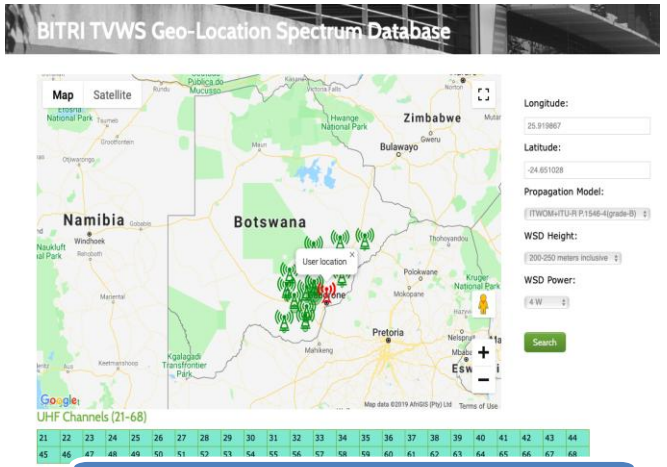
Cyprus



Ghana

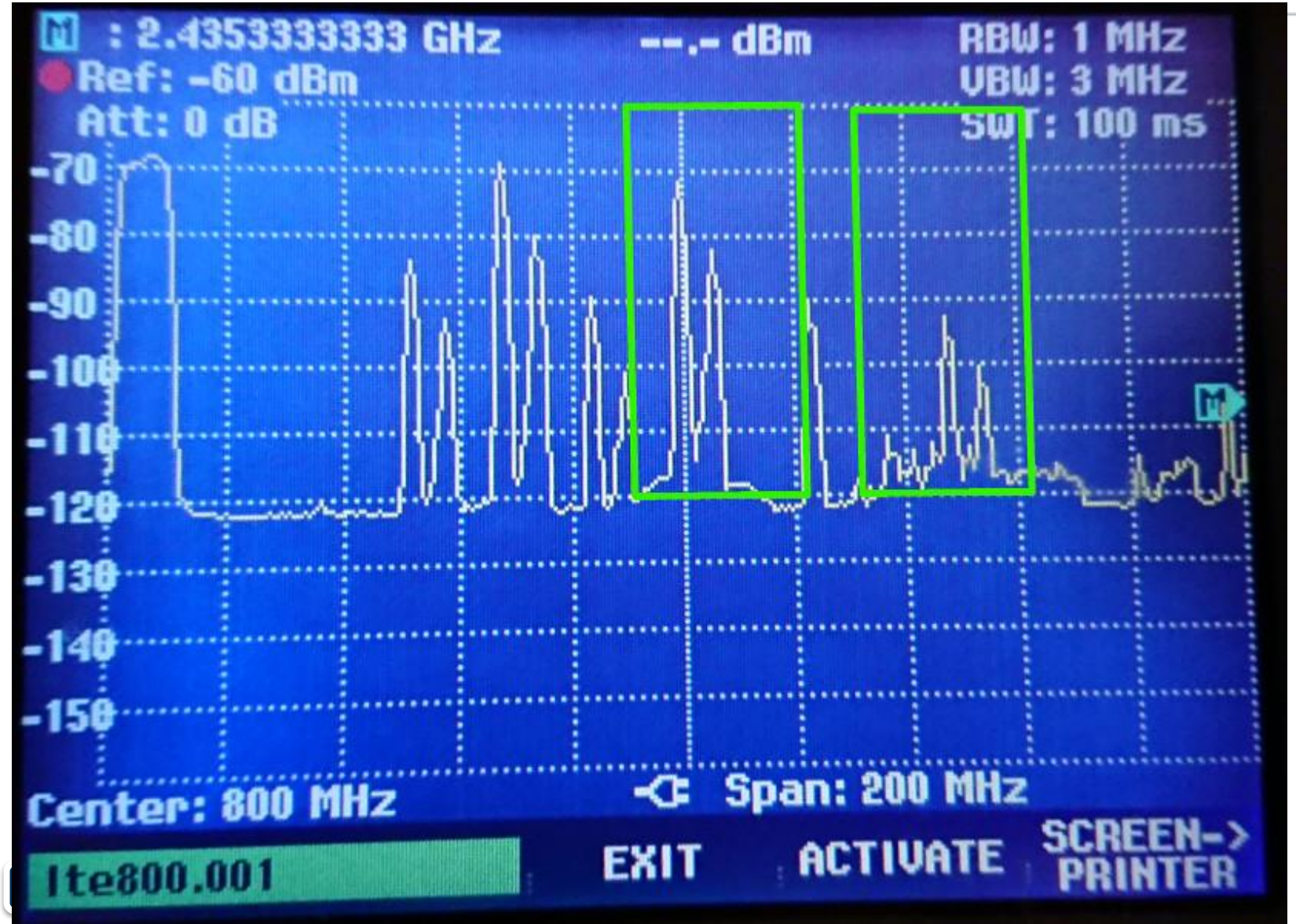


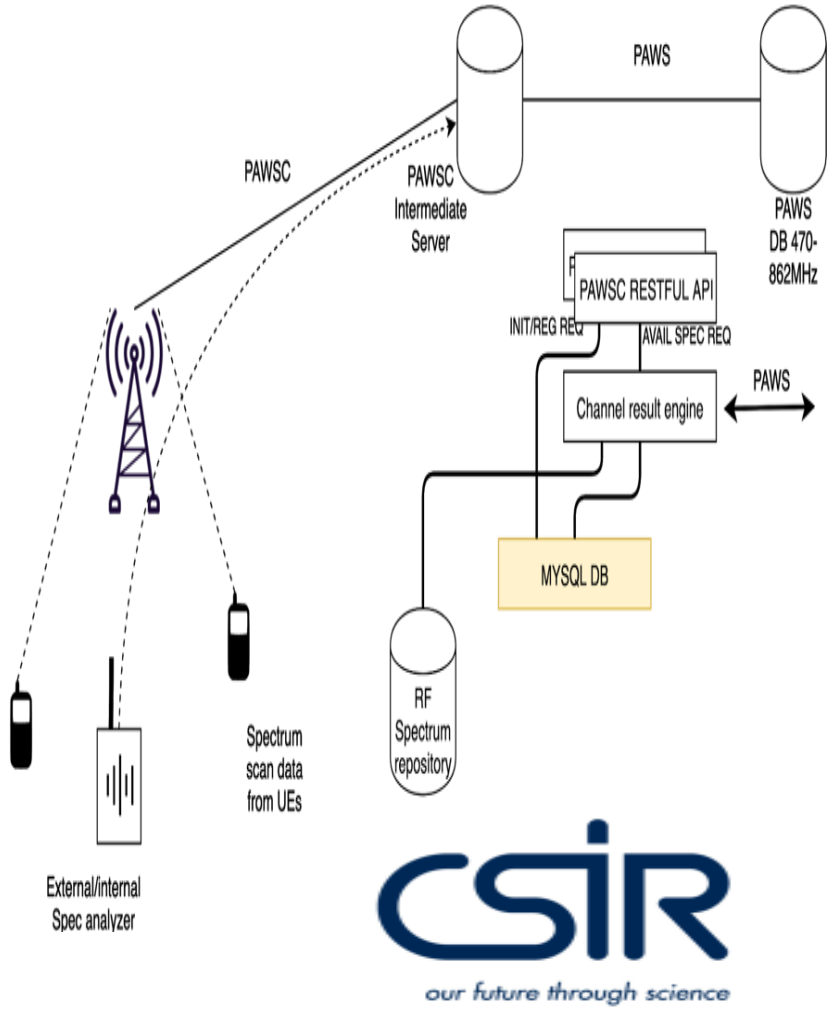
Tanzania



Botswana

Spectrum Sharing in IMT Bands: OpenCellular /TIP





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Our Offerings and Available Opportunities

- Licensing of the CSIR GLSD technology
- Open API access to the GLSD Calculation Engine:
  - *Input to your TVWS network planning tool*
  - *Powering your own GLSD Front-End*
- WSD Type Approvals
- TVWS network planning and deployments
- Supporting formulation of Telecoms policy and regulations

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Thank You!

Questions, comments!

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