

Adaptrum

SABISPA

Introduction to TVWS
12 August 2020

August 2020

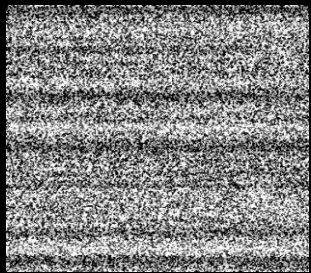


What is TVWS

- *What are the characteristics of UHF*
- *What is dynamic spectrum*
- *What is the RSA regulatory requirements*

Television White Space (TVWS) spectrum

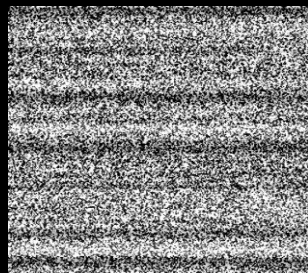
A portion of spectrum in a band allocated to the broadcasting service and used for television broadcasting that is identified by an administration as available for wireless communication at a given time in a given geographical area on a non-interfering and non-protected basis with regard to other services with a higher priority on a national basis.



Channel 25



Channel 26



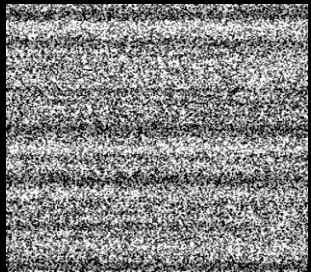
Channel 27



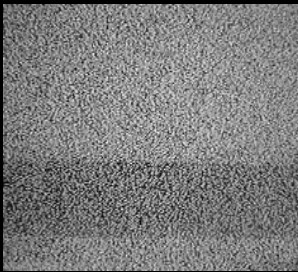
Channel 28



Channel 29



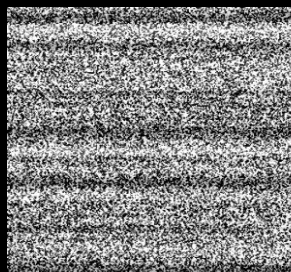
Channel 30



Channel 31



Channel 32



Channel 33

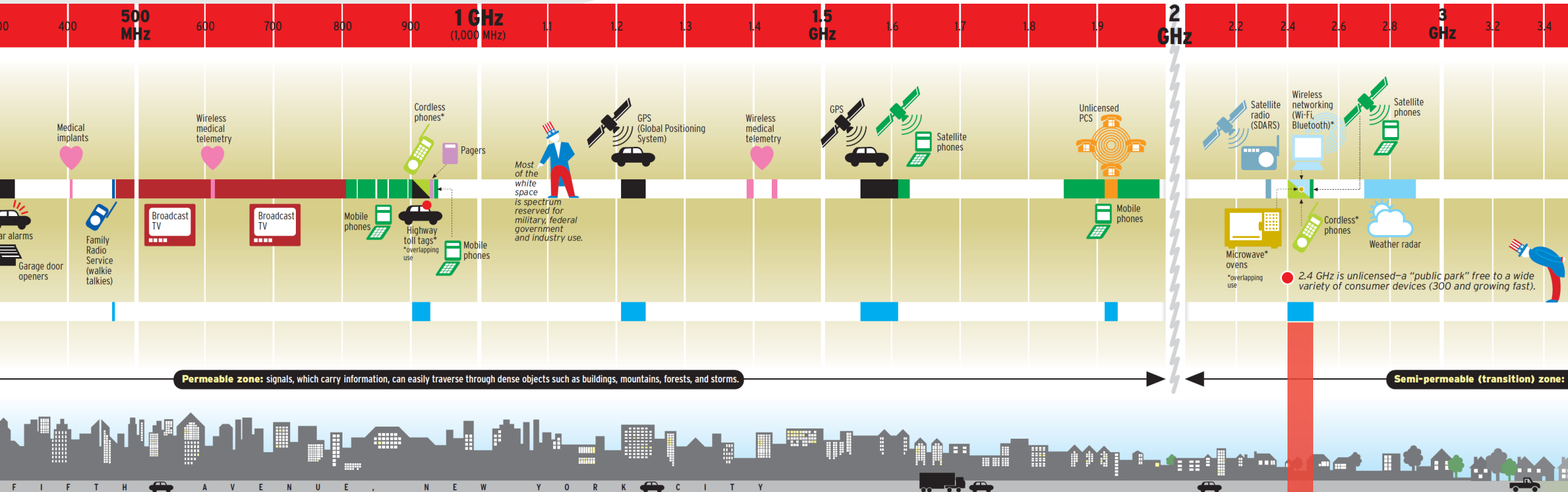


Channel 34

ADVANTAGES

- ✓ Longer range and greater coverage area
- ✓ Greater obstacle penetration in difficult terrain
- ✓ Non-line of sight operation available
- ✓ Global spectrum bands - allows for global economies of scale

The Value of Spectrum versus Frequency



The most **valuable** spectrum is below 1 GHz because of its superior propagation

The busiest spectrum is the 80 MHz at 2.4 GHz used for Wi-Fi

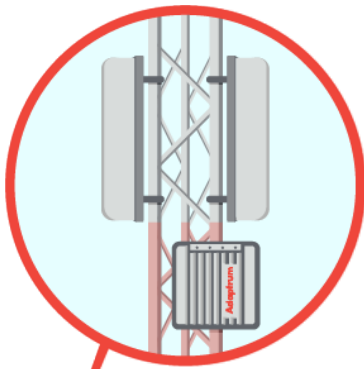
Sub-GHz Spectrum Ideal for Wireless Broadband

Long-Range

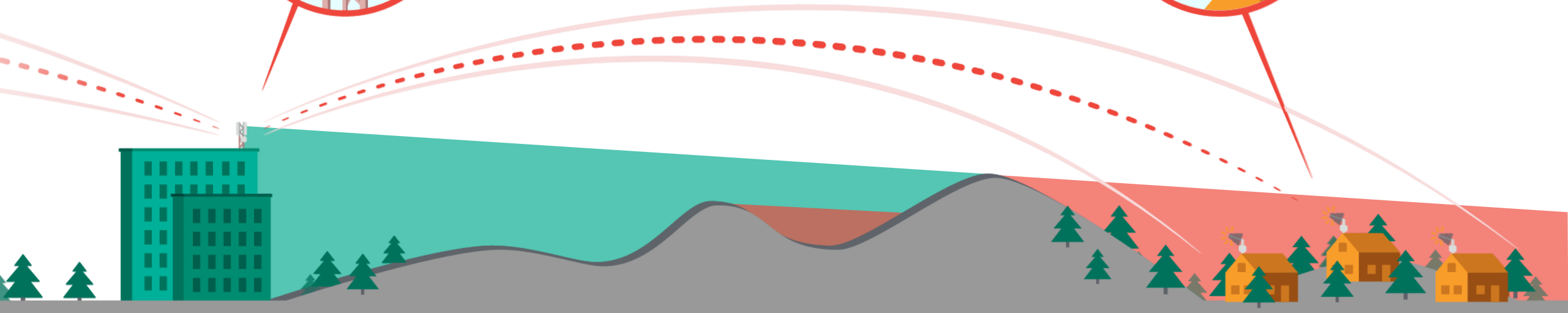
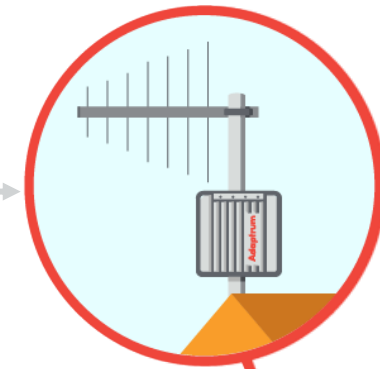
Non-Line-of-Sight

Great Penetration
trees, building, etc.

TVWS
Base

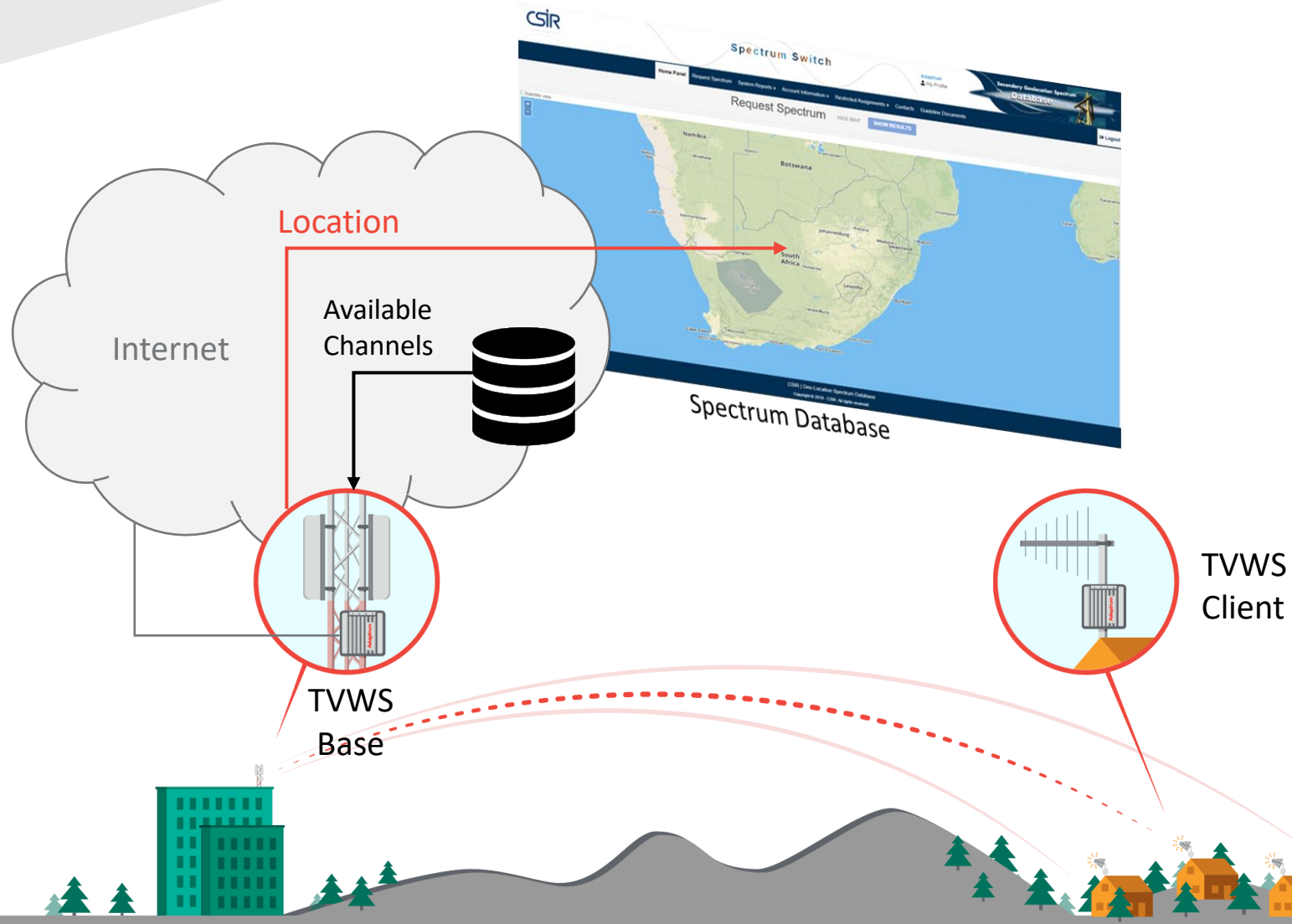


TVWS
Client(s)



Dynamic Spectrum Access

Frequency agile radios dynamically operate across entire TVWS band



Spectrum Sensing

Ensures Adaptrum networks operate with the optimal channels



South Africa regulatory framework

2018 ICASA regulation on the use of Television White Space

- White Space Devices to be **certified** by a secondary Geo-location Spectrum Database (S-GLSD) operator as database compliant
- White Space Devices to **exclude** the Radio Astronomy sub-band of 606 MHz to 614MHz from use
- White Space Devices to **automatically** determine its geo-location Astronomy Geographic
- Location Specific **Maximum** Permitted Radiated Power Levels
 - Rural : 41.2 dBm
 - Urban : 36 dBm
- White Space Devices to **access** the Secondary Geo-location Spectrum Database for database channels
- A White Space Devices network **shall** be installed by
 - (a) an installer of wireless equipment in possession of a radio dealer certificate or;
 - (b) by a professional radio technician registered with the institute of Electrical engineers
- Antenna placement
 - 30m AGL in the **urban** areas; and
 - 80m AGL in the **rural** areas.

Different Spectrum licensing models

Licensed

- Cellular, Broadcast ... good for high population density
- Very expensive
- Massively underutilized esp. in rural areas

Dynamic Access

- Allows secondary use of licensed spectrum to increase efficiency
- No barrier of entry associated with purchase or lease of spectrum

Unlicensed

- Wi-Fi, Bluetooth, etc.
- 2.4GHz, 5GHz
- Interference & no protection
- “Once thought unusable, the unlicensed bands are some of the most valuable bands in the world” FCC Commissioner Michael O’Rielly

TV White Space in South Africa

Steps to commercial TVWS framework launch

(1) Technical Trials

(2) Commercial Regulatory Framework Launched

(3) Refinements

1930 No. 41512

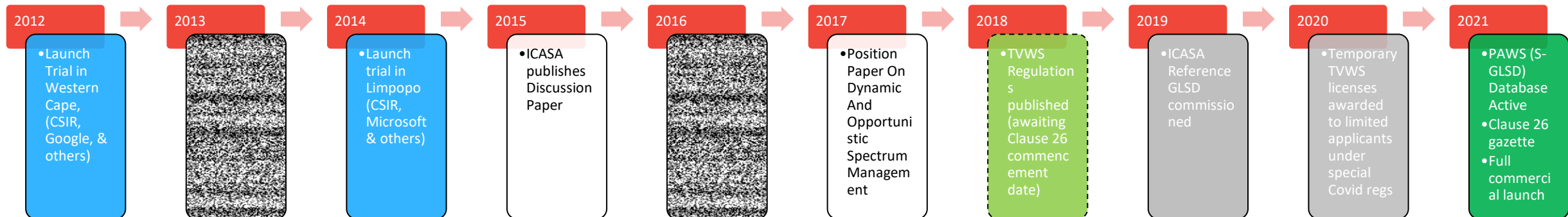
GOVERNMENT GAZETTE, 23 MARCH 2018

26 Commencement

These regulations shall come into force on a date determined by the Authority by notice in the Government Gazette.

<https://www.icasa.org.za/uploads/files/Regulations-on-the-use-of-Television-White-Spaces-2018.pdf>

South Africa TVWS timeline



Source : Multiple sources inc. ICASA web site, SA Government gazette, CSIR @ Internet Society workshop, Dynamic Spectrum Alliance

The role of TVWS

- Is not a silver bullet but an integral part of the overall solution
- Has low power requirements – suitable for off grid deployment
- UHF spectrum = long range and NLOS
- Ideal for connecting rural communities

Why TVWS

- *Why is TVWS good for South Africa*
- *Does TVWS deliver on NLOS and nLOS*
- *What coverage / throughput would I expect*
- *Why do I need to use a TVWS Database*
- *How does the last mile economics work*
- *Does TVWS drive digital inclusion*
- *Microsoft Global Airband Initiative*



WHY IS DIGITAL INCLUSION IMPORTANT?

How would you define digital inclusion?

What is digital inclusion?

- The ability of individuals and groups to access and use information and communication technologies (ICTs).
- Digital inclusion encompasses not only access to the Internet but also;
 - Access to the required hardware and software
 - Access to relevant content and services
 - Access to digital literacy skills required for effective use of ICTs

Source:

Institute of Museum and Library Services, <https://www.imls.gov/assets/1/AssetManager/BuildingDigitalCommunities.pdf>

Internet Governance Forum, <https://www.intgovforum.org/multilingual/content/igf-2018-ws-23-revisiting-digital-literacy-initiatives-in-africa>

The Broadband Commission. The State of Broadband. 2015

Mobile and internet services have the power to transform lives, offer life-enhancing financial, health, and other services.

Yet millions of people in emerging markets lack access to these services.

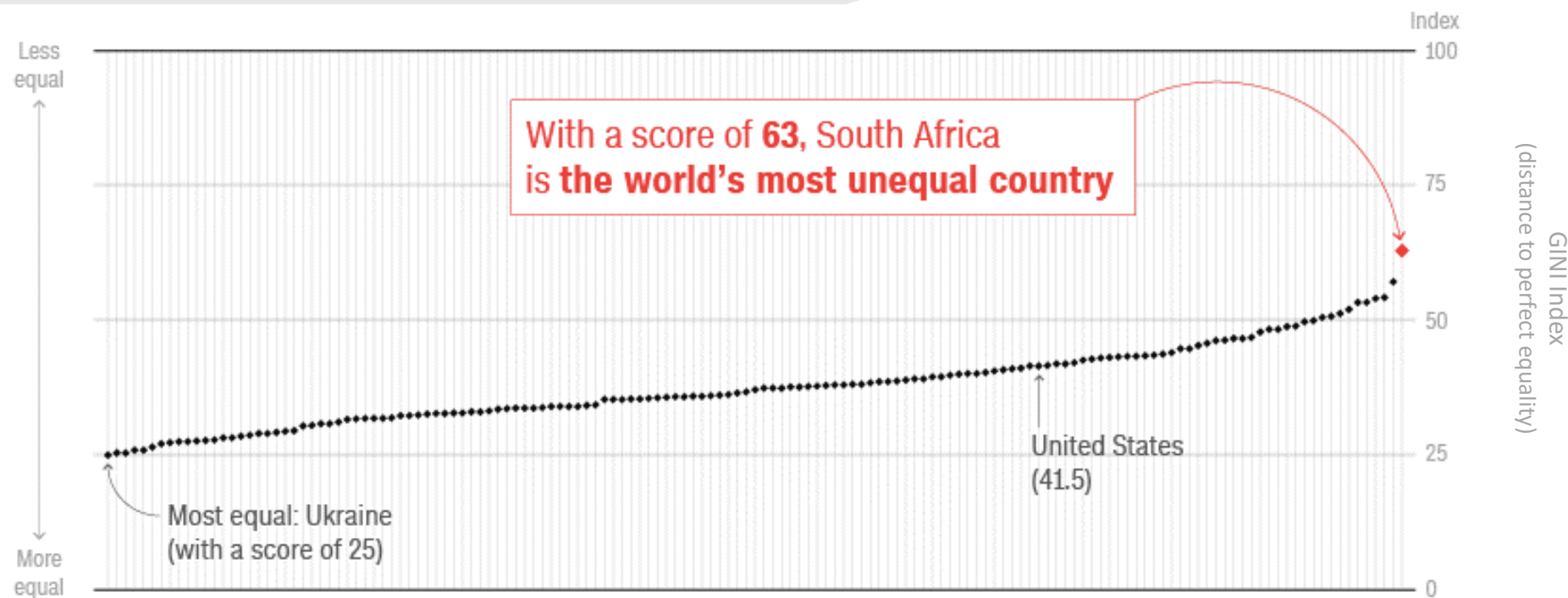
Those who have access often do not adopt services due to affordability, perceived value, and ability to use the services.

The resulting access and adoption gaps threaten to exacerbate existing economic and social inequities facing low-income, rural communities in emerging markets, particularly among women and girls.

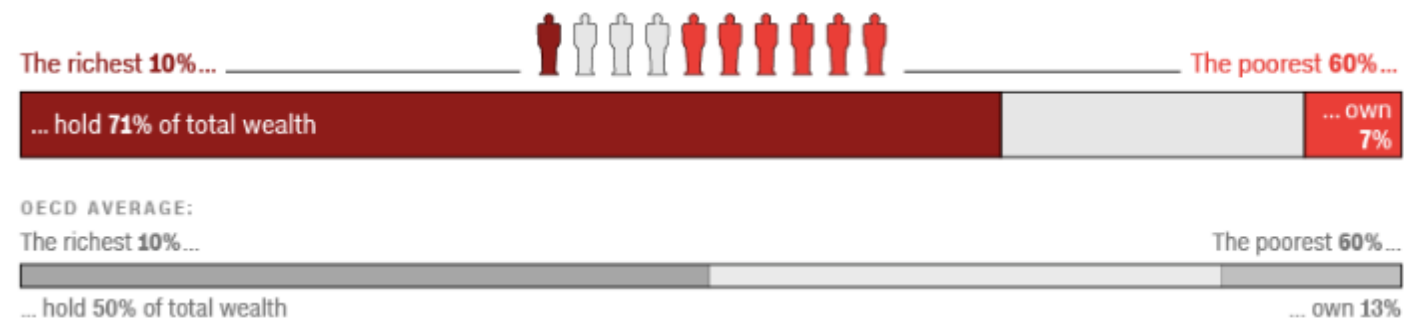
Source:

Broadband Commission for Sustainable Development. <http://www.broadbandcommission.org/publications/Pages/SOB-2015.aspx>

South Africa – World's Most Unequal Country (by income)



How is wealth distributed in South Africa?



Key Economic & Societal Issues to be Addressed

Income & Employment:

- Income Inequality
- Persistent High Unemployment
- Limited Access to Banking
- Equal access to education, healthcare, agriculture and other economic opportunities

Connectivity:

- Deficient Connectivity
- Slowing Connectivity Growth
- Unaffordable Broadband Options

Power:

- Unreliable electricity
- Rural areas unelectrified

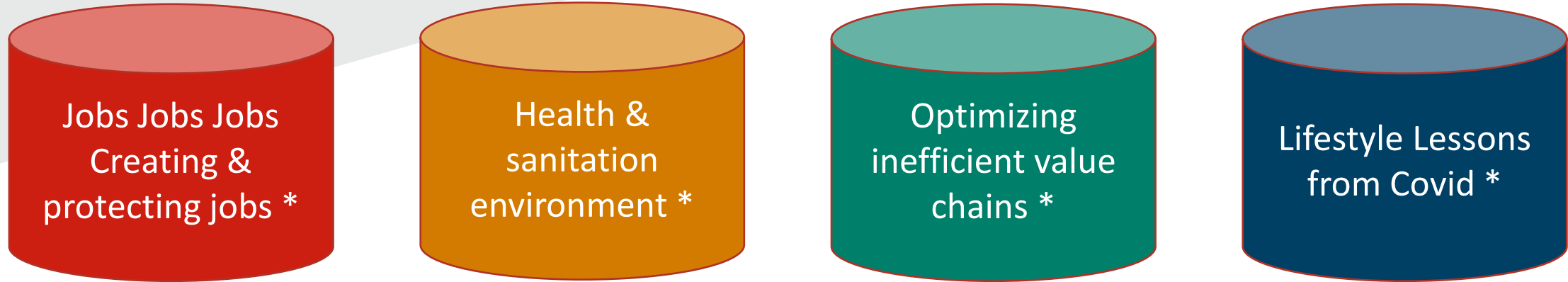
UN Sustainable Development Goals

Broadband enables and empowers every sector of society



Source : UN Sustainable Development Goals

CoVid Opportunities : Accelerating the digitizing of life



* Impacted by this trend

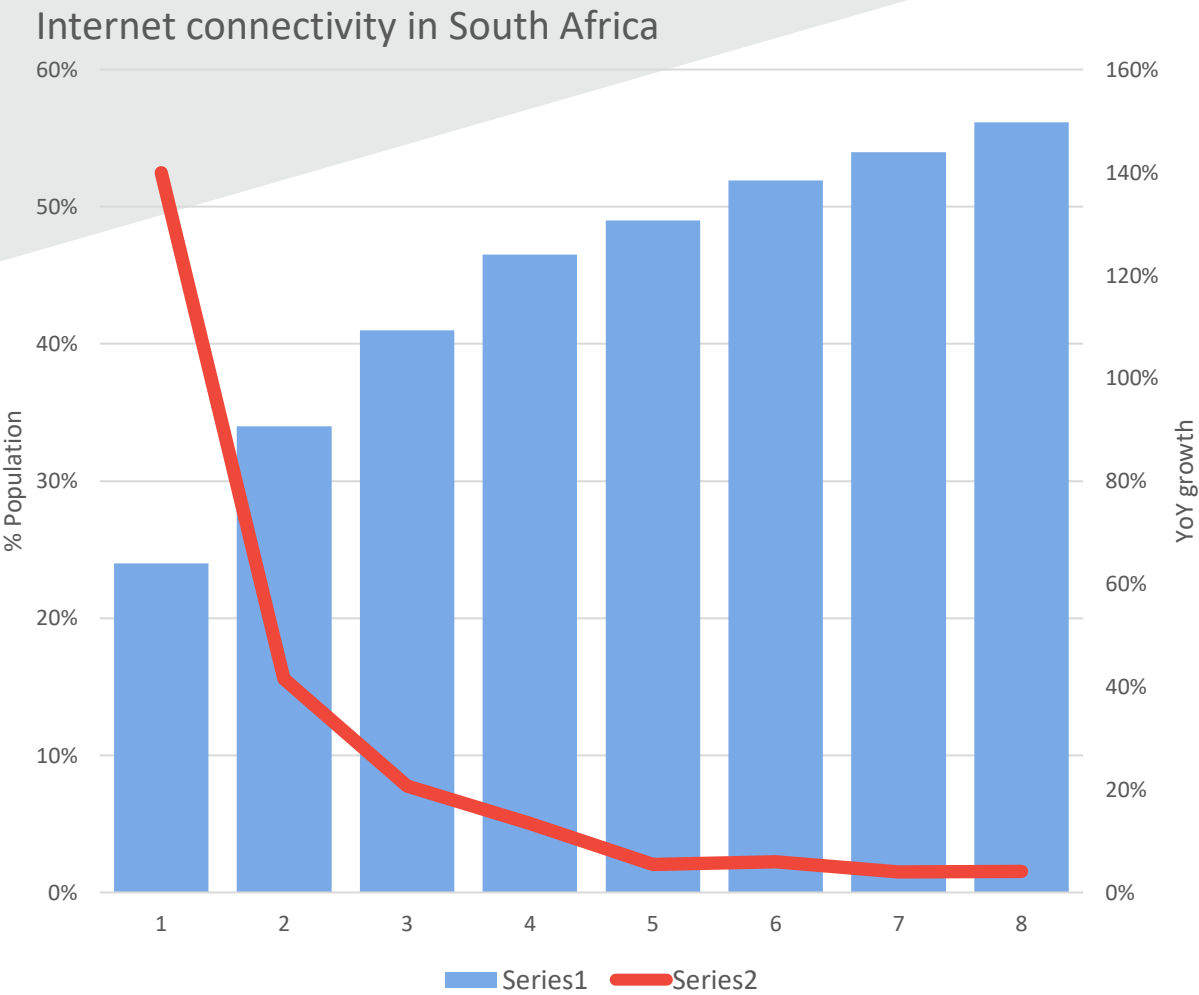
Early examples of scale behavior change

- **Kickstarting digital economy Liquid** : <https://medium.com/@benliquidkenya/did-corona-just-kick-start-the-digital-economy-2d6df96c03ce>
- **Regulatory acceleration ICASA** : <https://www.icasa.org.za/news/2020/icasa-engages-with-licensees-to-open-their-services-to-all-south-africans-as-the-country-fights-the-scourge-of-the-covid-19-pandemic>
- **Telepresence Growth Microsoft Teams / Zoom** : <https://www.microsoft.com/en-us/microsoft-365/blog/2020/03/19/microsoft-teams-3-everything-you-need-connect-teammates-be-more-productive/>
- **Working from home** : <https://fortune.com/2020/03/10/coronavirus-remote-flexible-work-from-home/>



Source : Stadia, Good Network, Adaptrum

Slowdown of broadband growth in South Africa



Source: itu.int

Relative ICT Development Index

90	Seychelles	5.03	92	4.80	↑
91	Mongolia	4.96	87	4.91	↓
92	South Africa /176	4.96	88	4.91	↓
93	Cape Verde	4.92	91	4.83	↓
94	Panama	4.91	93	4.80	↓

Source: #ITUdata ICT Development Index 2017

South Africa Income case study : Kwadebeka

Annual household income

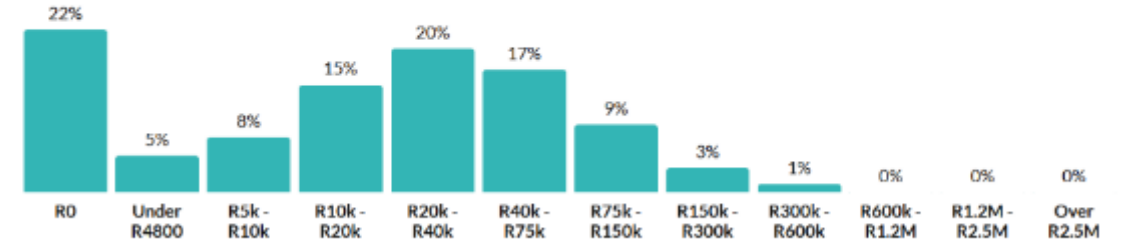
R29 400

Average annual household income

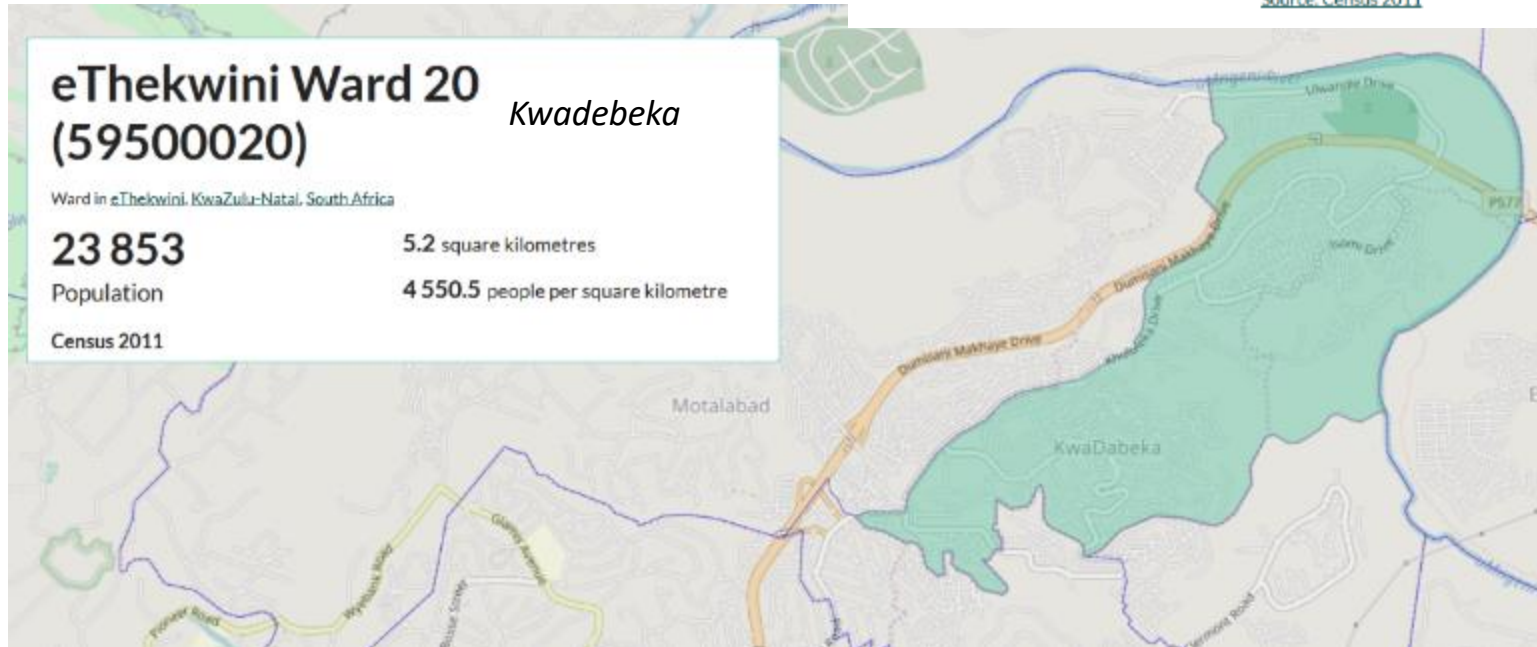
about the same as the amount in KwaZulu-Natal: R29 400

about the same as the amount in South Africa: R29 400

\$2000/year = \$167/month



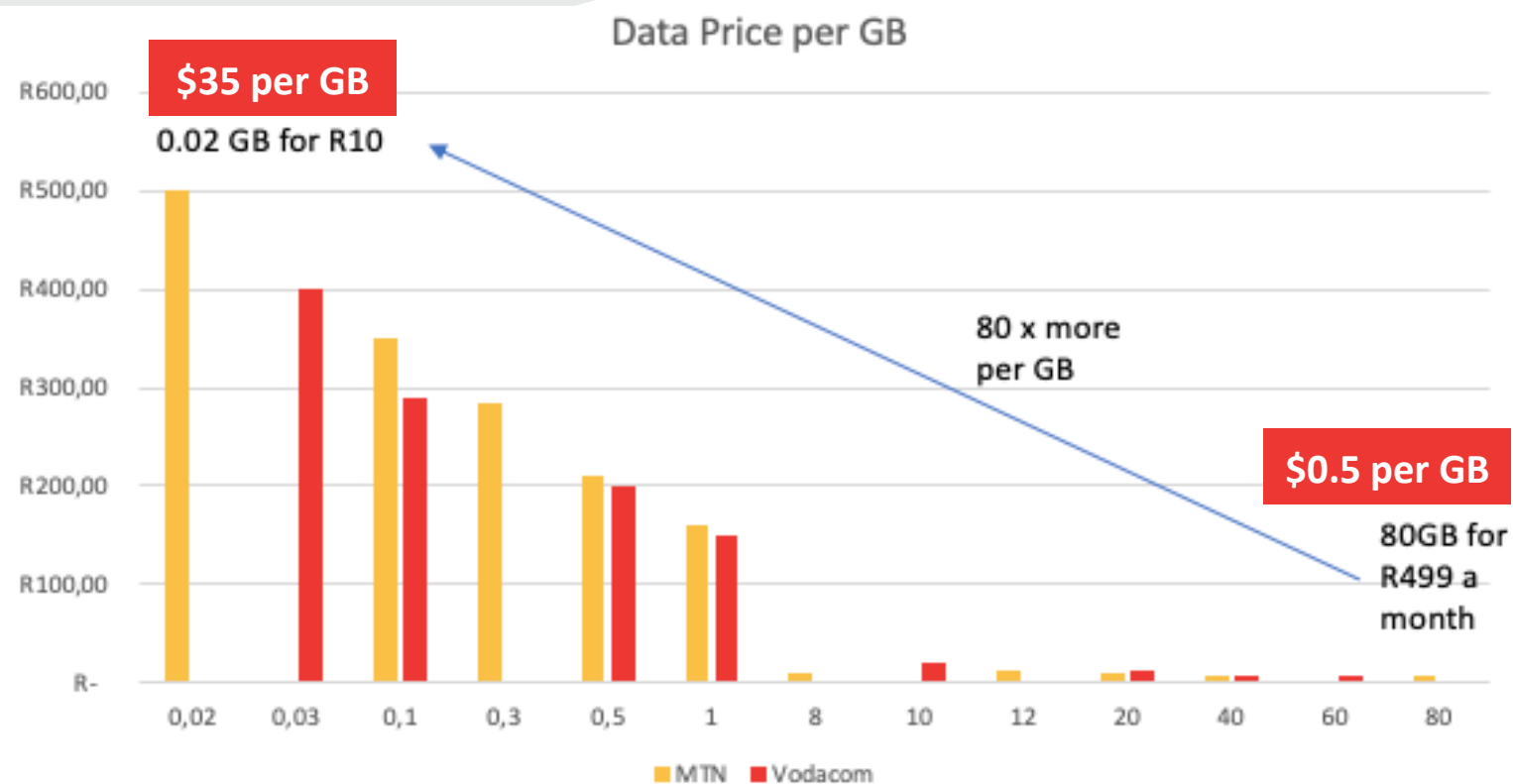
Source: Census 2011



\$2 per GB affordable for majority of South Africans

- <https://wazimap.co.za/profiles/ward-59500020-ethekweni-ward-20-59500020/>

South Africa : Affordability problem



Pre paid data bundles

Low income
Uncreditworthy
Only data option available

Post paid 24 month data contracts

High income
Creditworthy
One of many data options available

Source: WAPA, 2019

Areas suitable for TVWS

- 25% of area
- 42% of population

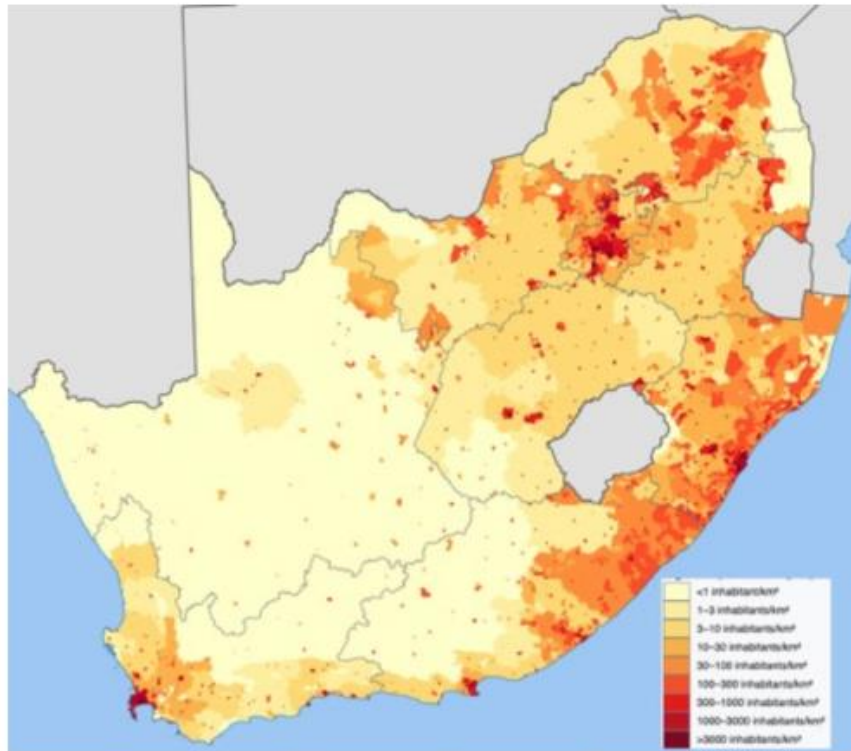
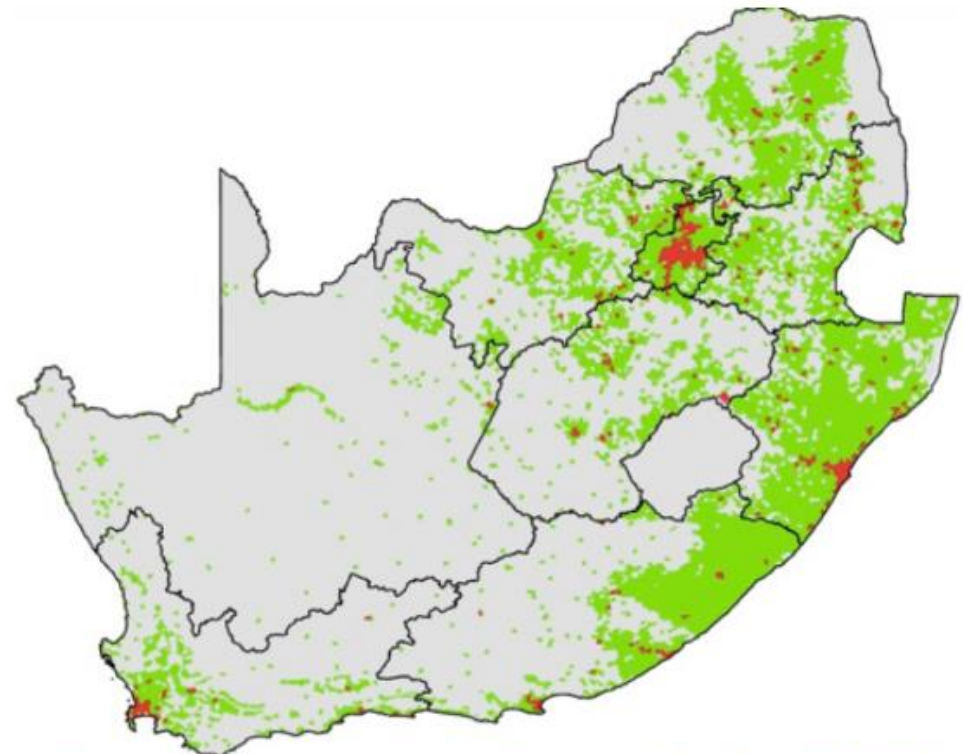


Figure 4 SA population distribution



*Figure 5 Areas generally suitable for TVWS
marked in green*

Source : Assessment of current and future spectrum for WAPA, 2019 , Dr. David Johnson

Opportunity for SA internet businesses

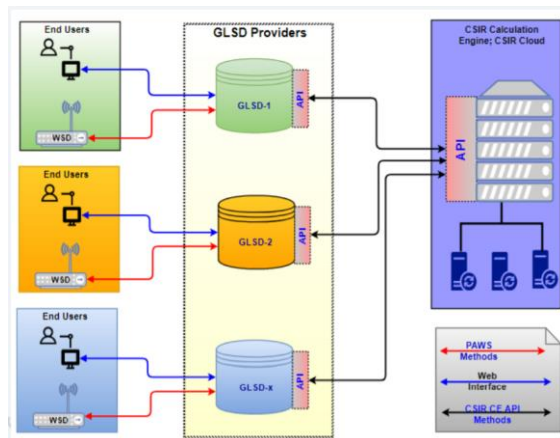
- **Connectivity business & entrepreneurship opportunities**
 - 50k sites
 - Previously unconnected rural/semi-rural
 - \$millions investment
- **Telecoms employment**
 - Engineering deployment, maintenance & support
 - Training
 - Sales & Marketing
- **Related Work, jobs & careers**
 - Online services
 - eCommerce
 - eWork
 - eSchools
 - eAgri
 - Content creation and distribution

Examples of opportunities for South African TVWS ecosystem

Value innovation !

CSIR

- **Industry** : Intellectual Property & Data science
- **What** : TVWS GLSD & rural telecoms demand & policy support
- **Where** : Tanzania, Botswana, etc



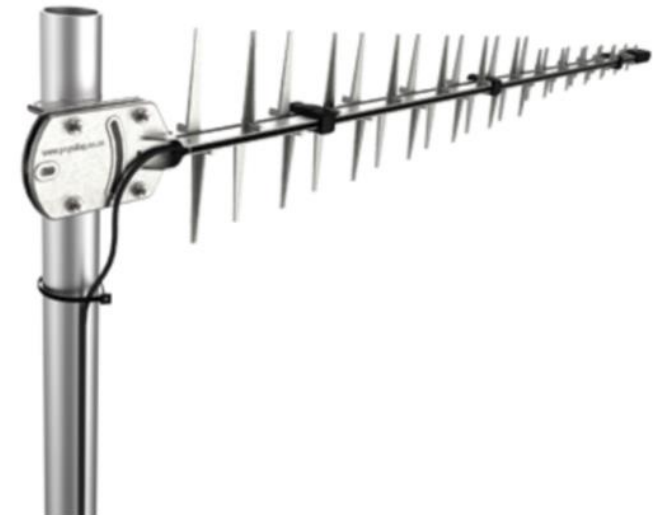
Clearline

- **Industry** : Manufacturing
- **What** : POE (Power over ethernet) with surge protection



Poynting

- **Industry** : Manufacturing
- **What** : Antennas for Wireless applications



Growing your WISP business

Technology

- “Just do it”
- Tech expertise
- Deploy customers

Customers

- Core values /principles
- Differentiators
- Customer expertise

Finance

- $P=R-(CX+OX)$
- Hire smart
- Prove tough
- SCALE

How to use TVWS

- *What licencing do I need to deploy TVWS*
- *How do I register as an operator with the database*
- *What are the considerations for building a TVWS network*
- *What are the considerations for managing a TVWS network*

Requirements to deploy

Database registration

- Register with a S-GLSD database, currently CSIR,
- <https://whitespaces.meraka.csir.co.za/public/netoperator/application>

The screenshot shows the 'Subscription - Network Operator' form on the CSIR Spectrum Switch website. The form is titled 'Subscription - Network Operator' and includes a header with the CSIR logo and 'Spectrum Switch' branding. The main content area contains a form with the following fields and sections:

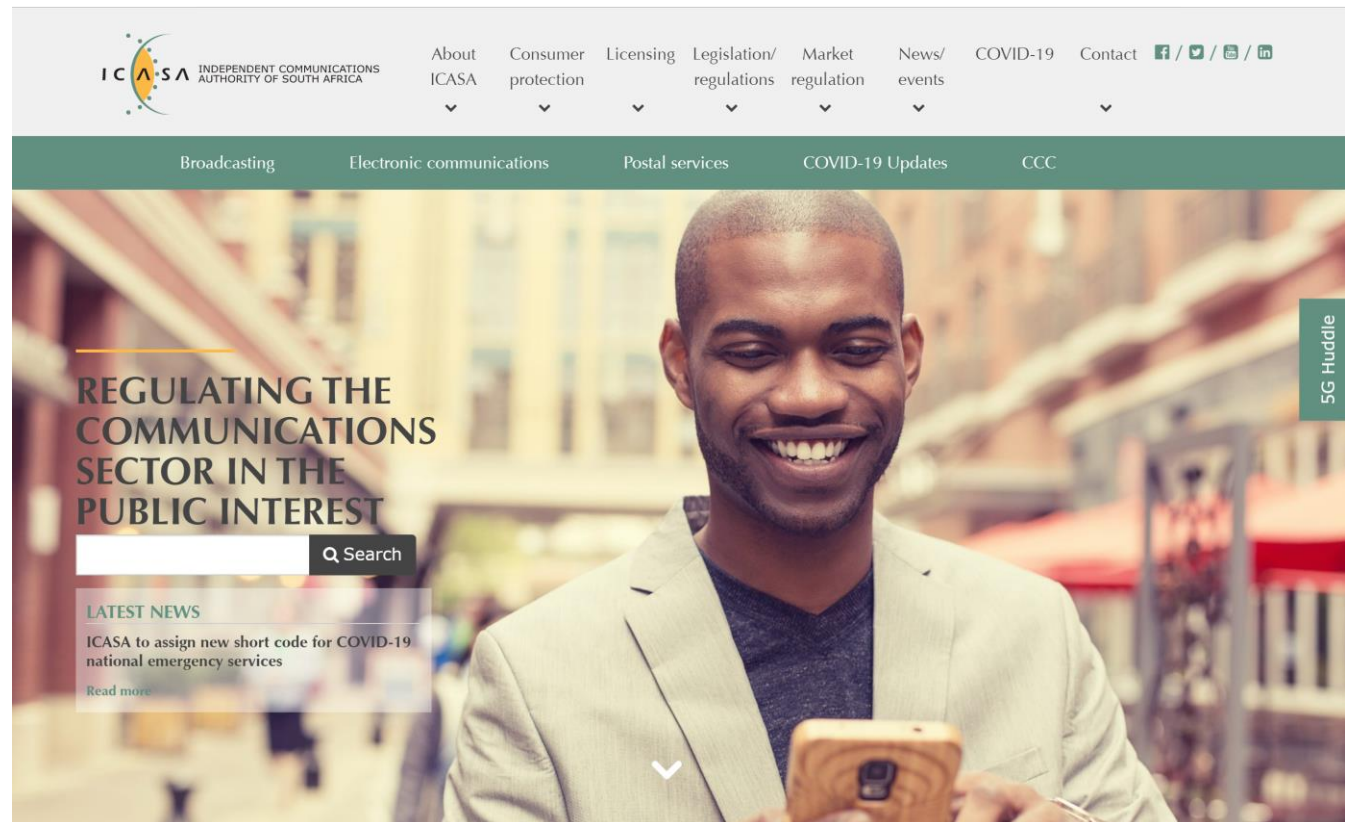
- Legal Status of Applicant:** A dropdown menu with the text '* Select Status: Please select your status'.
- Applicant Contact Details:** A section containing several fields:
 - * Trading Name/Full Name of Applicant:** The Council for Scientific and Industrial Research
 - Organization known as:** CSIR (with a note '(Change if different from Trading Name)')
 - * Organizational Unit:** NextGen Enterprises and Institutions
 - * Designated contact person:** Name Surname
 - Post Office Address:** P.O. Box 0123, Pretoria, South Africa, 0001
 - * Physical Address:** Building xyz, CSIR Pretoria Campus
 - * Street:** Meiring Naude Road
 - * Locality/City:** Brummeria, Pretoria
 - * State or Province:** Gauteng
 - * Postal Code:** 0004
 - * Country:** South Africa
 - Website:** <https://www.csir.co.za>
 - * Email:** twvs@csir.co.za
 - * Phone Number:** +27 12 041 wxyz

At the bottom of the form are two buttons: 'BACK' and 'SUBMIT'. The footer of the page reads 'CSIR | Geo-Location Spectrum Database' and 'Copyright © 2019 - CSIR. All rights reserved.'

Requirements to deploy

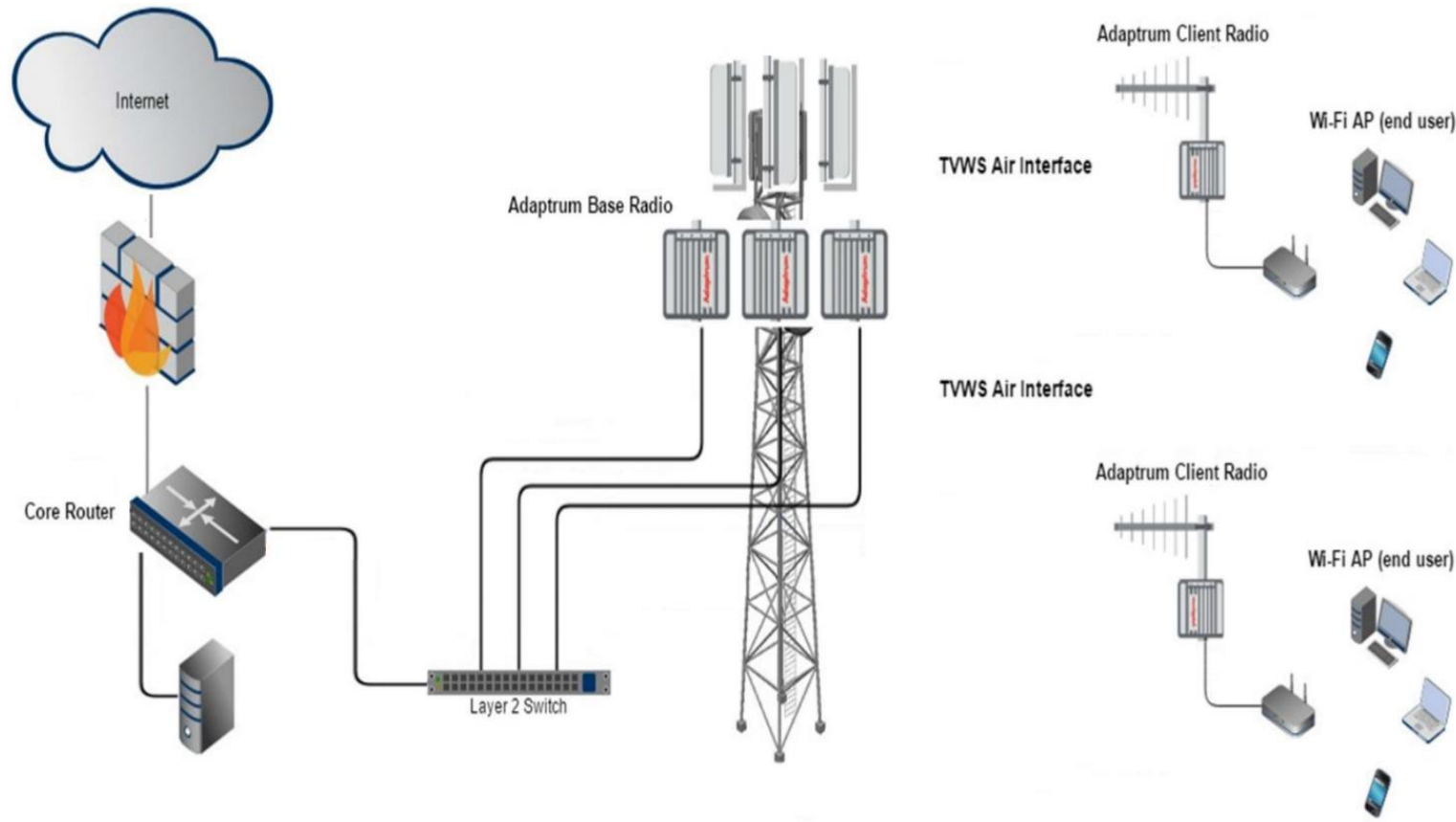
ICASA license

- Hold Electronic Communications Network Service Licence (ECNS)
 - <https://www.icasa.org.za/pages/services-licencing>



TVWS Network Architecture

Managed last mile connectivity



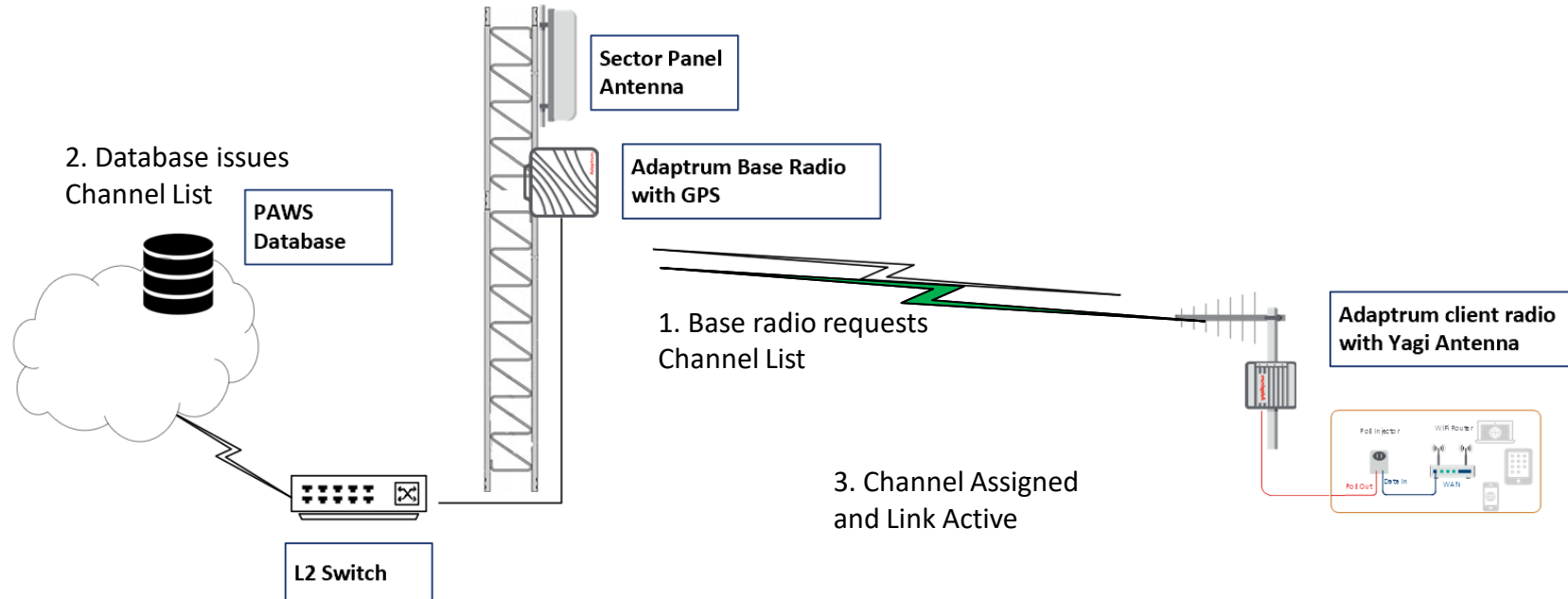
Last mile TVWS link.

Connects to the middle mile.

Can be a third-party ISPs layer 2 managed link or direct connection into TERACO.

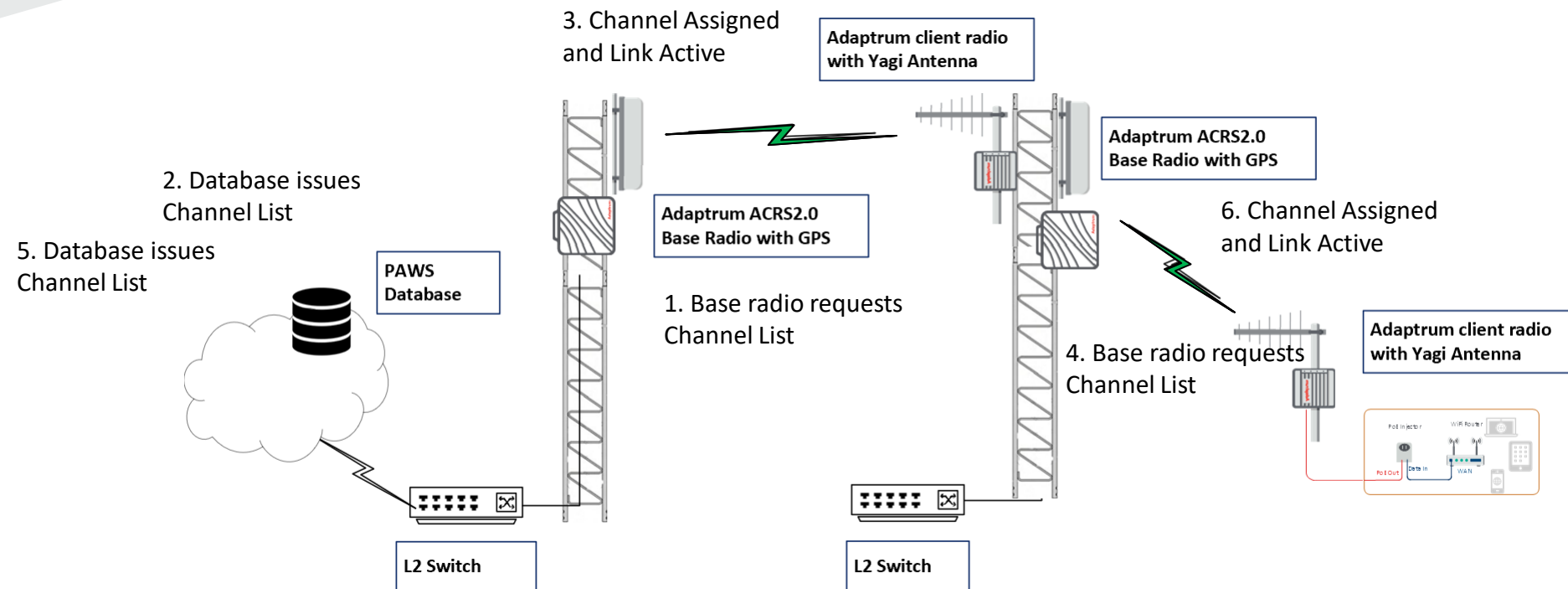
TVWS Point to Multipoint

Connecting the client



TVWS Relay Link

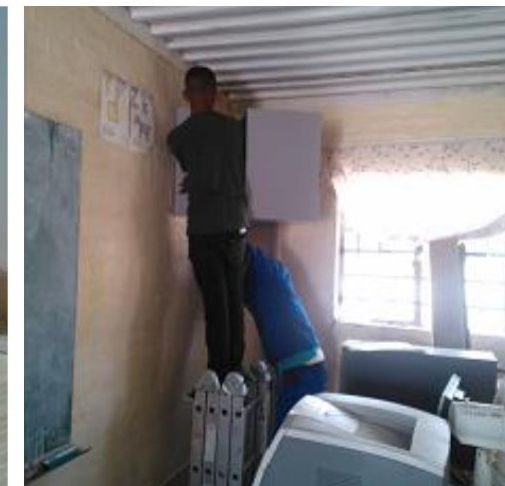
NLoS relay



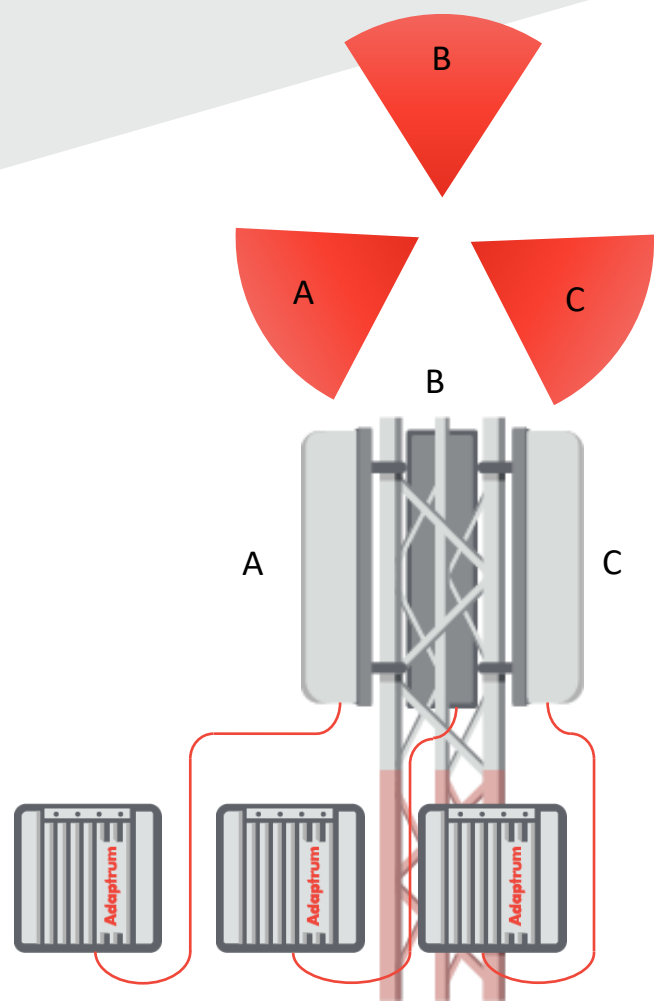
Planning the site

Fail to plan - plan to fail

- Site location
- Site security
- Structure (new tower, existing tower, on a building)
- Land rights
- Immediate obstruction and clutter
- Proximity to other transmitters
- Power (Mains, Solar, Hybrid)
- Backhaul (to the high site)

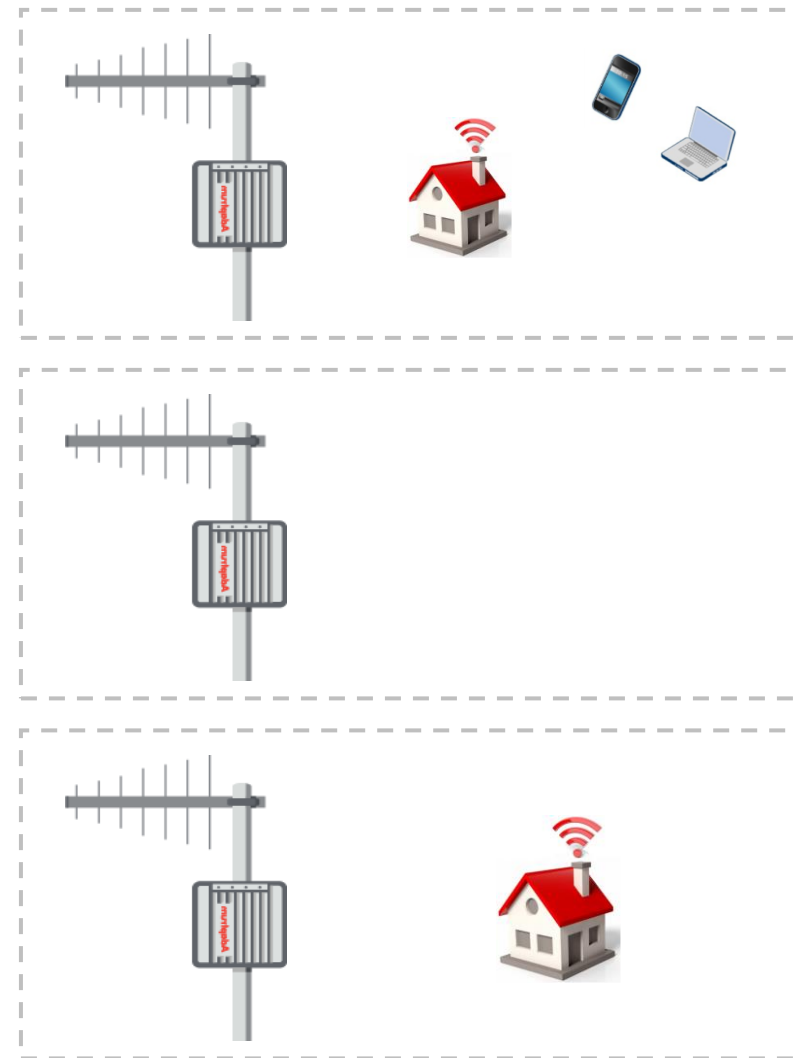
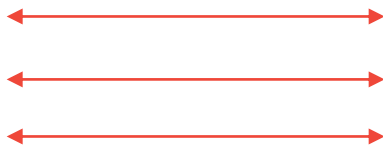


Typical High Site Deployment



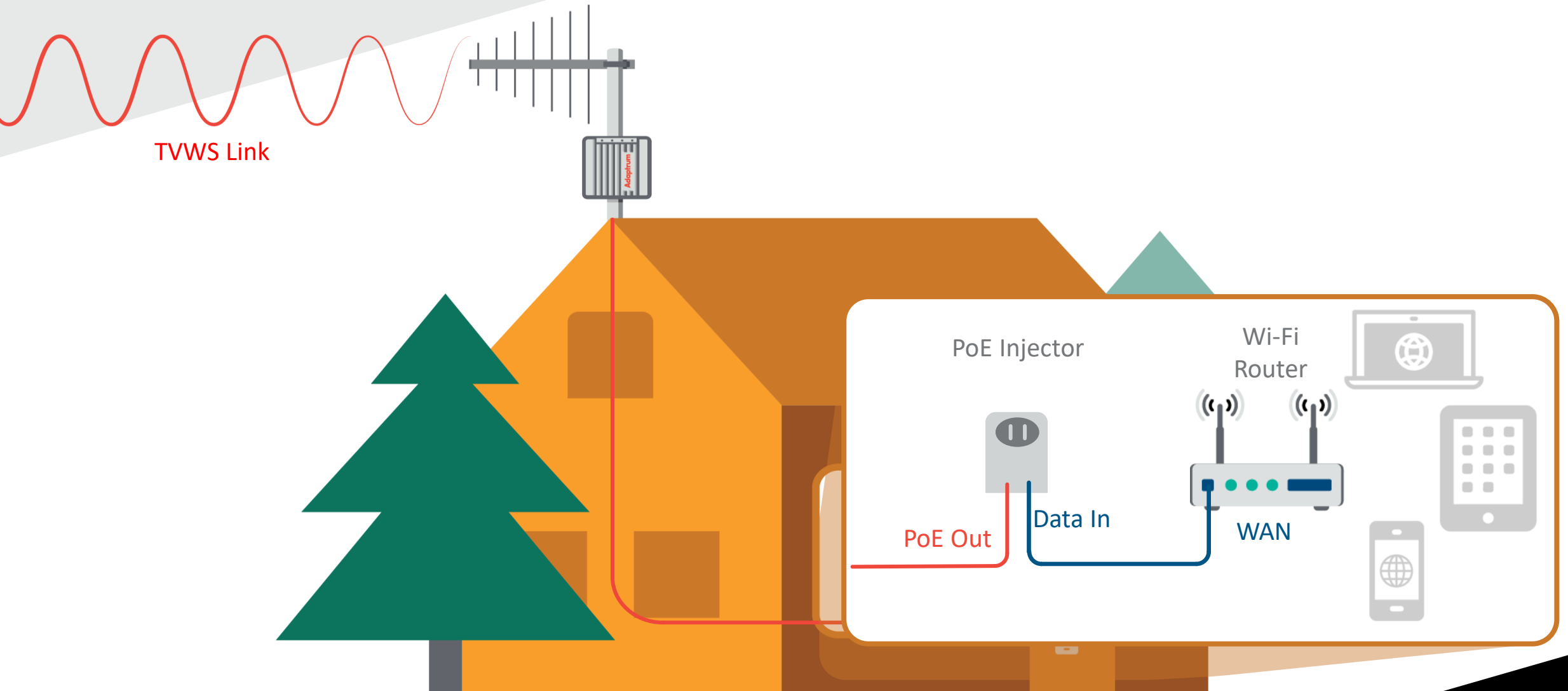
From 1 to 3 x ACRS 2.0 Base Stations

Non-LOS TVWS over
the air link



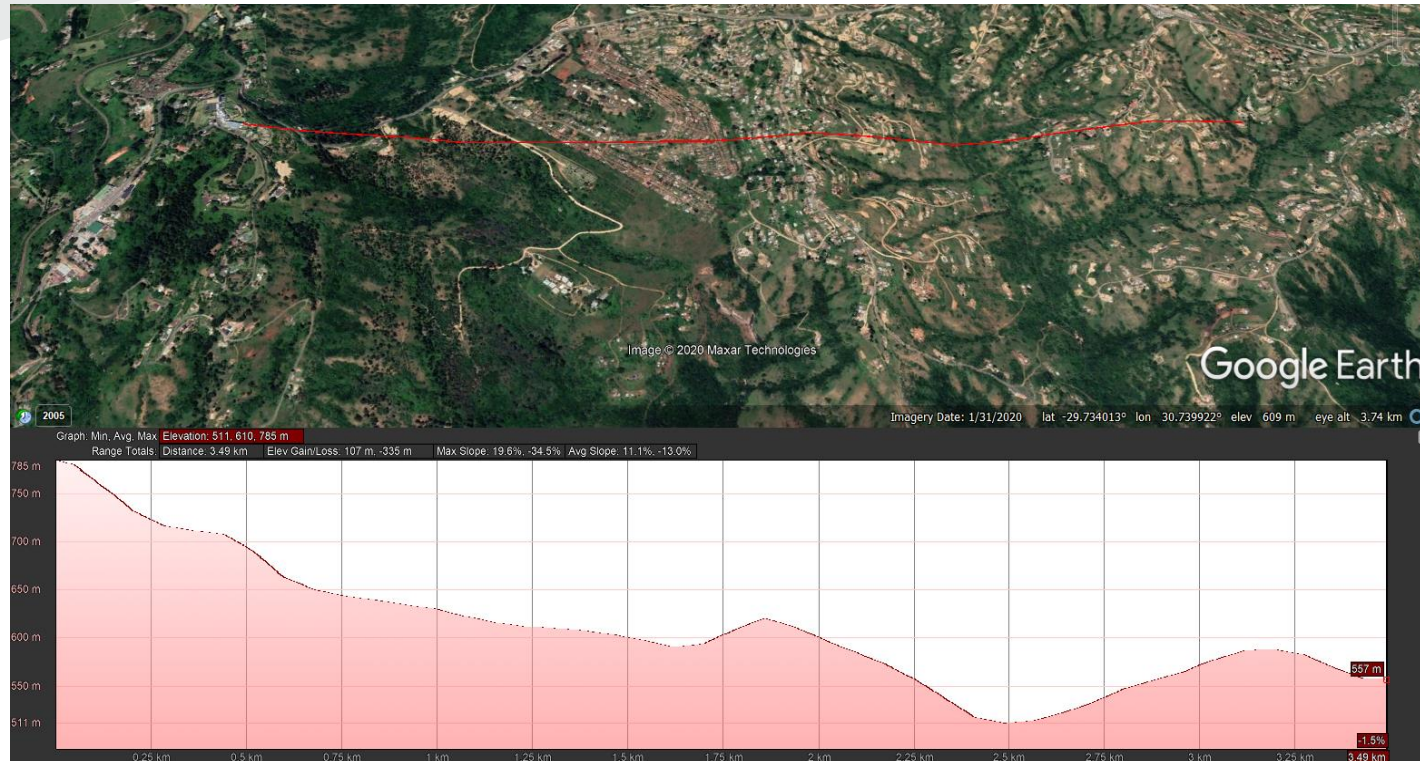
ACRS 2.0 CPE connects to an external Wi-Fi router

Typical Fixed Wireless Client Deployment



RF Planning

Google Earth Pro



Google Earth Pro offers a simple but often useful first glance of a potential link elevation profile and is often a first tool of choice when validating a new site.

Elevation profile from Google Earth Pro

RF Planning

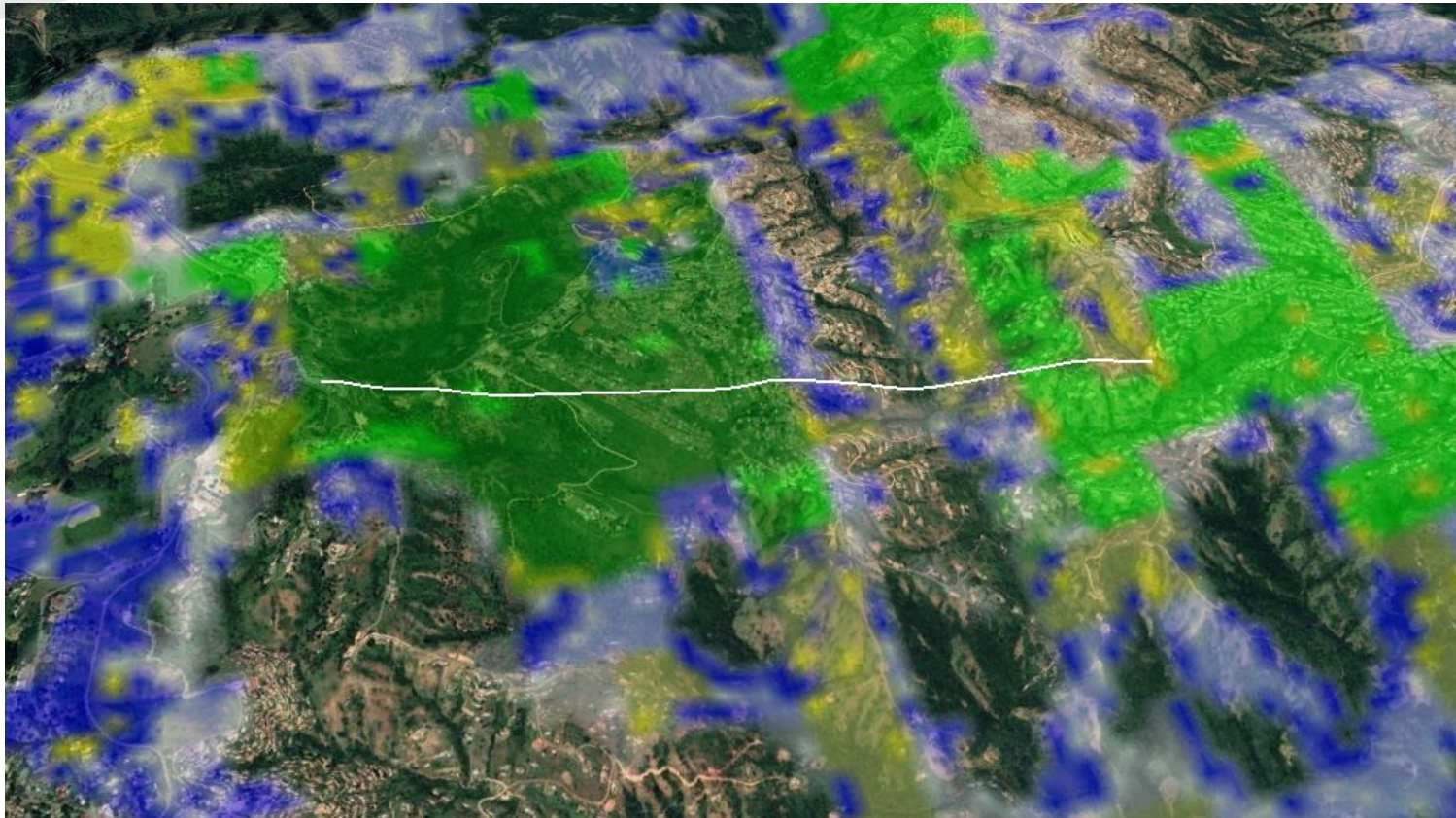
RF Planning tool



RF planning tool provides a more detailed view and helps determine NLoS links.

RF Planning

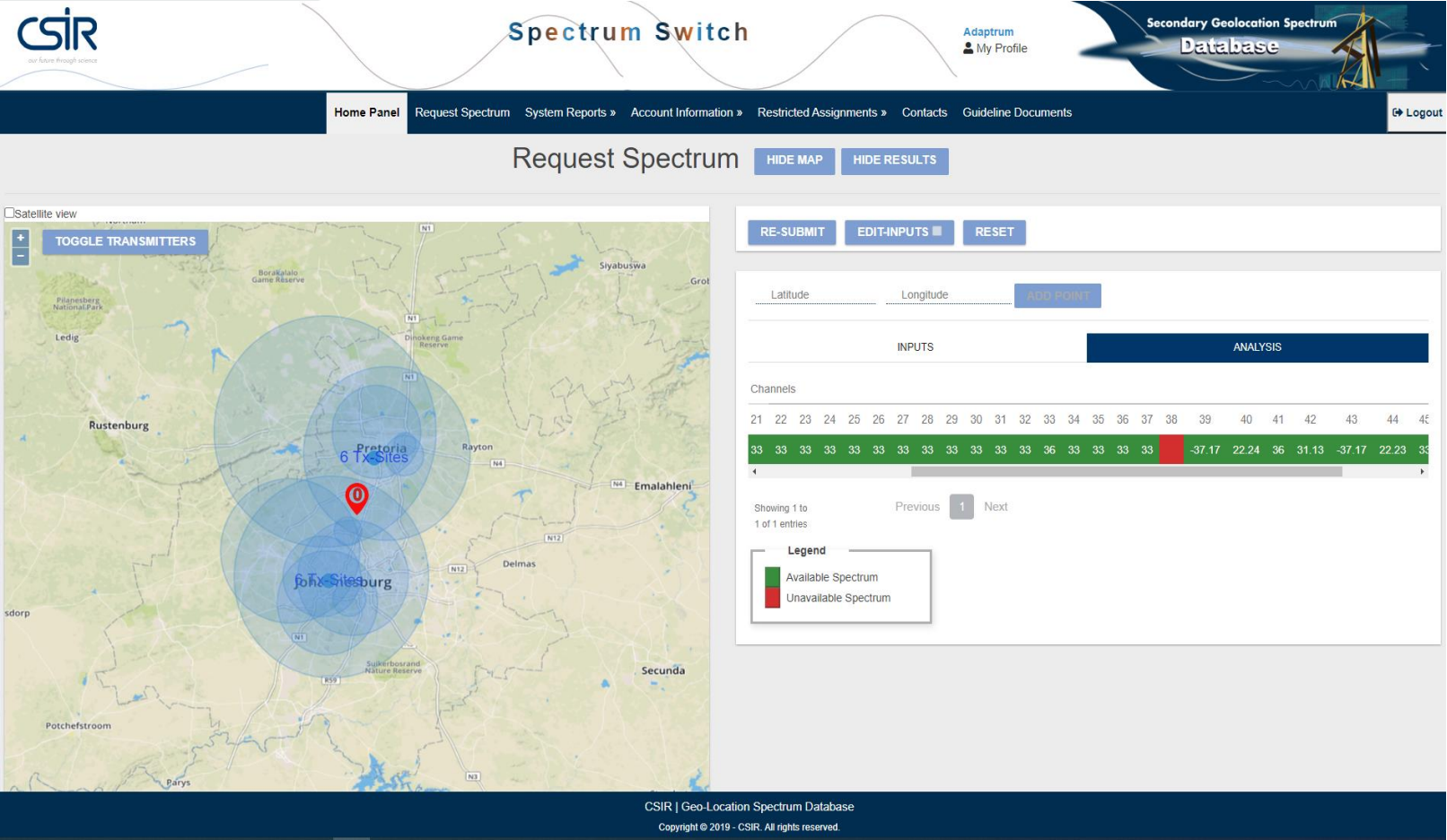
RF Heat Map



RF heat map, offers a good insight into the TVWS coverage area.

Spectrum availability

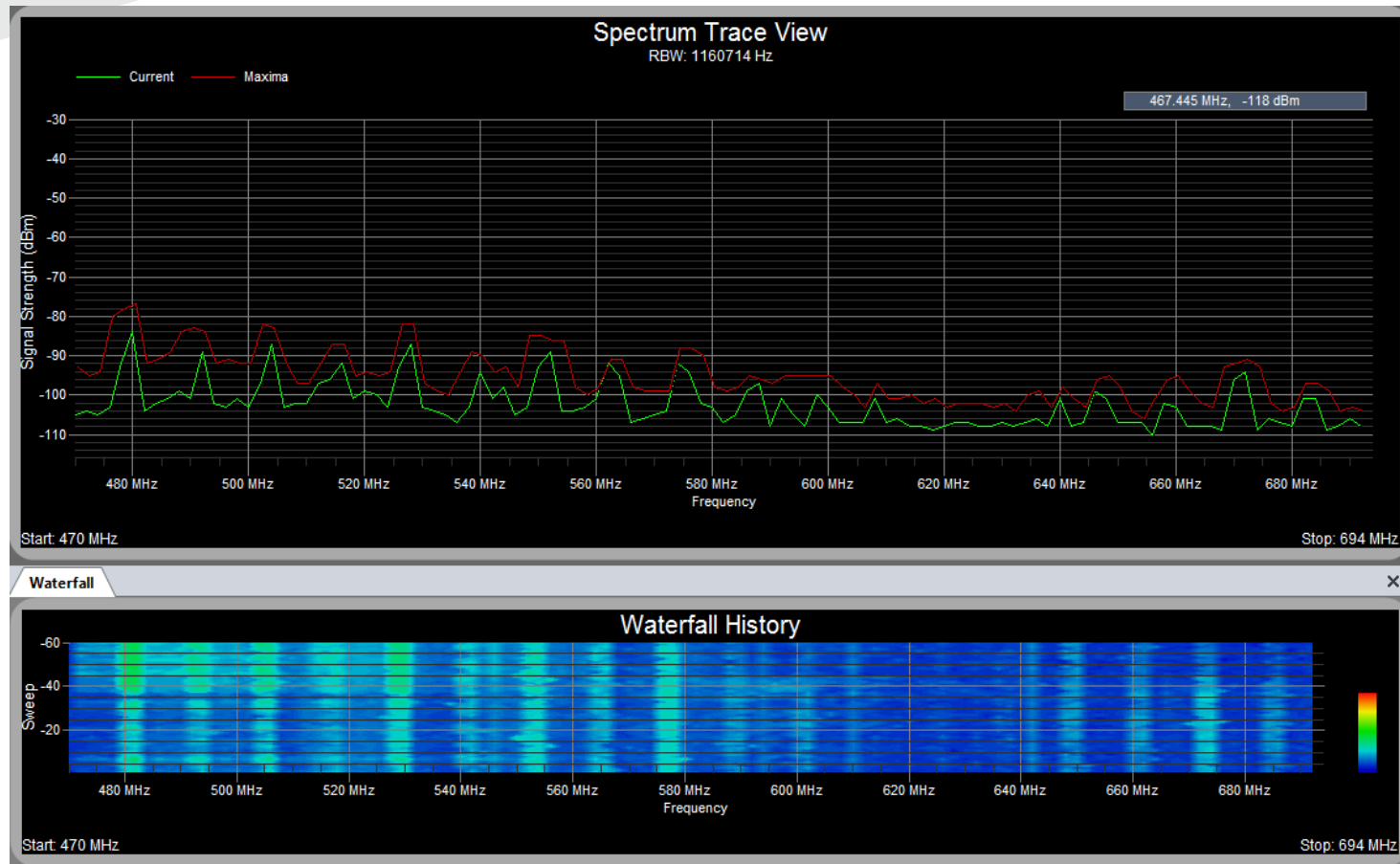
CSIR Request Spectrum



CSIR Request Spectrum gives us a first view of channel availability and adjacent TV transmitters.

Spectrum analysis

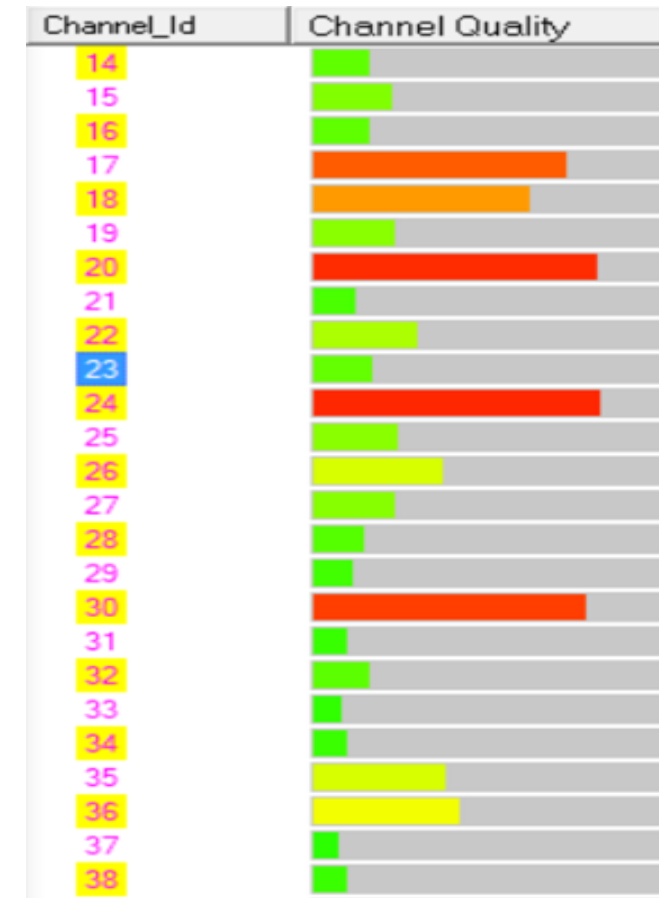
RF Explorer Spectrum Scan



Clean spectrum is a key component to a good TVWS link.

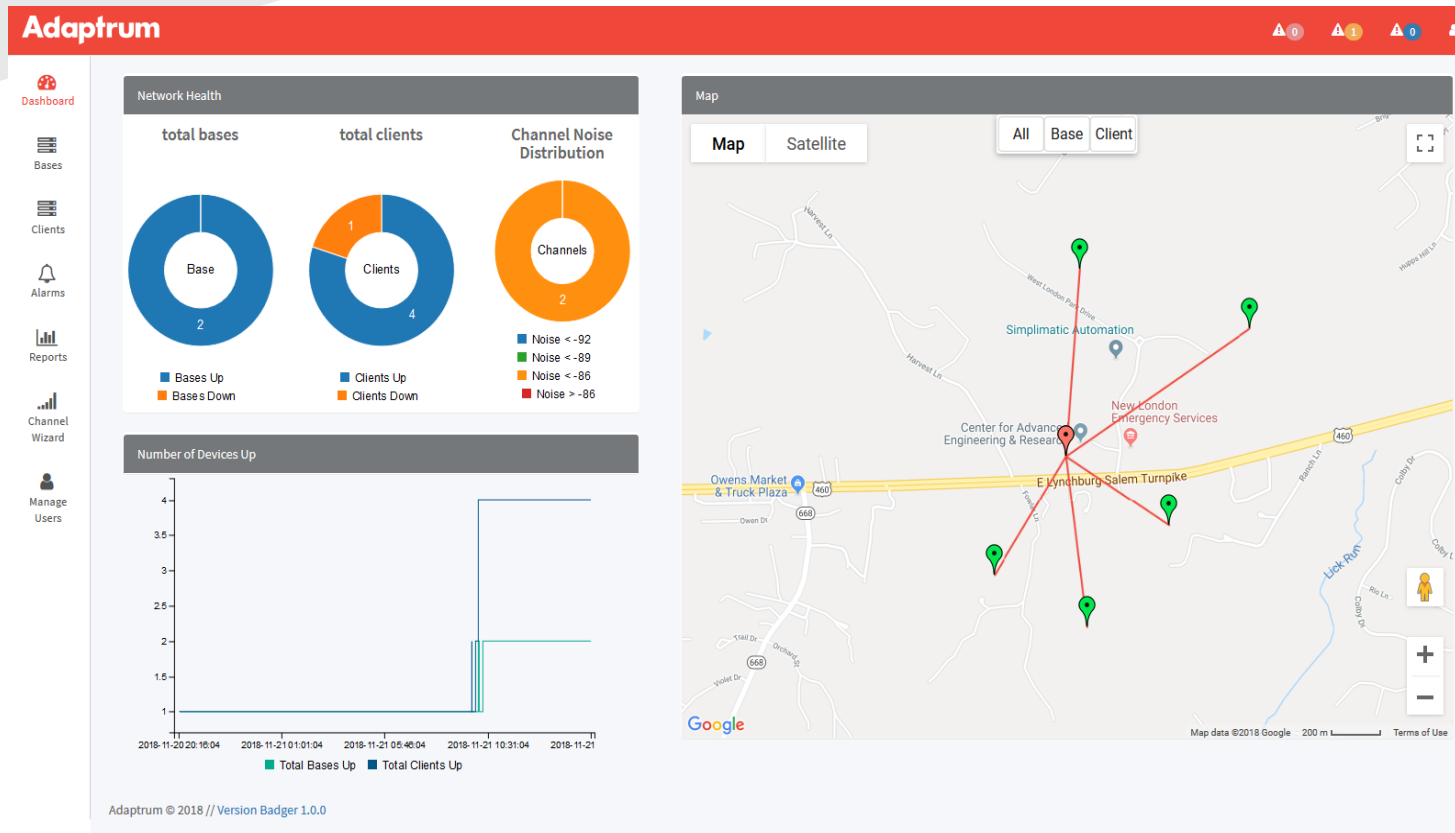
Network Channel Planning

- Patented Agile Sensing technology
 - Real-time spectrum sensing & analysis gives instant visibility of the radio spectrum
 - ACRS radios measure channel background noise and interference level in a matter of seconds
 - Scan the complete UHF TV band Choose the best channel(s) for operation
- Channel Planning for whole network
- Multiday and Overnight Spectrum Scan
 - Optimize network channel planning across conditions that change over time



Channel Quality: Lower number = Clean channel

Managing the network



Management of the equipment can typically be via the vendor network management software or via SNMP.

Planning is key

- Fail to plan - plan to fail
- Document everything
 - Sites
 - Physical, GPS, Contact information
 - Equipment
 - IP, NM, Serial Number, Firmware, MAC Address
 - Network
 - Configuration, topology, backhaul
- Test everything

THANK YOU !

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www.Adaptrum.com