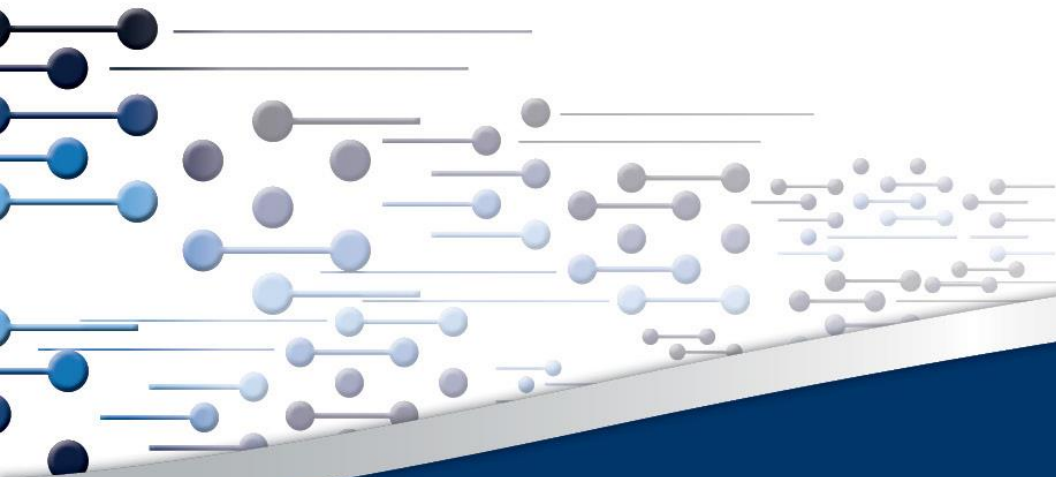
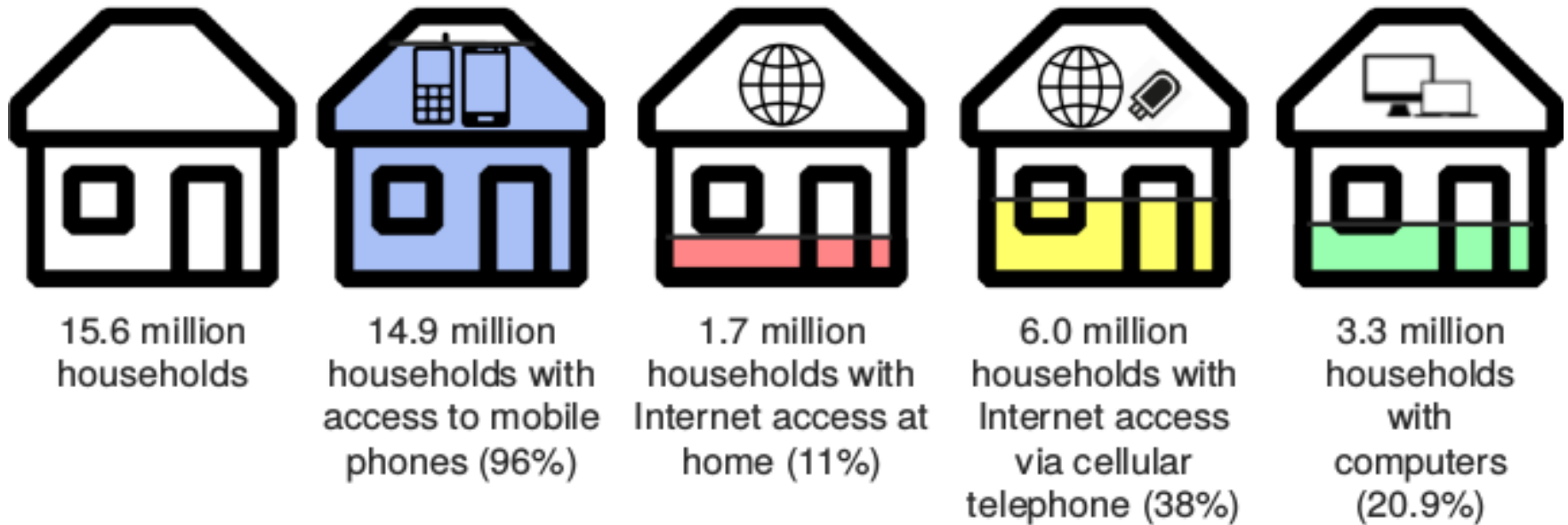


Dynamic Spectrum Access Innovation to lower the cost of Access

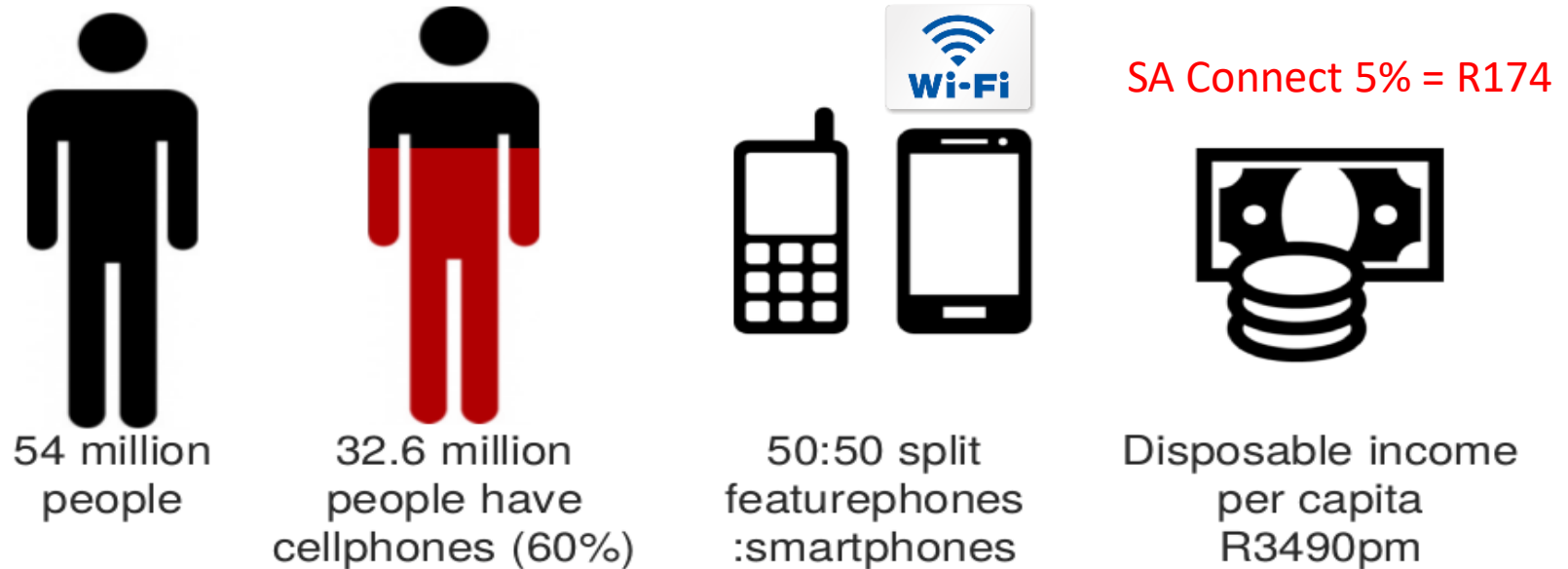
Dr David L Johnson
Principal Researcher
Meraka, CSIR



South Africa 2015 household statistics

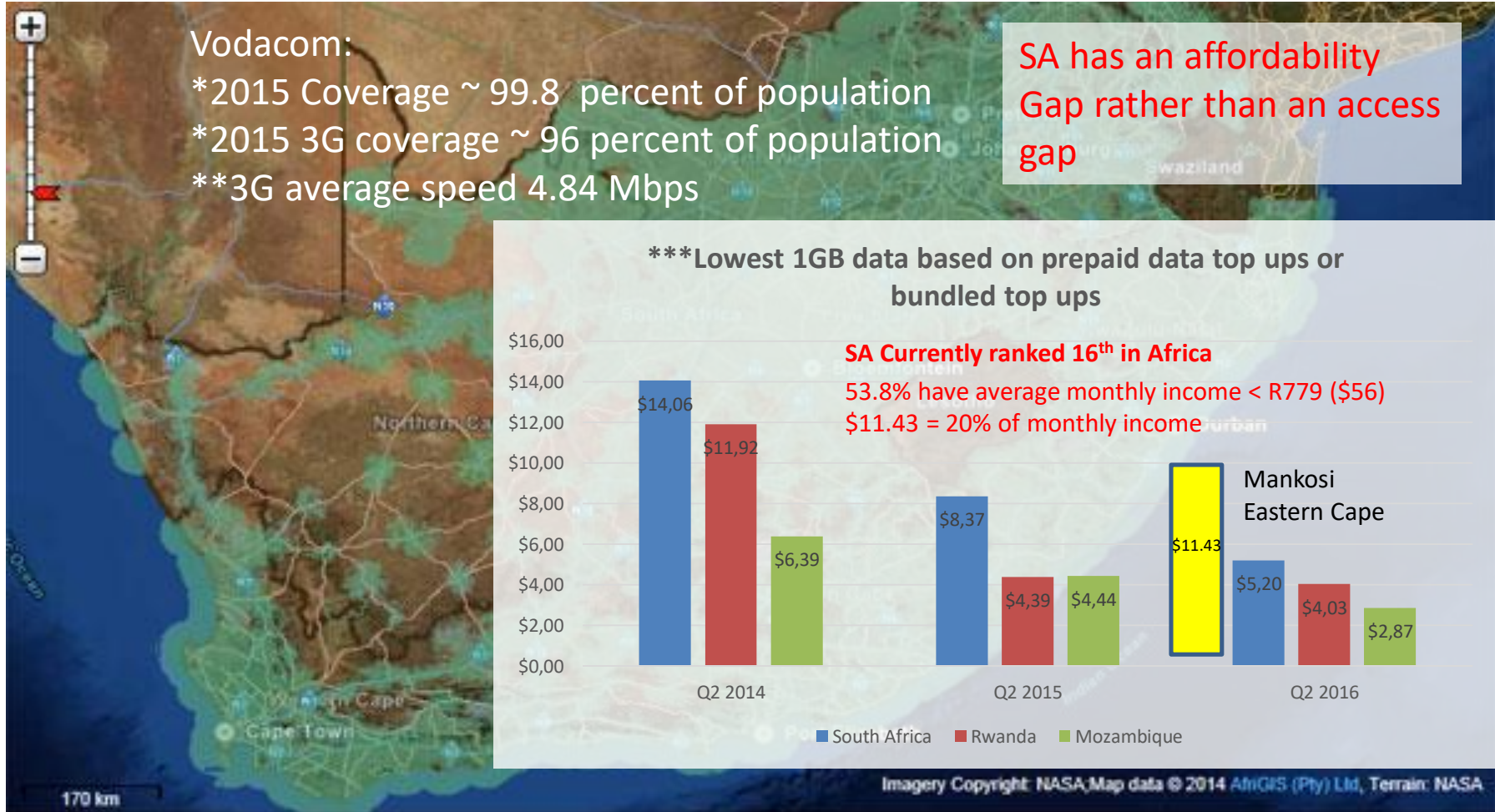


South Africa: 2015 Individual statistics



Source: Stats SA, General Household Survey - 2014, 2015; AMPS 2014B, 2015; *Disposable income per capita of households*, SARB Quarterly Bulletin, June 2015. Target for 5% of R3490 is R174.50.

Current Cellular coverage / cost South Africa



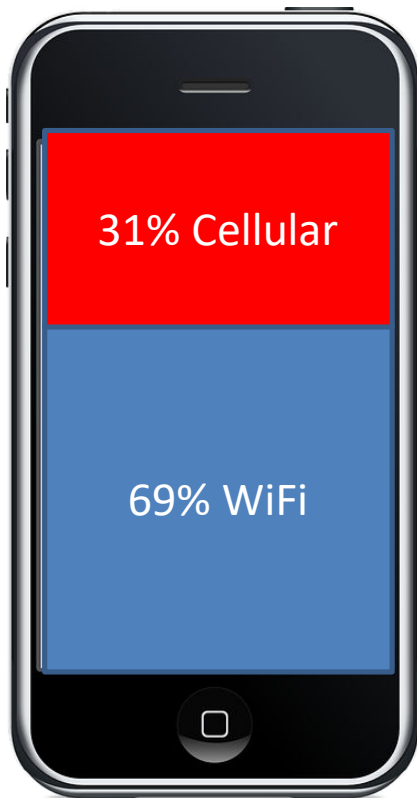
*<http://mybroadband.co.za/news/cellular/126694-does-vodacom-really-have-the-best-network-in-south-africa.html>

**<http://mybroadband.co.za/news/broadband/124643-best-broadband-speeds-in-south-africa-2.html>

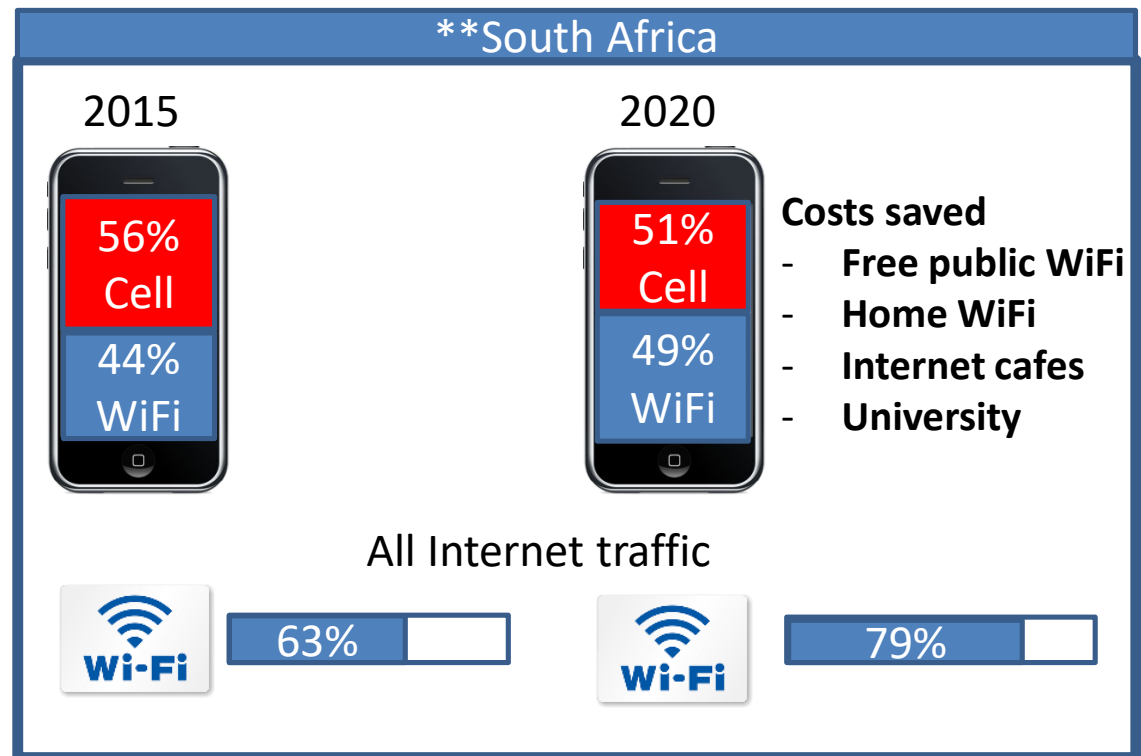
***http://www.researchictafrica.net/pricing/ramp_1gb.php

WiFi success story

*2014 Global picture
of Smartphone traffic



Globally 150,000 to 450,000 new radio base stations would be needed to cope with smartphone traffic – an investment of between 30 and 93 billion dollars



WiFi providing low-cost connectivity

free
TshWi-Fi
calls•chat•movies•tv

500MB free per day



- Philipstown no 3G
- Albies wireless (WiFi)
- 58% cost of cellular

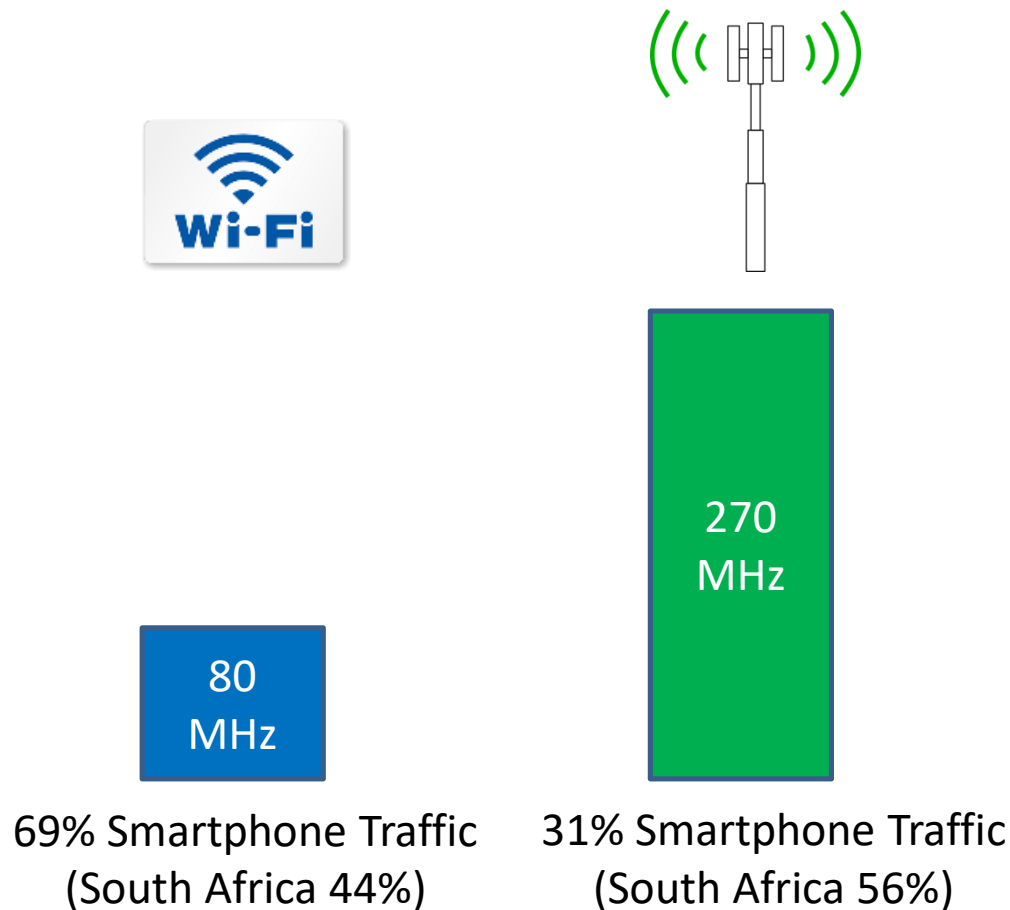


- WISPs (mostly WiFi)
- 173 full members
- 22 associate members

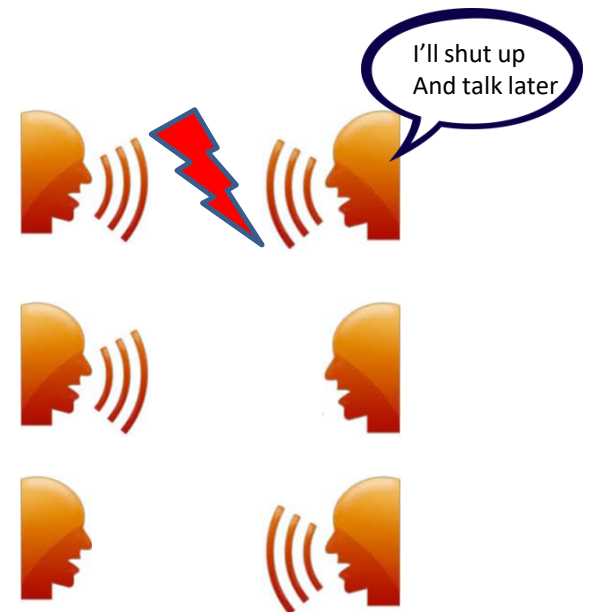


- Zenzeleni Network co-op (Mankosi)
- 22% of their income on connectivity
- Free local voice calls
- Outbound calls = 50% cellular rate
- Data = 10% current market rate

From WiFi to Dynamic spectrum access

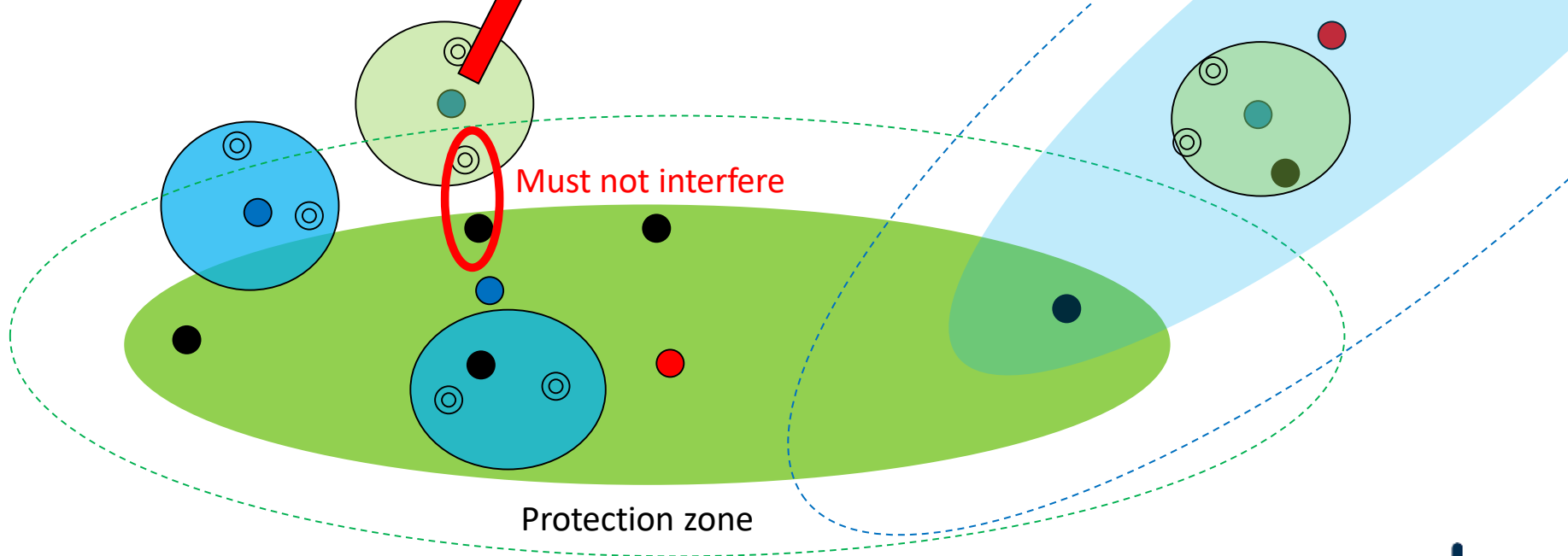
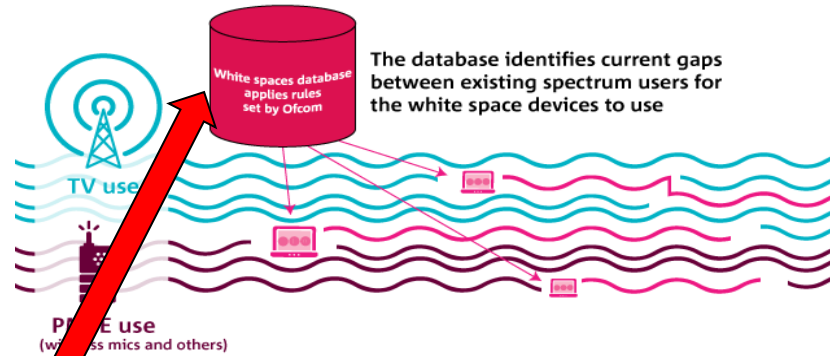


WiFi achieved success in a
Licence-exempt shared band
Using **Rule based access**



Sharing spectrum with primary users

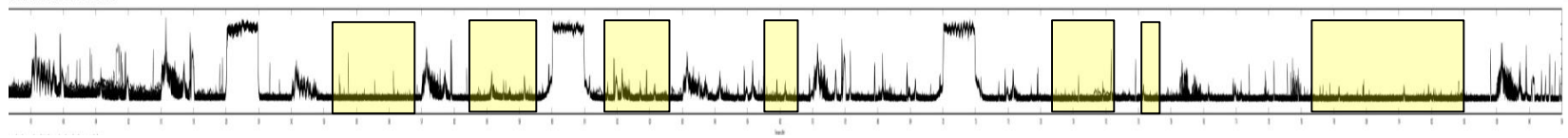
- Primary transmitter
- Primary receiver
- White Space base station
- ◎ White Space client



Spectrum Sharing models

- License shared access (LSA): Purchase exclusive access to primary user spectrum in regions where it is unused.
 - E.g. USA 2.3 GHz band, used for coastal radar and in the UK, the 3.6 – 4.2 GHz for defense, emergency services and broadcasting services.
- Dynamic Spectrum Access (DSA): Use portions of spectrum dynamically in regions or at times that it is not used using spectrum sensing or a geo-location database. Access is granted on a license-exempt or light-licensing basis.
 - E.g. TV band from 470 MHz to 694 MHz

TV White space – DSA in TV bands

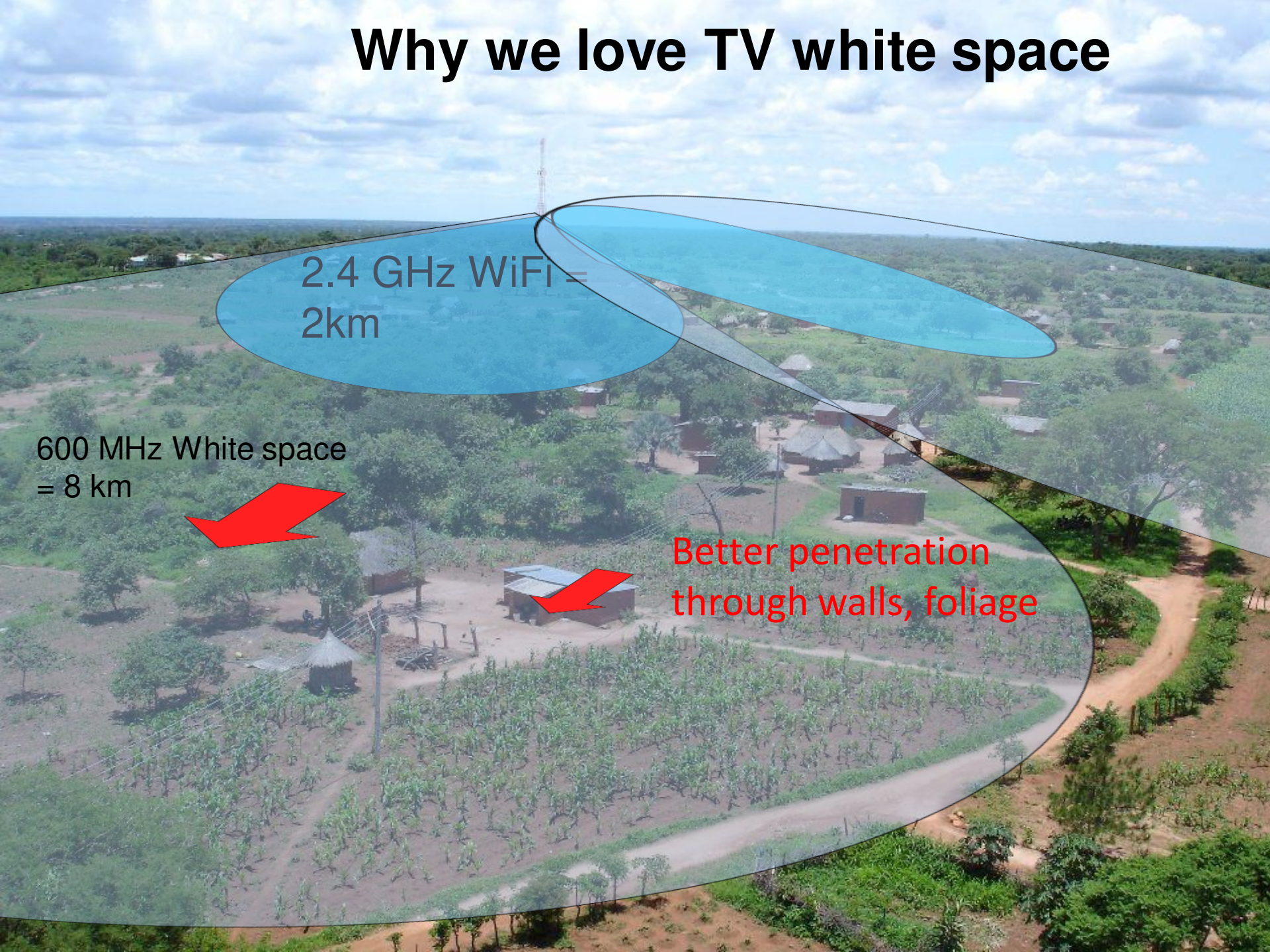


450 MHz

900 MHz



Why we love TV white space



2.4 GHz WiFi =
2km

The image is an aerial photograph of a rural village with several small houses and a large field of young trees in the foreground. A tall radio tower is visible in the distance. Two overlapping blue oval shapes represent signal coverage areas. One oval is labeled '2.4 GHz WiFi = 2km'. A red arrow points from the text '600 MHz White space = 8 km' to a second, larger blue oval. Another red arrow points from the text 'Better penetration through walls, foliage' to a small building within the larger oval.

600 MHz White space
= 8 km

Better penetration
through walls, foliage

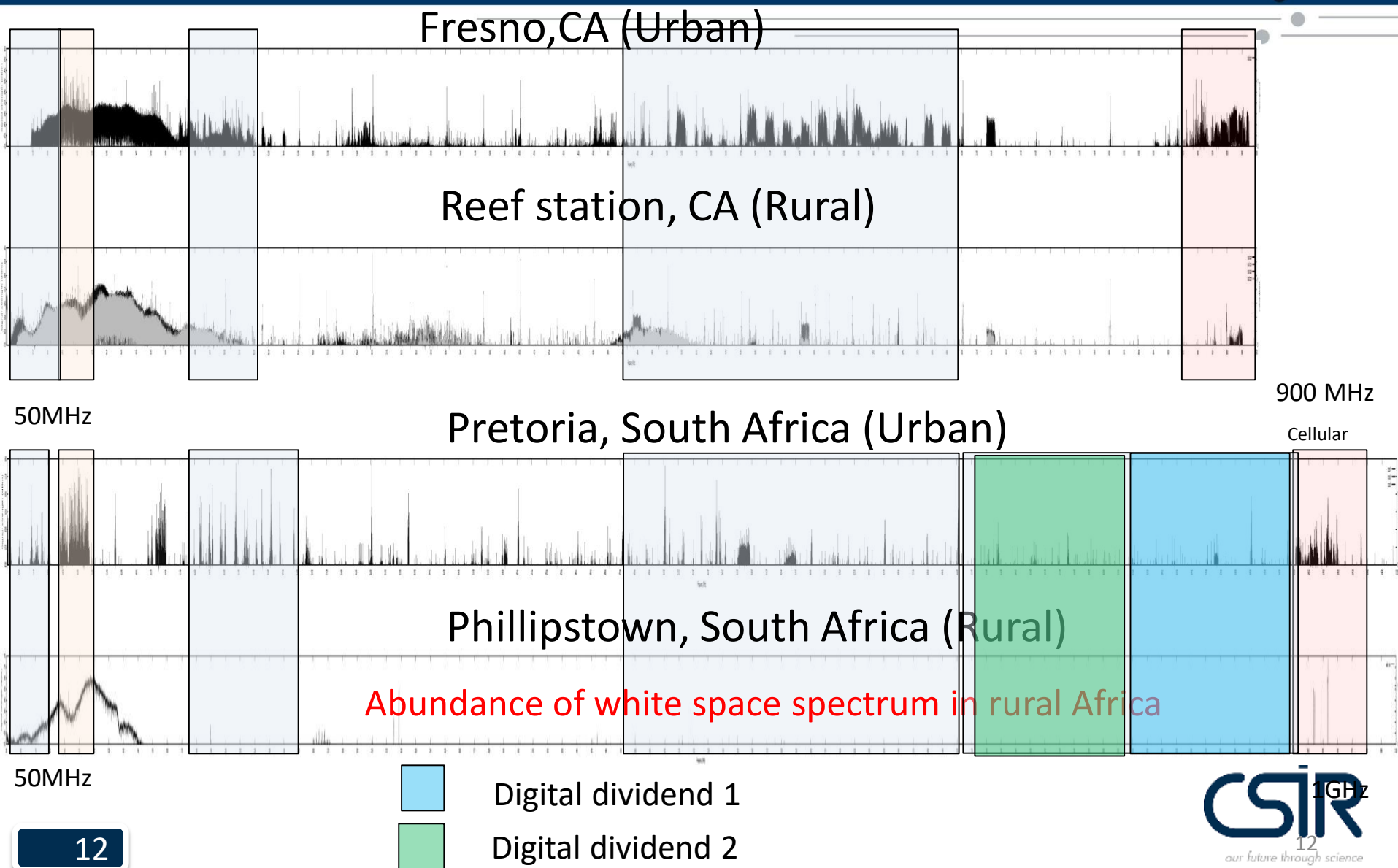
How much white space?

VHF-L FM

VHF-H

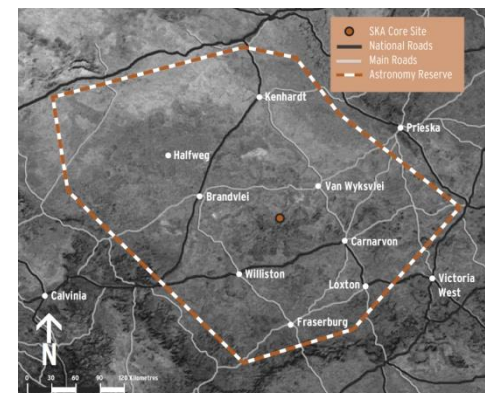
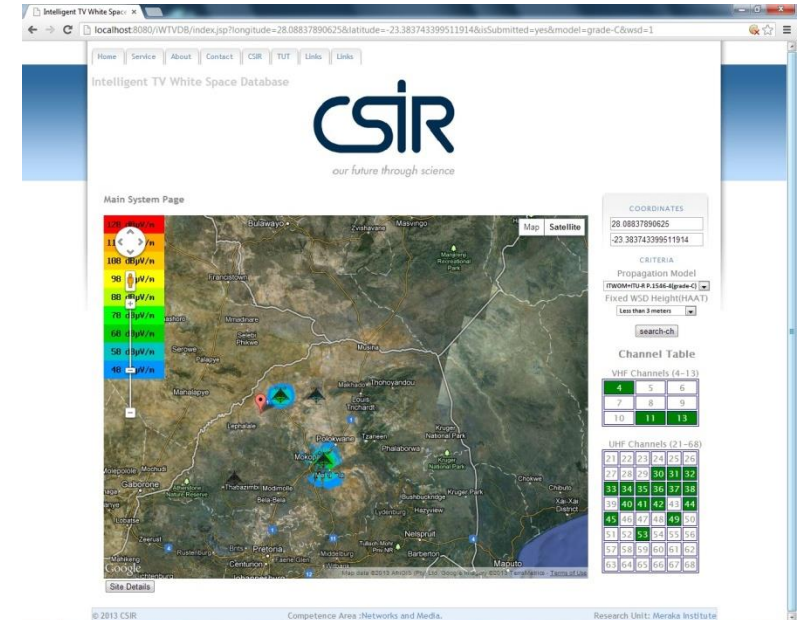
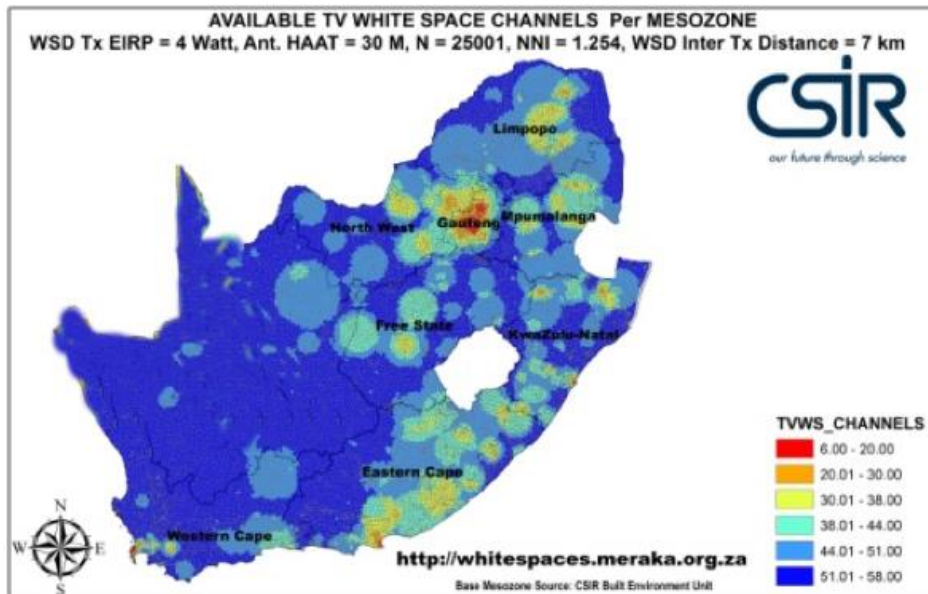
UHF

Cellular

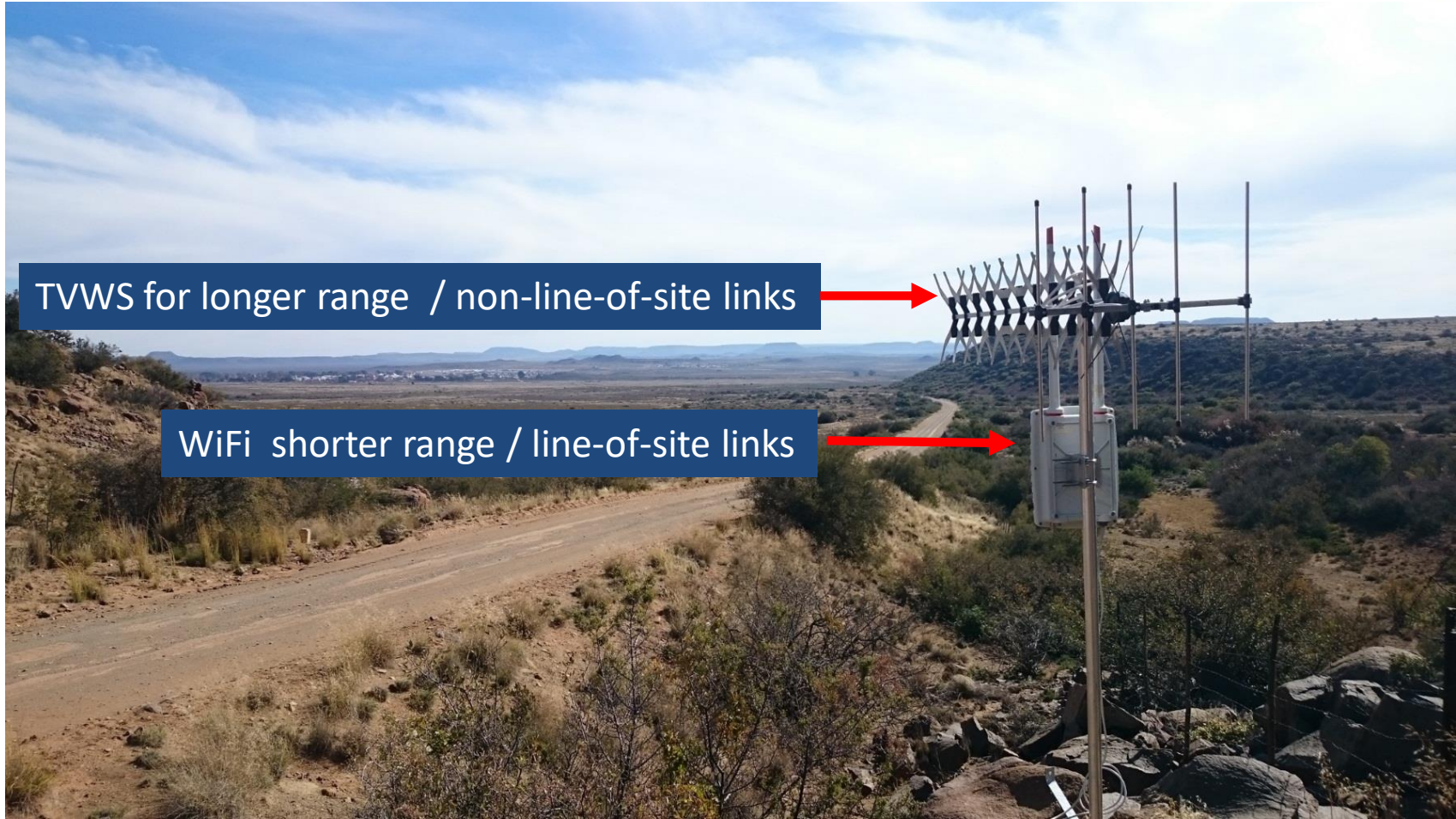


CSIR geo-location spectrum database

- <http://whitespaces.meraka.org.za/>
- OFCOM certified (UK Regulator)
- Build in protection for SKA



CSIR White Space Mesh node

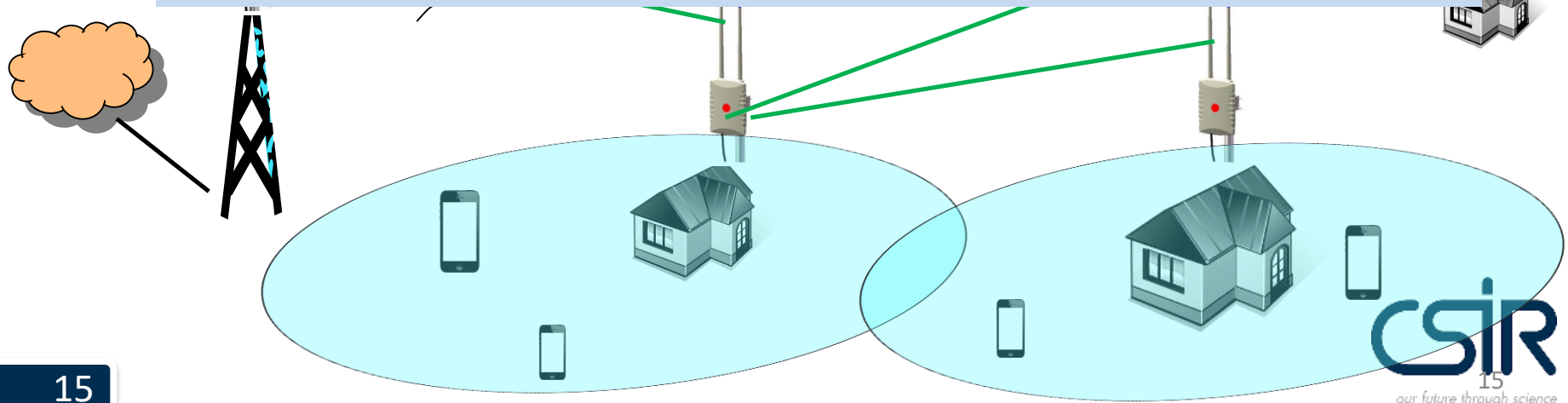


Adding TVWS to WiFi mix to reach further

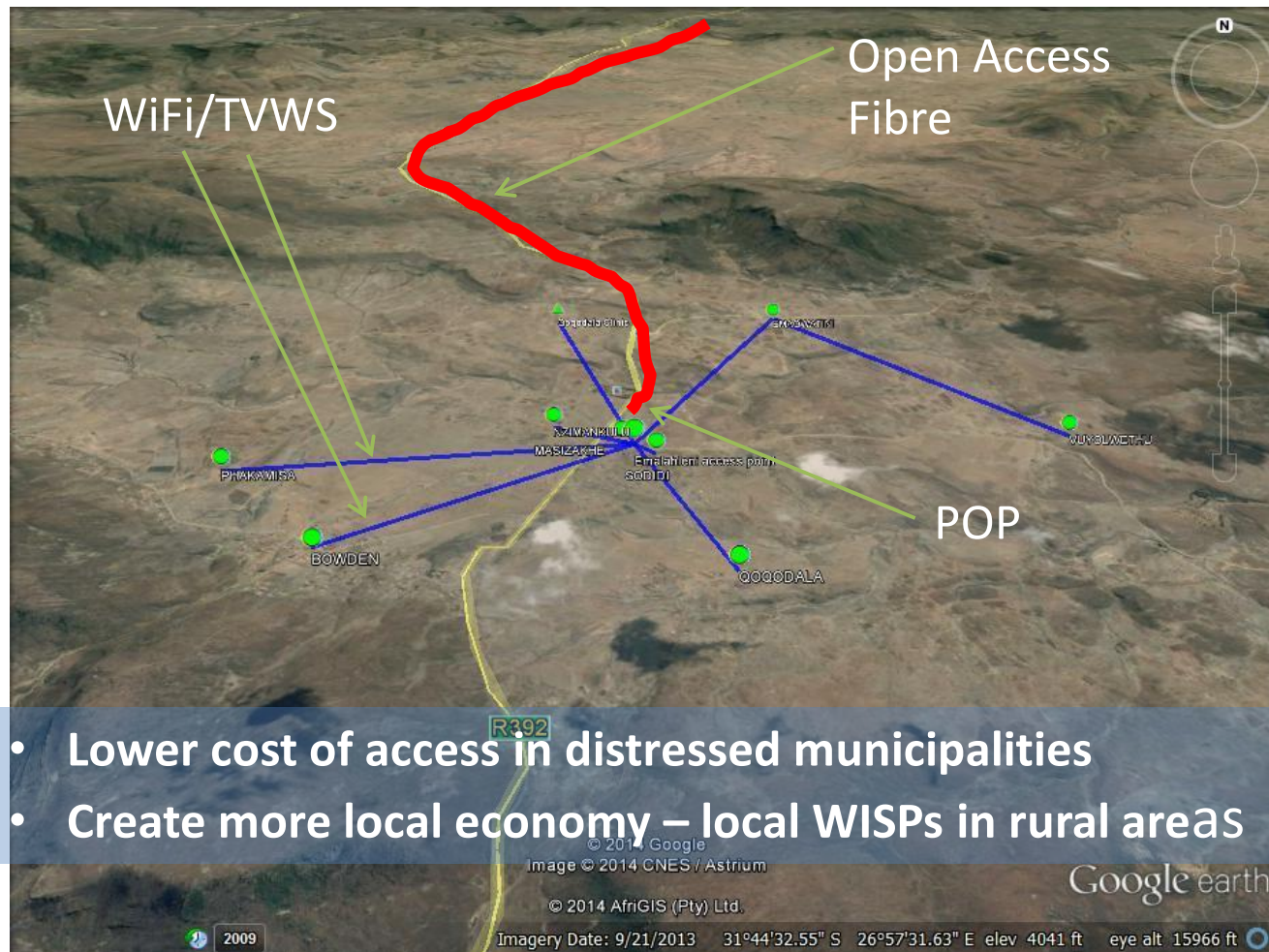
- TV White Space (UHF)
- 5 GHz WiFi
- 2.4 GHz WiFi Access

Albies Wireless add more reach
In this area

- WiFi proven to lower cost
- Dynamic spectrum access (e.g. TVWS) will amplify success of WiFi and lower costs even further

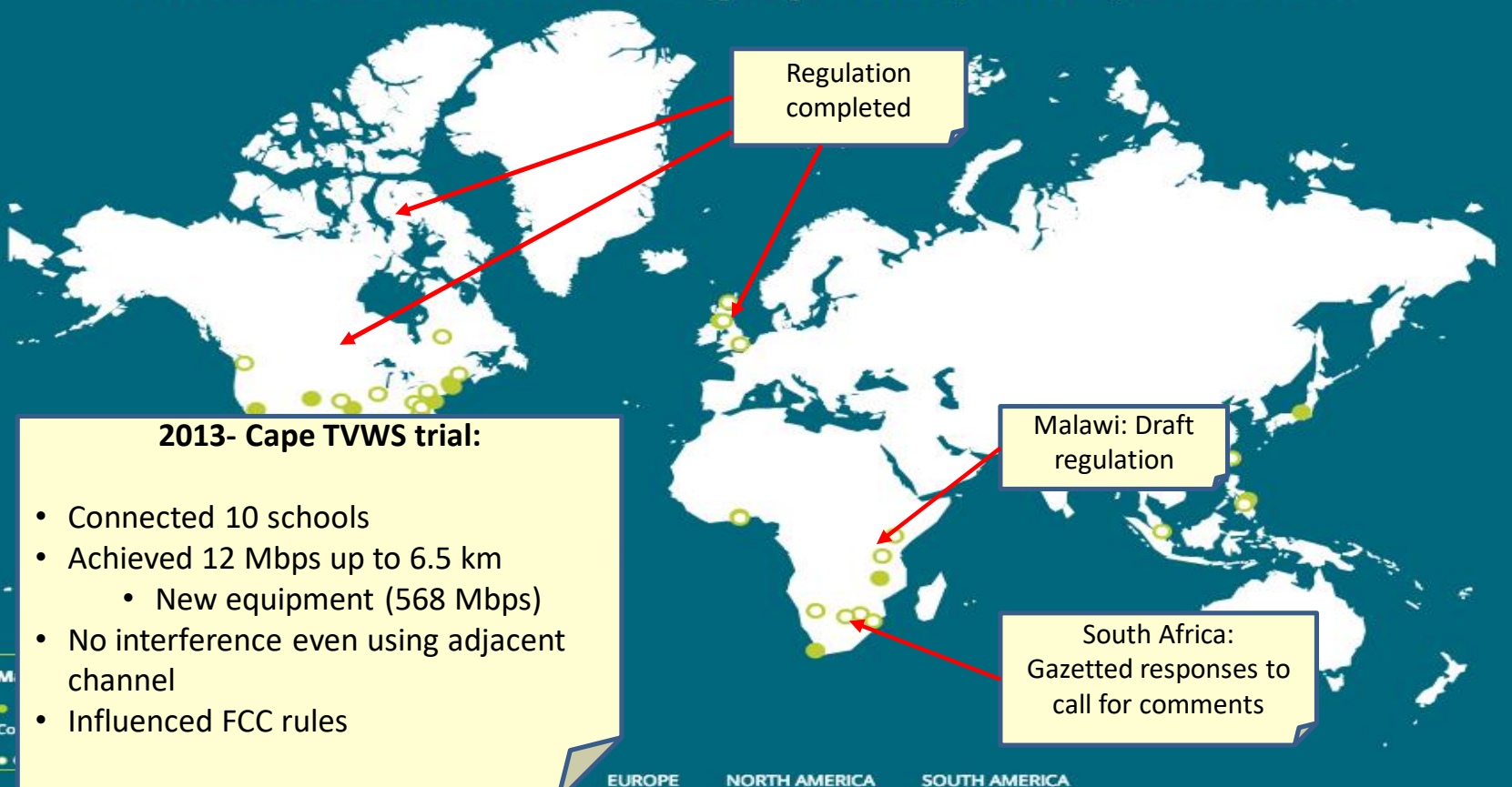


WiFi/TVWS in the rural ecosystem



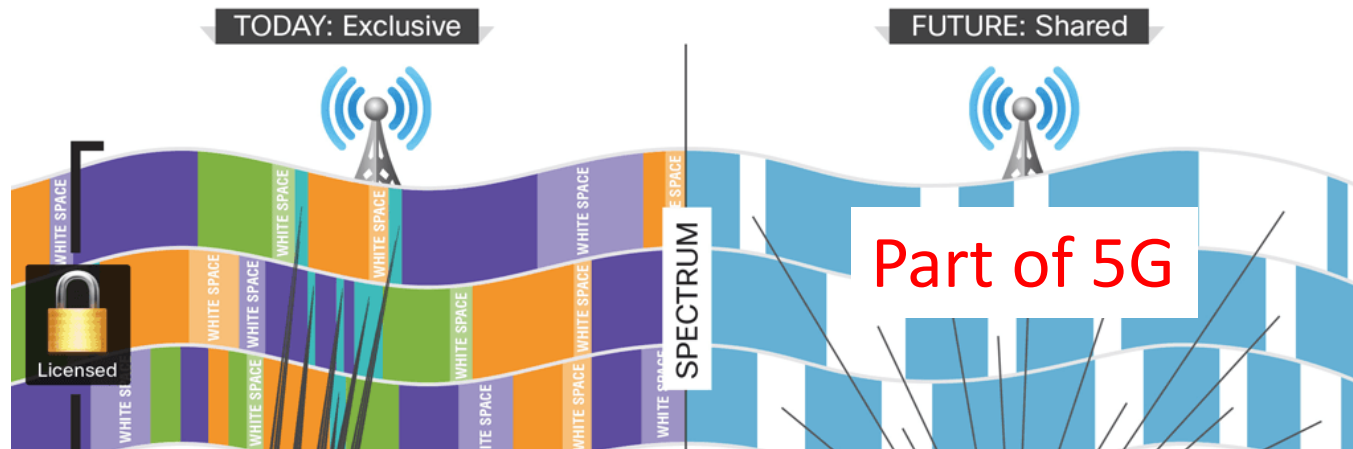
Current global status of DSA and pilots

Worldwide Commercial Deployments, Pilots, and Trials



9 Pilots in Africa

DSA is an inevitable part of our future



South Africa should not play a passive role
But rather be early adopters/ developers
Influence and use the technology to expand
broadband access and lower costs



Recommendations

- Continue to support the process to **allow new spectrum management regimes** such as Dynamic Spectrum Access (e.g. TVWS) on a license-exempt or occasionally light-license and License Shared Access basis in appropriate cases.
- Support the entrants of **new operators** into the market, including WISPs, community networks, and co-operatives – especially those that can serve under-serviced areas - ensuring that they have access to appropriate spectrum at an affordable cost.

Recommendations

- Continue theme of spectrum sharing into **infrastructure sharing** and support open access models for all infrastructure such utility poles, ducts and backhaul fibre as well as local loop fibre/copper.
- Connection of open access telecommunications infrastructure to **hubs such as public facilities** (schools, libraries and clinics) in poorly serviced areas that new operators can use to lower the cost of their backhaul connectivity.

Parting thought



Lets continue to apply our **minds, imaginations and will** to ensuring that the more vulnerable of our population living under or close to the poverty line have access to affordable broadband connectivity.



Thank you



Name (email@csir.co.za)

Extra slides

Contents

- **Contents**
 - **Background on South Africa's connectivity**
 - **Current status of cellular**
 - **The success story of WiFi**
 - **Spectrum usage: history of regulation**
 - **Dynamic Spectrum Access – a new possibility**
 - **TV White Space – ideal spectrum for expanding access**
 - **Recommendations**

Exclusive use spectrum - How we got here

Exclusive use

1900s: Marconis Wireless telegraphy

Exclusive use

1920s: AM radio

Rules based

1938: FCC Radio

Nurse unlicensed

1906: Radio Treaty

- We still think about most spectrum using early 1900s thinking
- Innovation in software defined radio, cognitive radios, geo-location spectrum databases has created new innovative ways to use spectrum
- Regulation needs to catch up with new better ways to use spectrum
- To innovate we need to move from right to exclusive use -> right to protection from interference

Dynamic
Spectrum
Access

2008: FCC allows
TV White space

Rules based

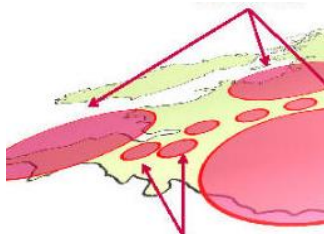
1989: FCC
licence-exempt

Cellular

1971:
AlohaNet

Broadcast
licences

Exclusive use
TV



Cellular
licences



Case of Philipstown, Northern Karoo

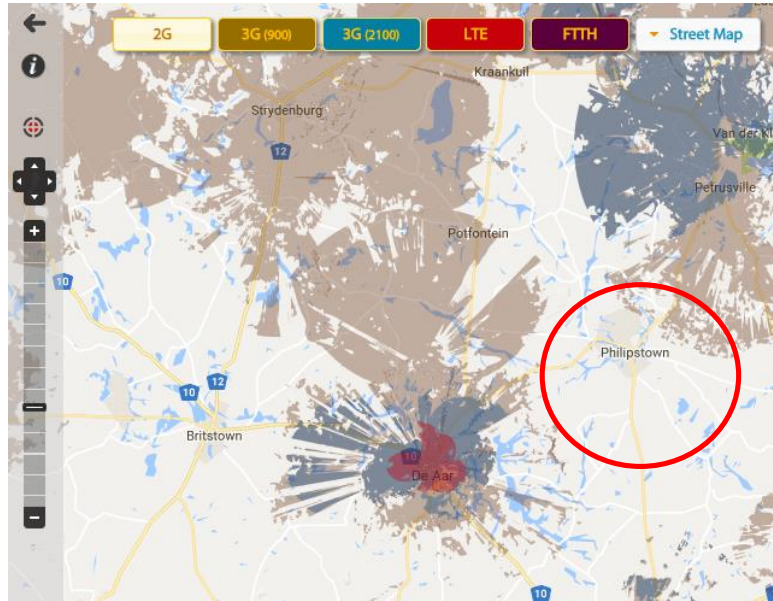
- Town outside the market edge of most operators

Country	South Africa
Province	Northern Cape
District	Pixley ka Seme
Municipality	Renosterberg
Established	1863
Area ^[1]	
• Total	44.12 km ² (17.03 sq mi)
Population (2011) ^[1]	
• Total	3,365
• Density	76/km ² (200/sq mi)
Racial makeup (2011) ^[1]	
• Black African	36.3%
• Coloured	58.5%
• Indian/Asian	0.4%
• White	4.5%
• Other	0.3%

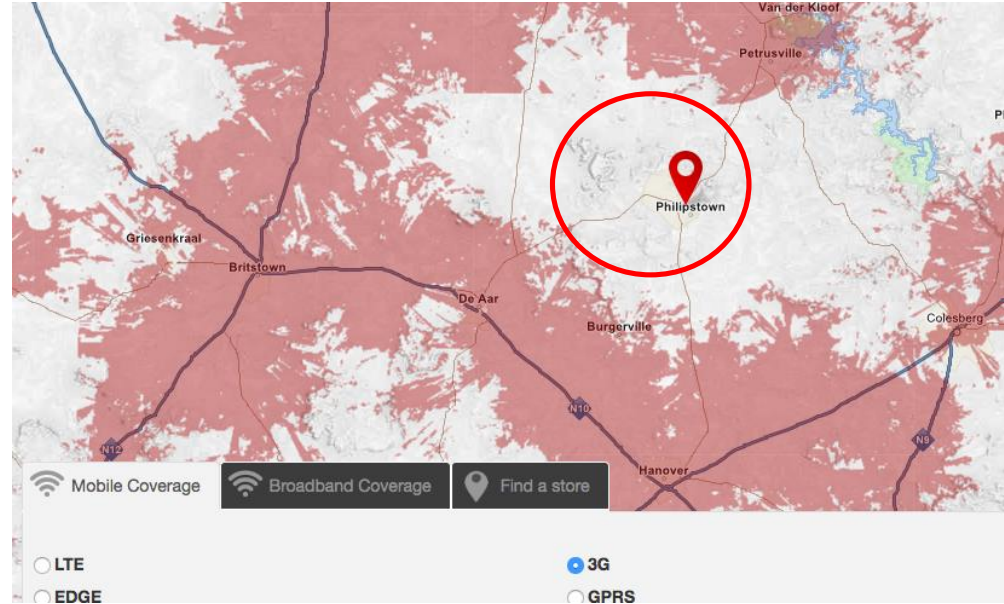


Lack of Coverage in Philipstown

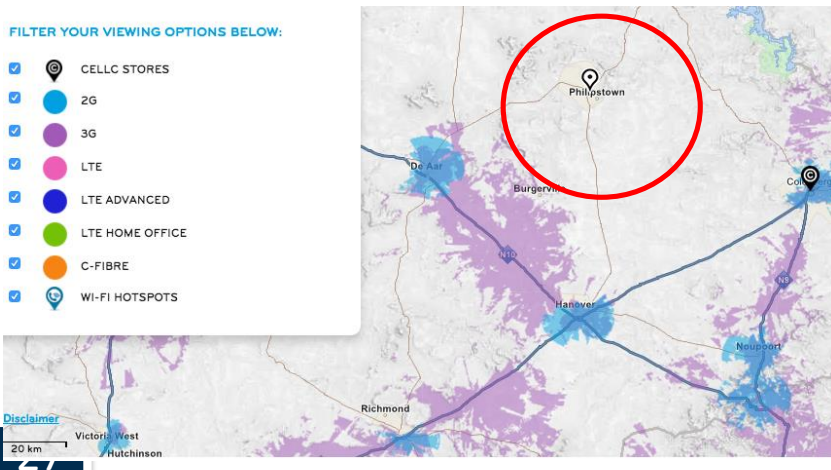
MTN



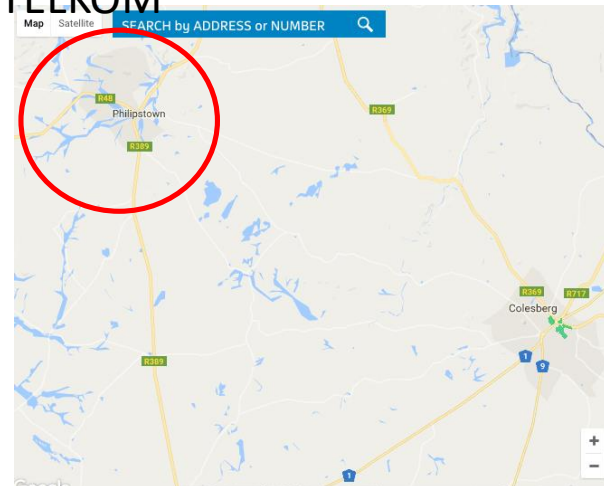
VODACOM



CELLC



TELKOM



Telkom coverage

See which areas are covered for our su

- FIXED** Fibre 100 Mbps
- MOBILE** 100 Mbps
- Wi-Fi HOTSPOTS** 100 Mbps

VDSL

2 Mbps

IS MY AREA COVERED?

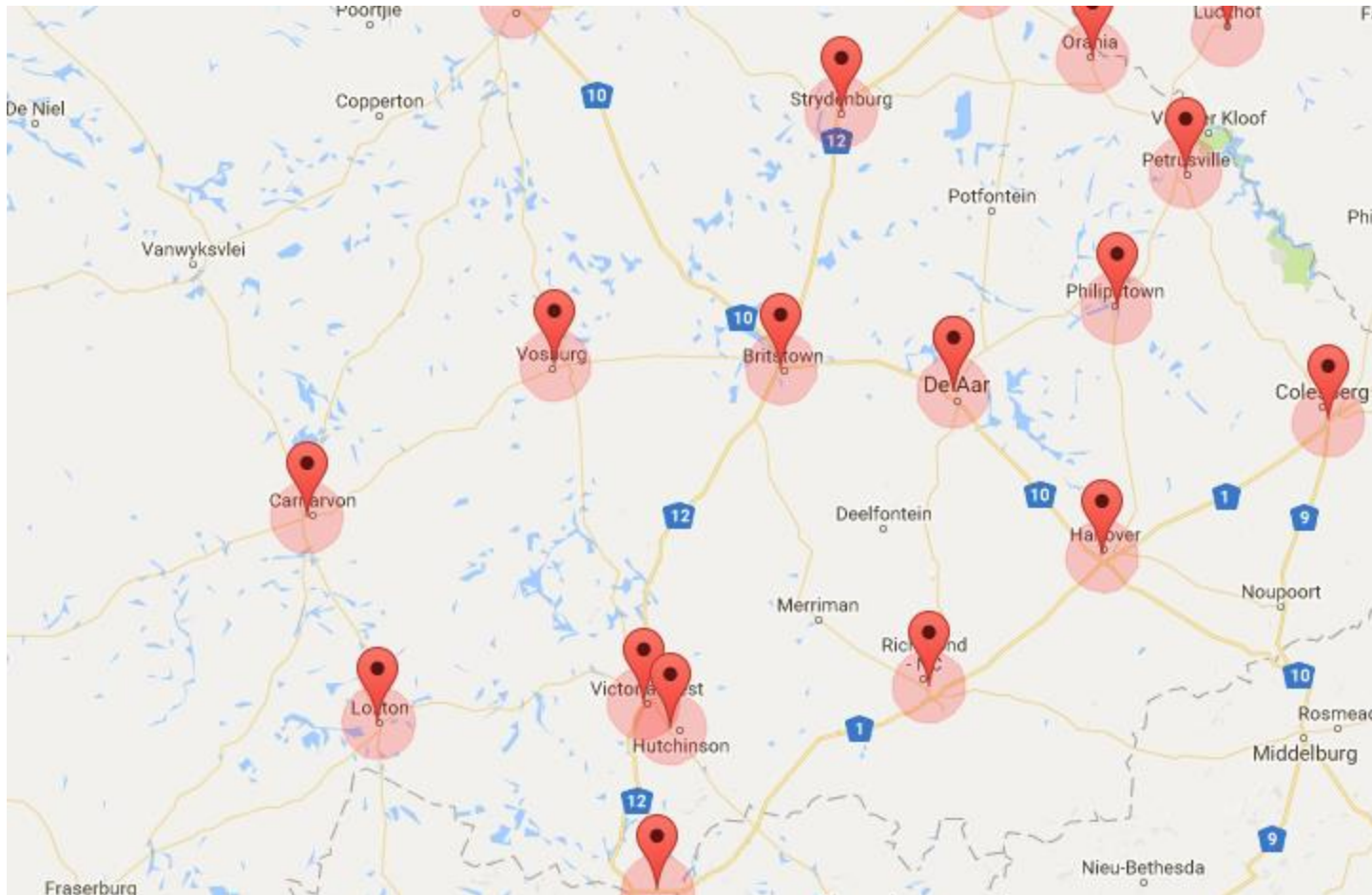
ADSL

0 Mbps

IS MY AREA COVERED?



Albies WiFi-based WISP

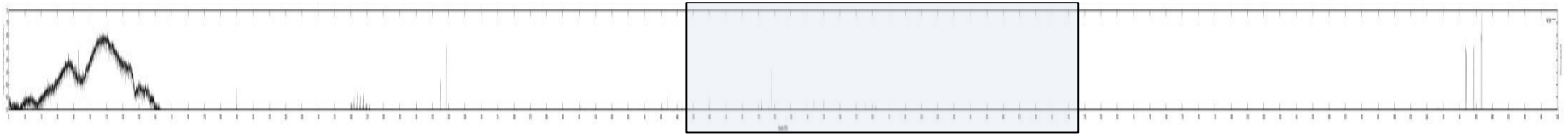


Albies Wireless cost structure

	2GB cap	5GB cap	10 GB cap	Uncapped 2Mbps
Connection speed	Up to 5Mbps	Up to 5Mbps	Up to 5Mbps	2 Mbps
Cap	2GB	5 GB	10 GB	x
Monthly price	R195	R300	R350	R750
Soft Cap	x	x	x	30 GB
Soft Cap speed	x	x	x	1 Mbps
Comparison with Cellular (although only Edge available 75-135 kbps Vodacom, MTN)				
Vodacom	R249	R399	R599	x
MTN	R260	R430	R650	x

TVWS in Philipstown

Spectrum Scan



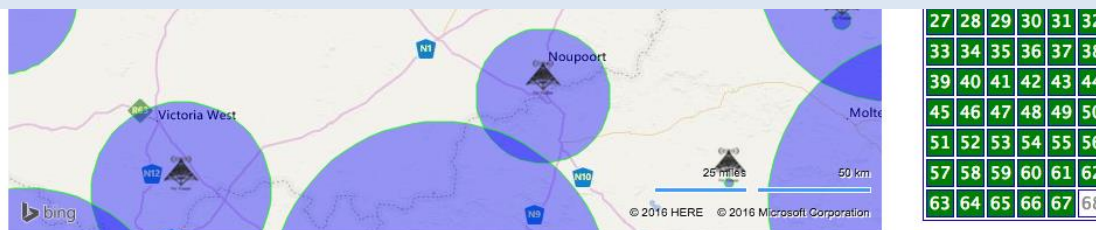
CSIR Geo-location Spectrum Database



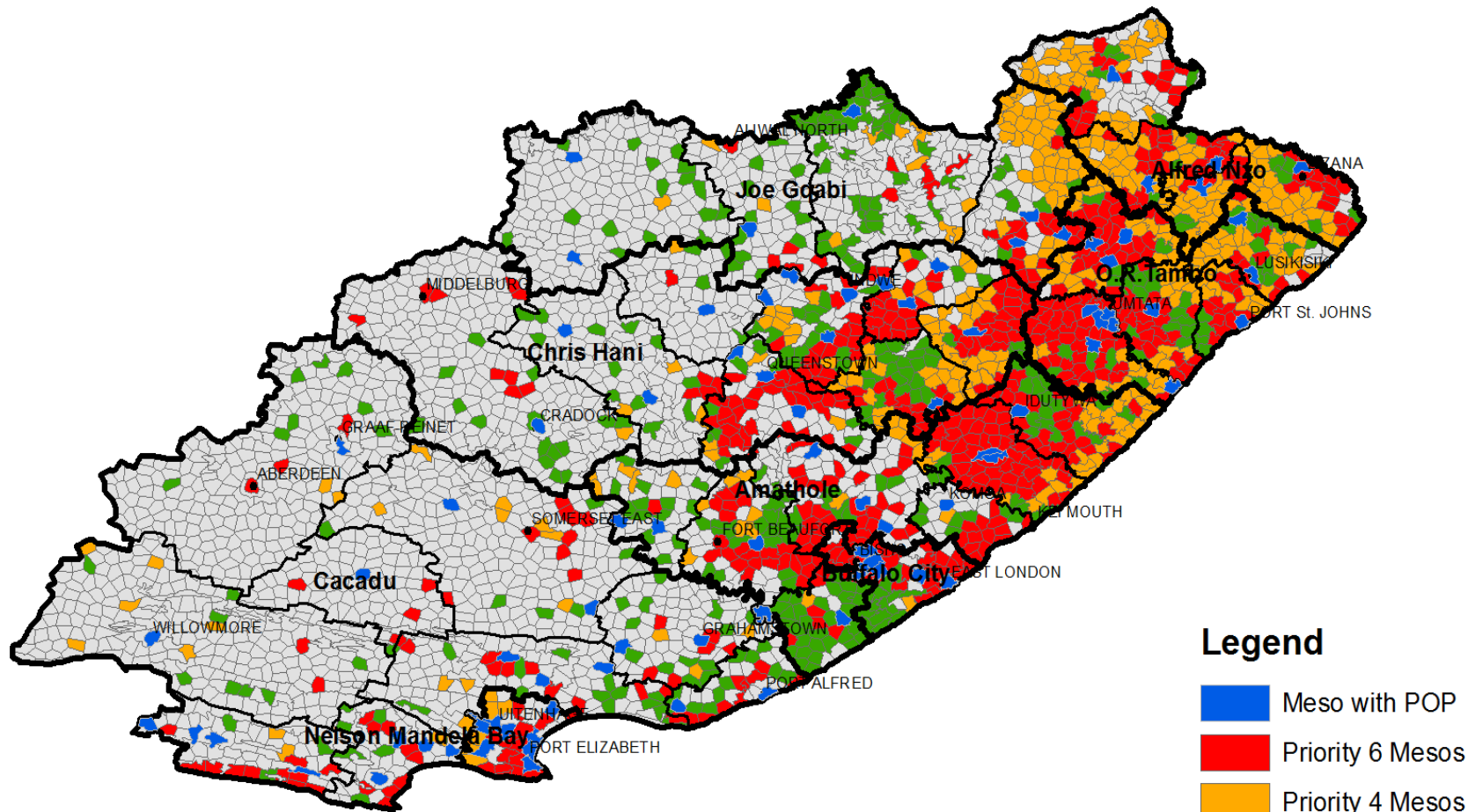
Almost full 230 MHz TV White Space spectrum available

If using 802.11af TVWS standard this translates to

- 35.6 Mbps for 8 MHz channels.¹
- If using four spatial streams and four bonded TV channels (32 MHz) we can achieve 568.9 Mbps



Expanding access in rural Eastern Cape with WiFi and TVWS



2014 Green (Electricity and <75% 3G at facilities) and orange (no electricity and <75% 3G at facilities) areas ideal for mix of WiFi and TVWS