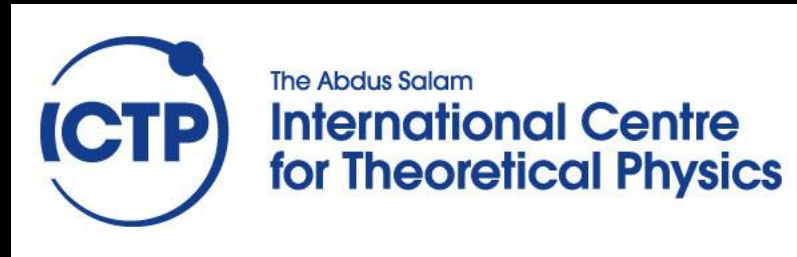


UC2013 (Kigali (12-16th Nov, 2013))

Piloting White Spaces for DSpaces in Malawi

Based on the Spectral Sensing Technique

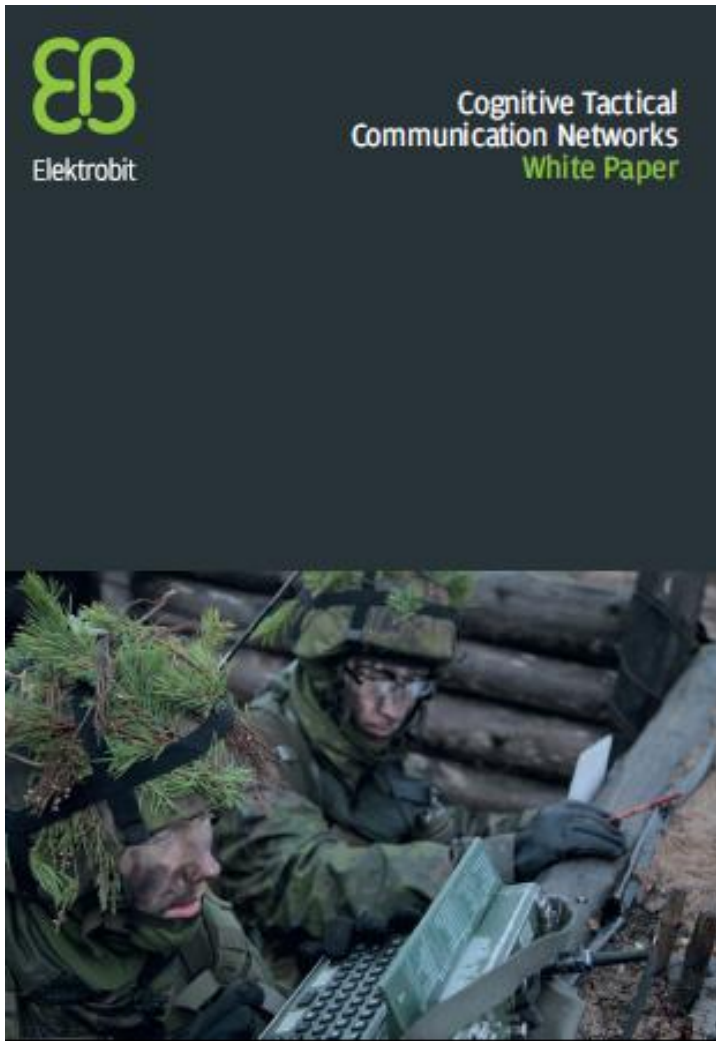
Chomora Mikeka, PhD, Physics Department at Chancellor College in the University of Malawi
Email: chomora@gmail.com
URL: <http://malawitech.com>



Contents

- Definitions of TVWS and the Spectral Sensing Method or Technique
- Scan Results Using the Spectran, RF-Explorer and Geo-tagged S/A
- Thoughts from Ofcom on the Pilot Phase for the United Kingdom
- TVWS Applications in Malawi (The Speech from the Minister of Information, Malawi)
- Pilot Network Simulation, BS Design
- FTRA 2013 Recommendations
- Actual Pilot TVWS Deployment and DSpace Application
- Preliminary Network Performance and Conclusions

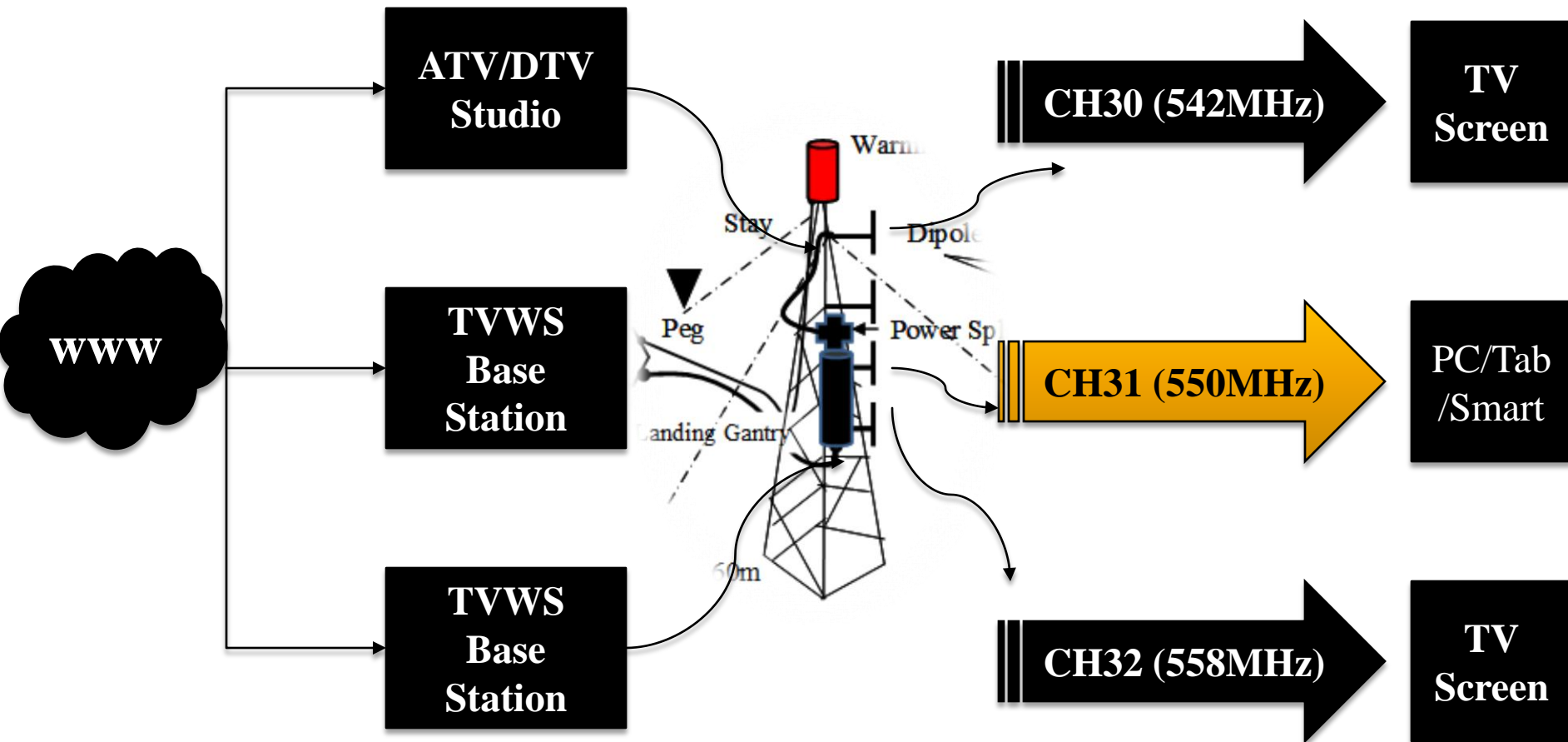
Motivation Source



Cognitive Radio (CR) has been an intensive topic of research in recent years. Its main applications range from the utilization of TV white spaces to interoperability between large communication systems in all layers. Tactical communication systems that have to operate in hostile radio environments with interfer-

In addition to terrestrial applications such as utilizing the TV “white spaces” (the unused frequencies in between high-power TV-transmitters within the spectrum allocated for this application), cognitive radio has been proposed for, for example,

Exercise: Which Channel Depicts TVWS Communication?



Coming Up Next

Basics of Spectral Sensing & Results

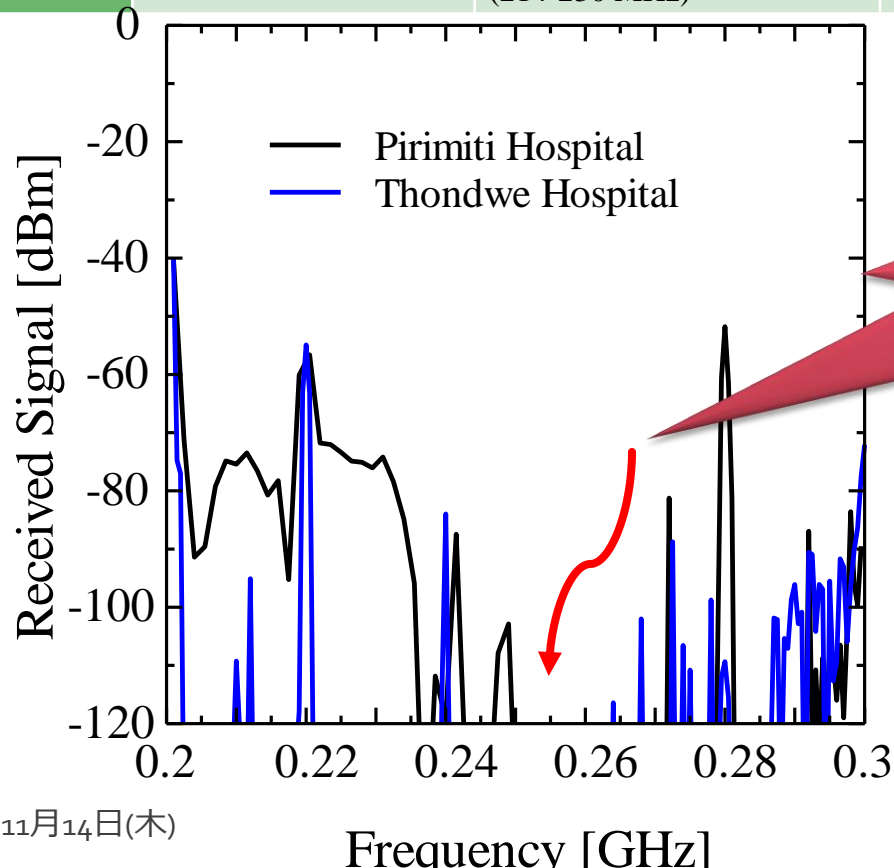
Sensing Using the Spectran



Pirimiti Hospital Matron (Nurse) trains in spectral sensing to confirm TVWS pilot deployment at the hospital

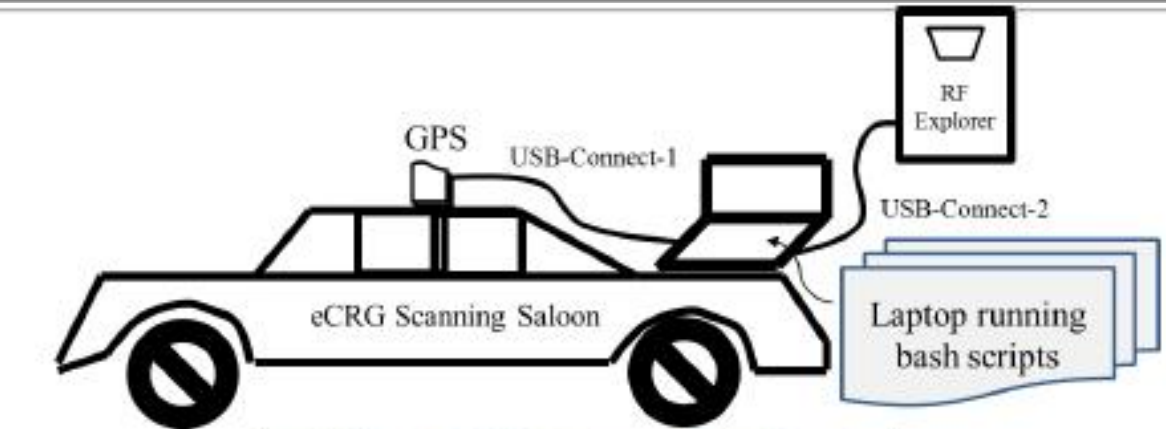
Observation in the VHF Window: using the Spectran

ITU Region 1	SADC	Malawi	Addition Info	Malawi Examples
174-223 MHz BROADCASTING 5.235 5.237 5.243	174-223 MHz BROADCASTING <u>5.237</u>	Digital TV Broadcasting (174-214 MHz) Digital Audio Broadcasting (214-230 MHz)	TV Band III (Geneva Plan GE-06 applies). Migration from analogue to digital broadcasting.	Digital TV Broadcasting Services (VHF band 3). DAB, Fixed/Mobile services on sec. basis per F/note 5.237

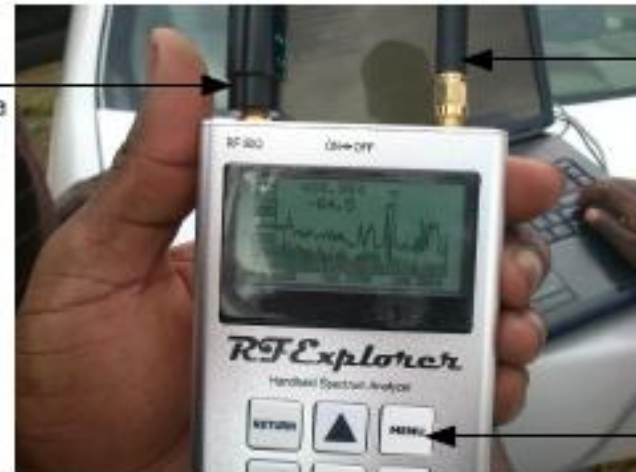


Blank Space = White Space

Sensing Using the RF Explorer



240-960 MHz
monopole antenna

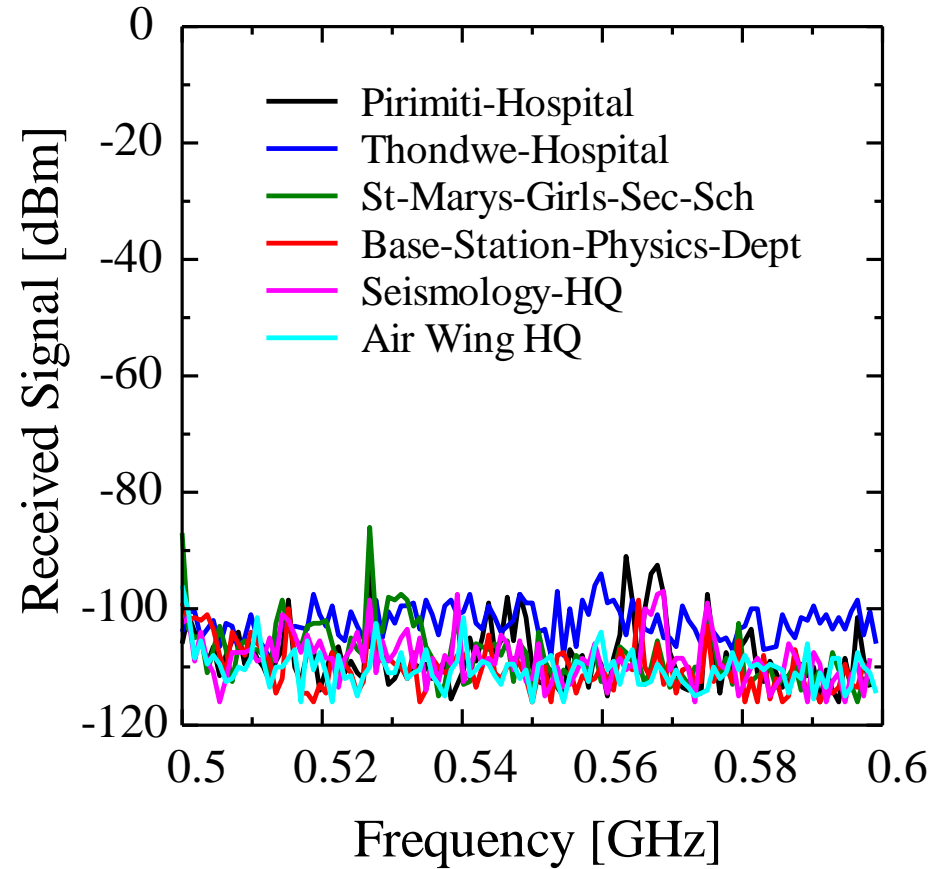
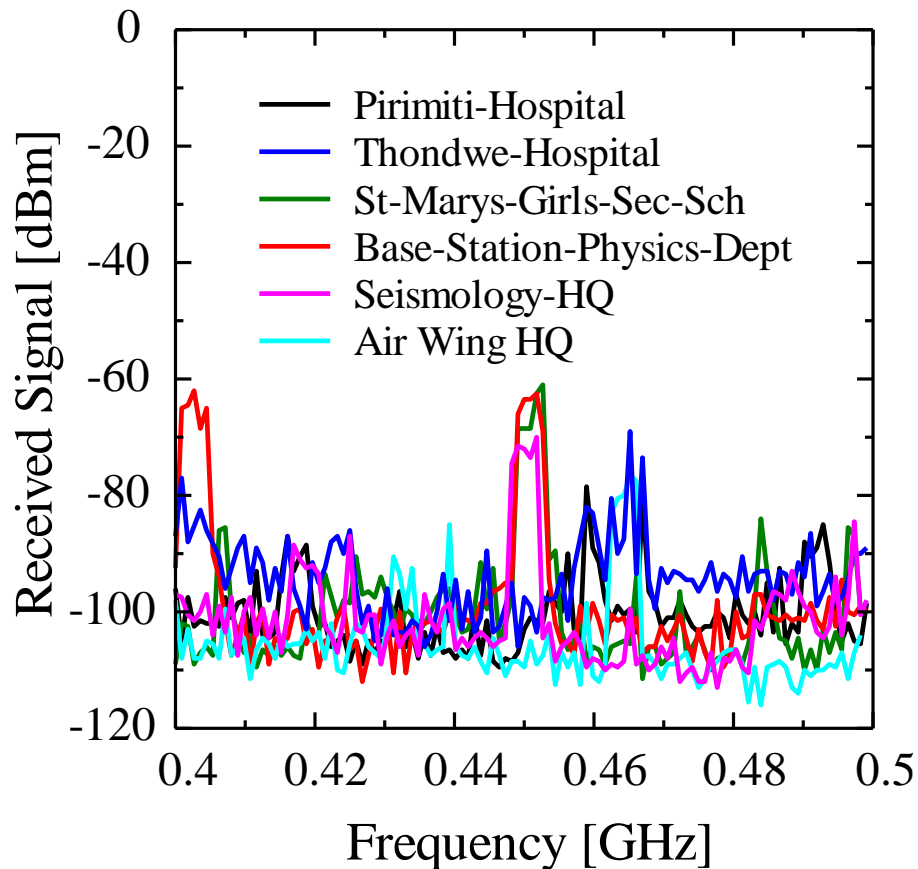


2.4-2.5 GHz
monopole antenna

Laptop for
data acquisition

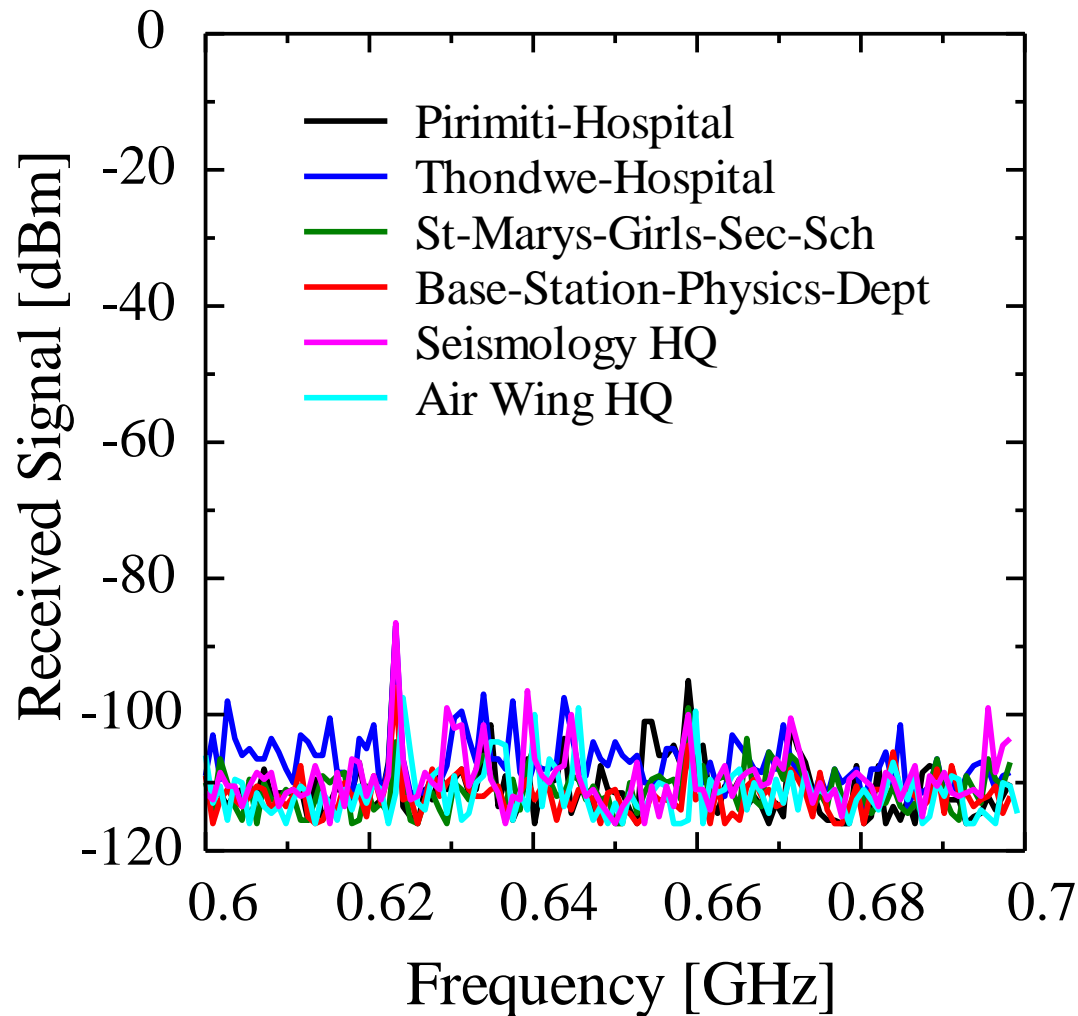
Control panel
for the spectrum
Analyzer

Using RF-Explorer Spectrum Analyzer (in Pilot Sites)



*Demonstrated by *Caspah Kamunda* and Later by *Martin Thodi* with Bash Scripts on Ubuntu Linux for Data Acquisition During the TVWS Training in Malawi July-Aug 2013

Pretty White: Good Sense Huh?



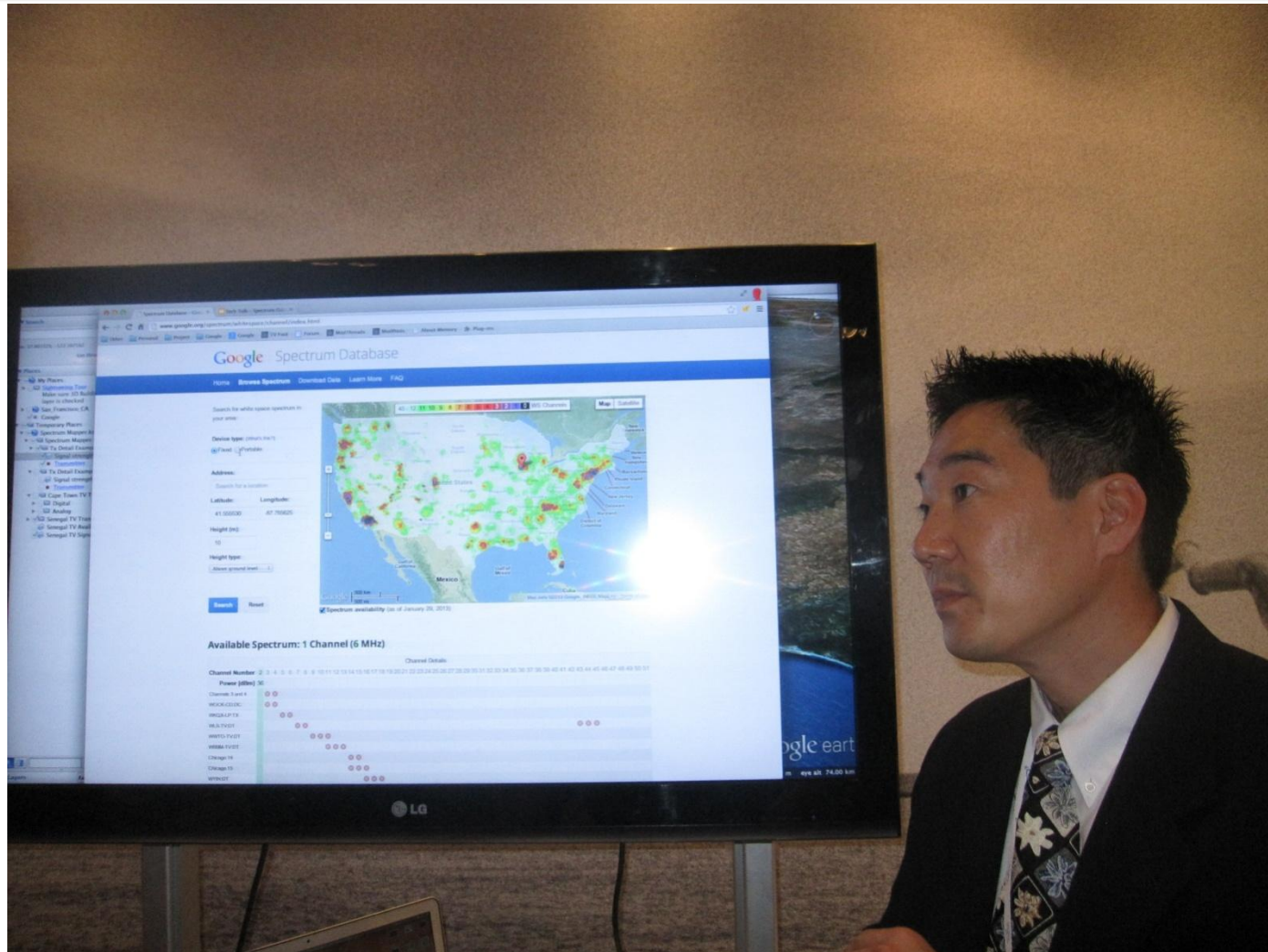
Coming Up Next

**TVWS Training in Malawi & Soft
Benchmarking from Google, Microsoft
and Ofcom (UK)**

Technology Abstraction from Google and Microsoft: Towards Building Capacity Within Africa on White Spaces Technology for Broadband Revolution



USA Towers and Masts: Rain Drops



2013年11月14日(木)

Dr. Chomora Mikeka, Director for Malawi White Spaces Project

USA White Space Channels

Search for white space spectrum in your area:

Device type: (What's this?)
 Fixed Portable

Address:
Search for a location

Latitude: 37 Longitude: -95.5

Search Reset

28-12 11 10 9 8 7 6 5 4 3 2 1 0 WS Channels

地図 航空写真

アメリカ合衆国

カリフォルニア湾

メキシコ湾

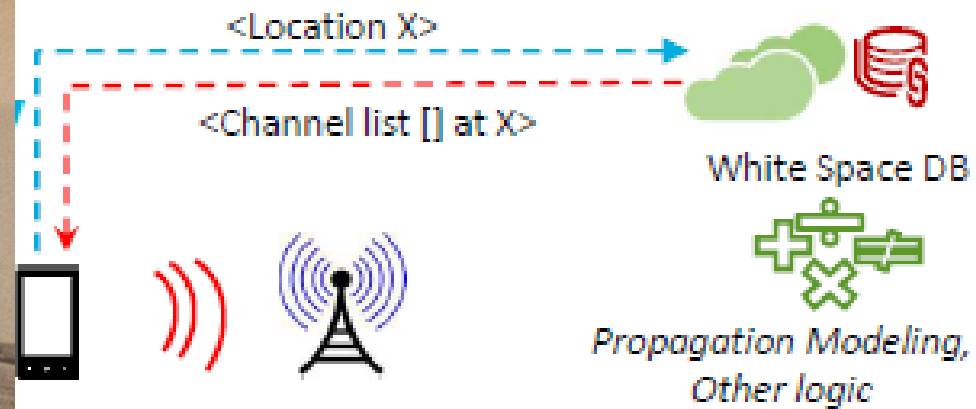
メキシコ

dspace-diagram.pdf 962/962 KB agenda_of_afigf_2...pdf mikeka_ubuntu_r...pdf

すべてのダウンロードを表示

23:01 2013/09/23

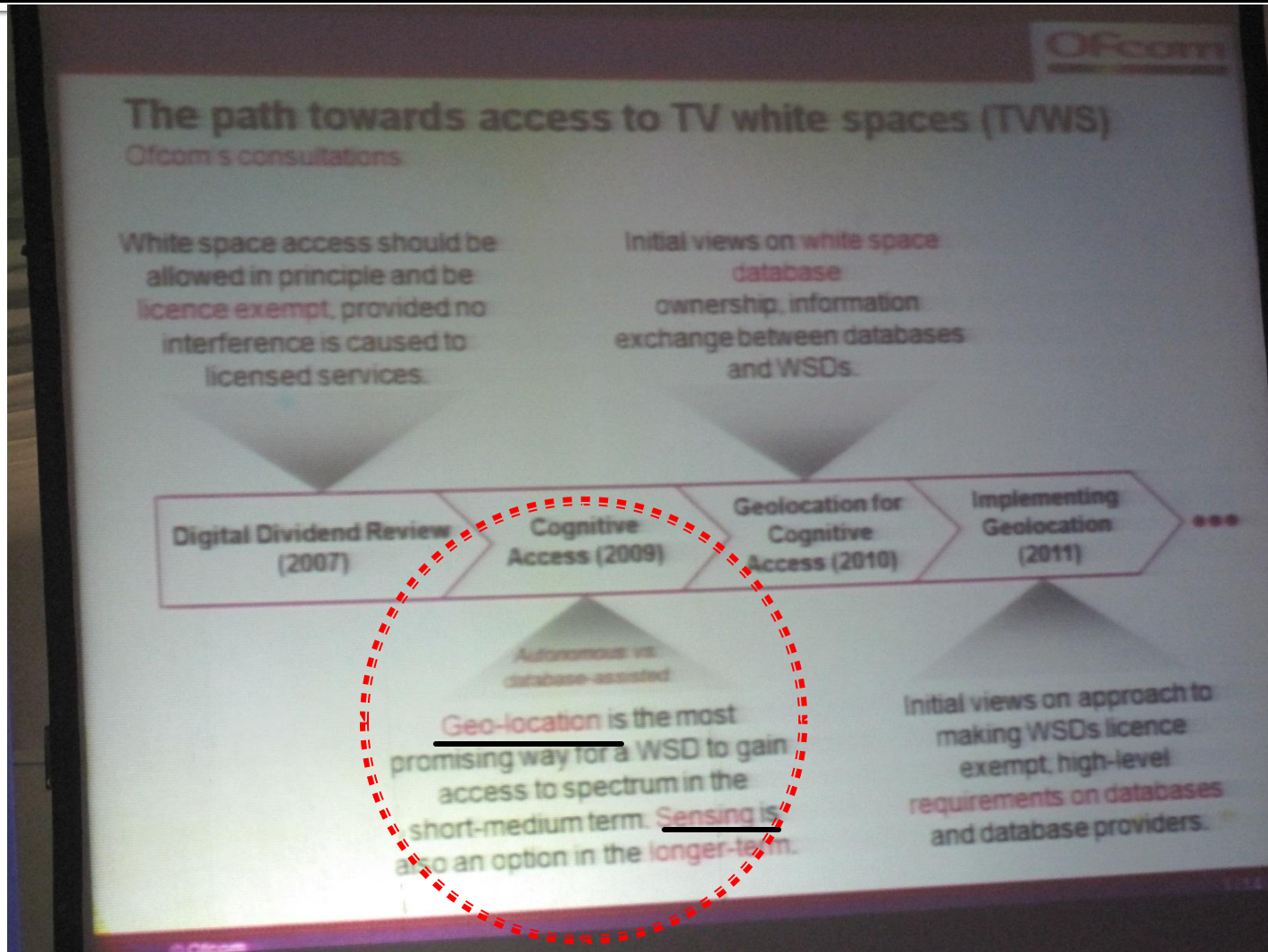
Google and Microsoft *Database: The Popular Approach*



OfCom Defends Whites Spaces



Geo-Location versus Sensing: Ofcom Perspective



Pilot in UK to be Spearheaded by OfCom

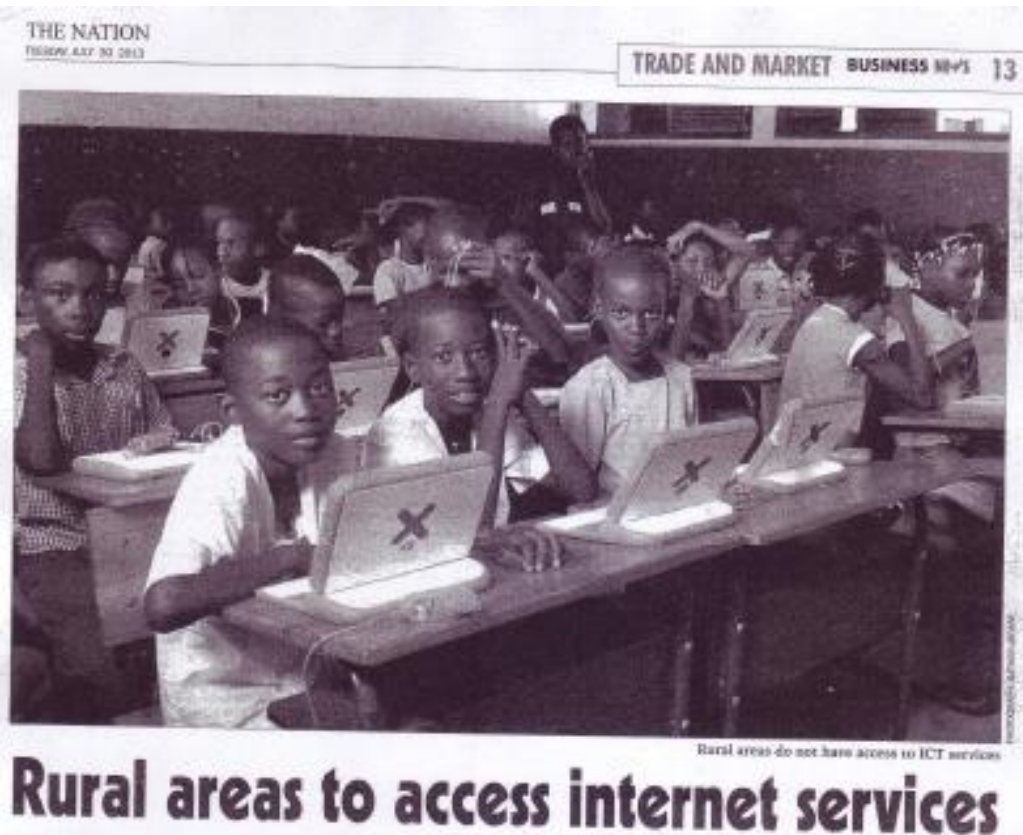
Pilot

- Ofcom is proposing to run a TV white spaces pilot in Q4 2013
- It will be a **proof of concept** of the proposed framework and involve industry in the form of database and service providers
- We plan to test:
 - ❖ Device operations;
 - ❖ Database contract qualification, operation, and calculations;
 - ❖ Ofcom provision of qualifying database listing;
 - ❖ Ofcom's DTT calculation results and provision of PMSE data; and
 - ❖ Interference management
- Also test our proposals for co-existence to gather further evidence
- Assuming the pilot is largely successful, we will move to implementation of the full solution – our target for launch of the full solution is to do so in Q3 2014

Coming Up Next

TVWS in Malawi Embraced by the Government

TVWS Applications in Malawi



The introduction of the Television White Spaces (TVWS) project will ensure that rural and underserved areas have access to affordable and reliable broadband connectivity that is poised to close the digital gap in such areas.

Summary: *The Minister Prides in White Spaces for Rural Broadband Connectivity*

12 BUSINESS

THE DAILY TIMES, Tuesday, July 30, 2013

Malawi pilots White Spaces

BY CAROLINE I

MALAWI will become the third country to roll out a pilot project for the White Spaces in Africa after South Africa and Kenya, the Malawi Communication Regulatory Authority (Macra) has said.

White spaces project aims at providing broadband connectivity to rural Malawi at affordable cost using the identified gaps (white spaces) in the television UHF band.

ill always strive at with emerging ends. vision White spaces manifestation that collaboration with trying to make use ologies to connect to the internet

se in the access to the country has a nomic growth and of citizens in the l implemented, this is poised to make various institutions e social well being "Malawians," said

VWS is being by the Physics Chancellor College with Macra and the ss Lab.



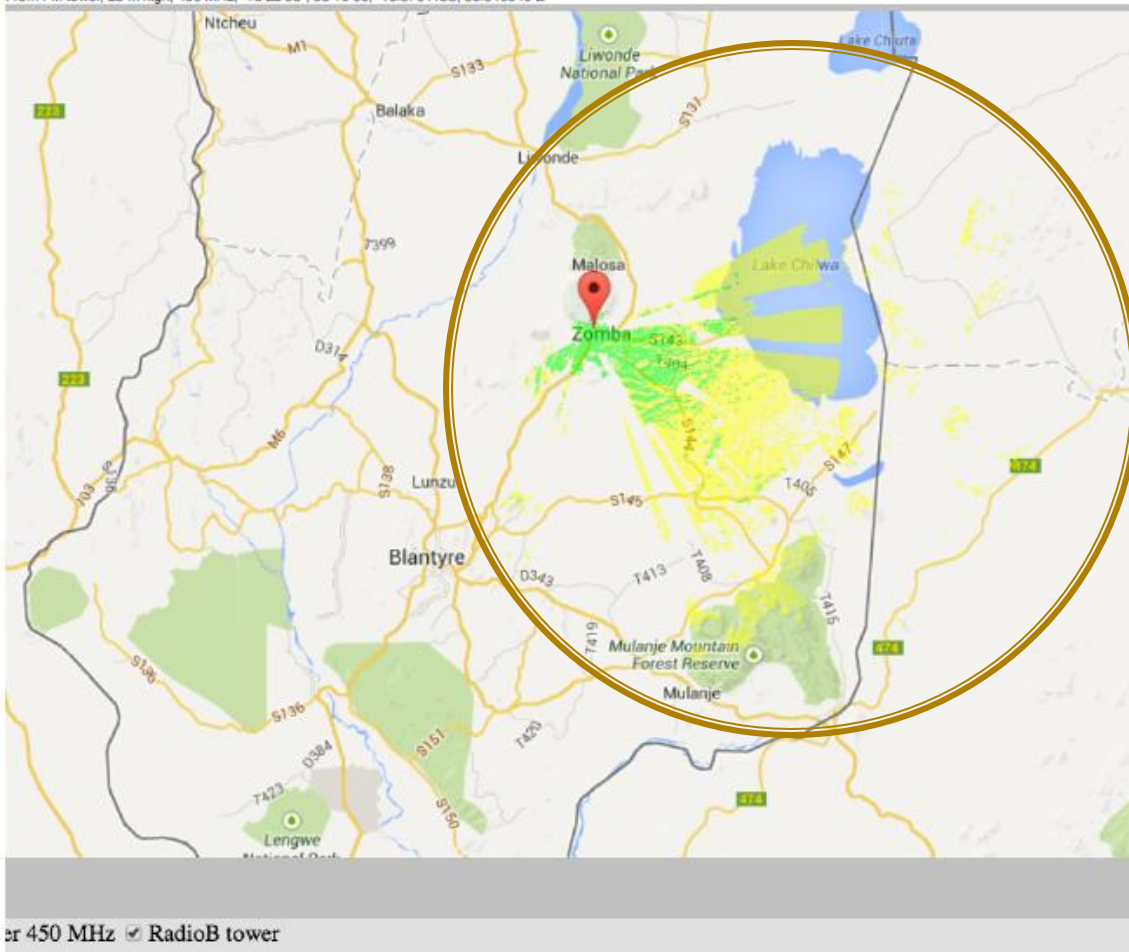
KUNKUYU—Malawi is one of the countries involved

Coming Up Next

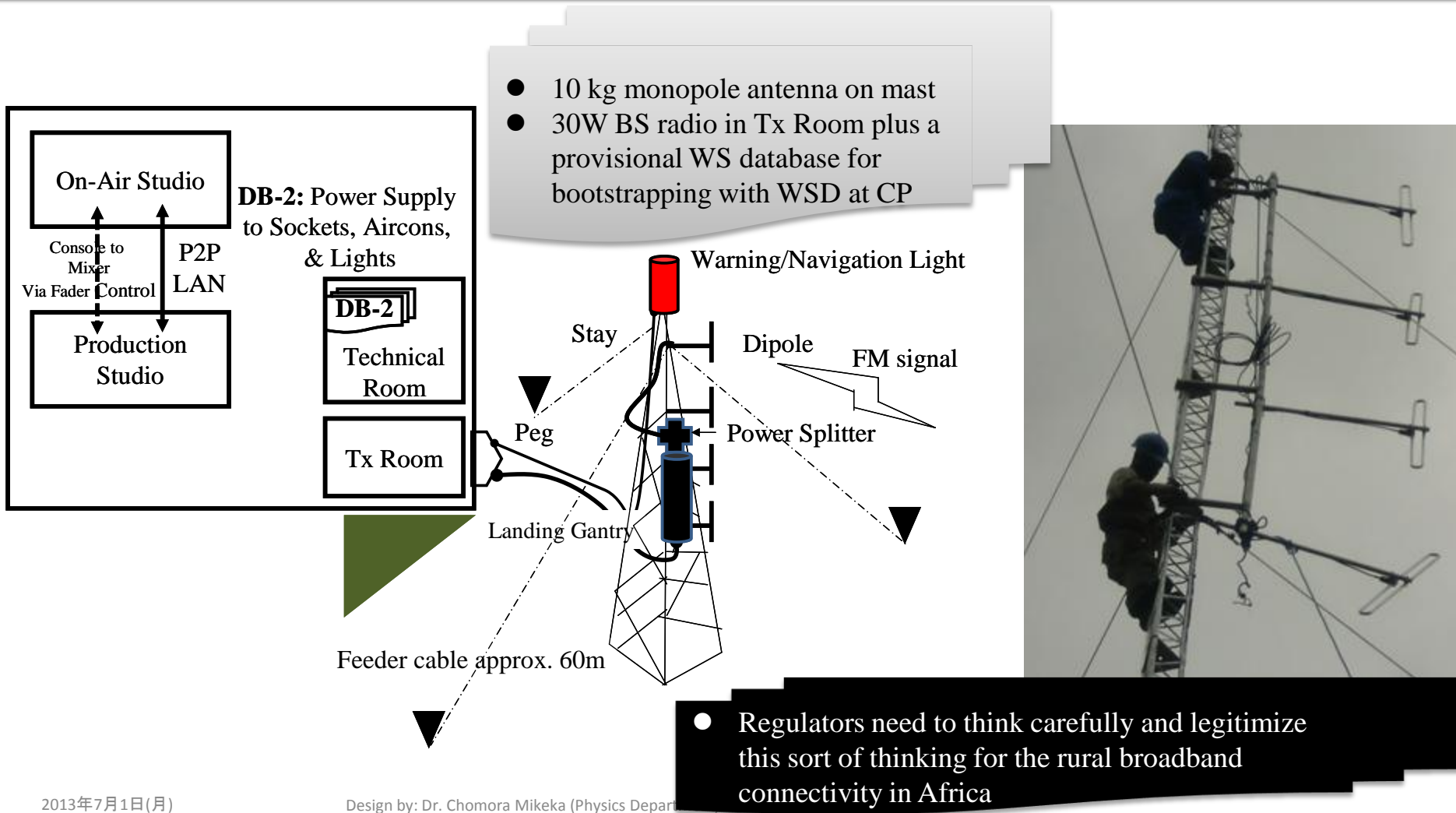
Malawi Pilot TVWS Signal Propagation Modeling

Longley-Rice Simulation Using the FM Mast, 25m High: TVWS Pilot Coverage from -15.37, 35.31E

From FM tower, 25 m high, 450 MHz, -15 22 35', 35 19 06, -15.378415S, 35.318349 E



Malawi TVWS Pilot Phase BS Site



2013年7月1日(月)

Design by: Dr. Chomora Mikeka (Physics Department)

2013年11月14日(木)

Dr. Chomora Mikeka, Director for Malawi White Spaces Project

Coming Up Next

**Malawi Selected by ITU to Give Expert
Presentation on White Spaces Technology at FTRA
2013 (Victoria Falls 3rd – 6th Sept., 2013)**

[Session 6 1 - ITU](#)

www.itu.int/ITU-D/afr/events/FTRA/.../Session6_FTRA2013_PaperI.pdf

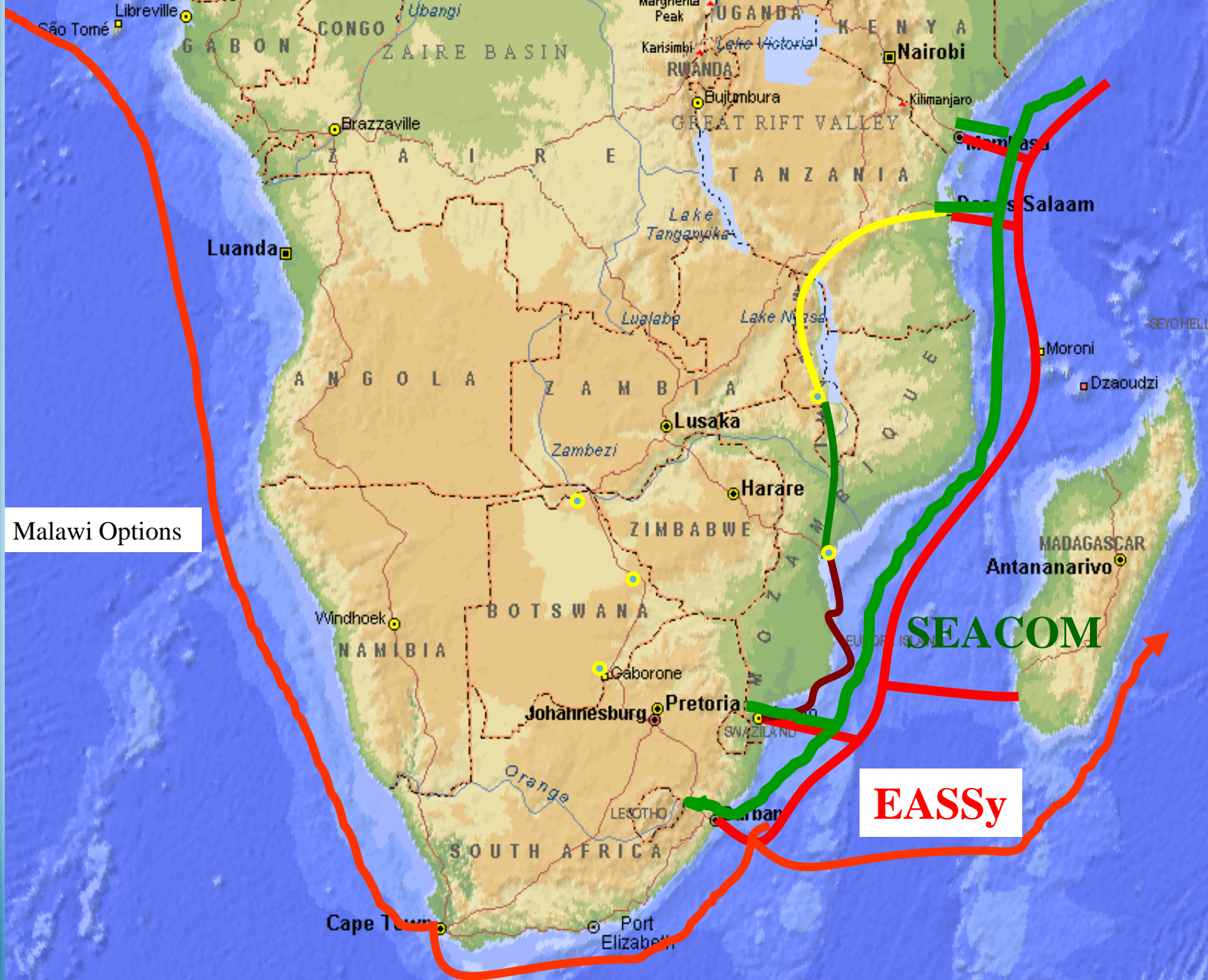
[Session 6 2 - ITU](#)

www.itu.int/ITU-D/afr/events/.../Session6_FTRA2013_PaperII_rev.pdf



SATA Backhaul Links Approved Minimum Network and Route Resilience

By the SATA BHWG

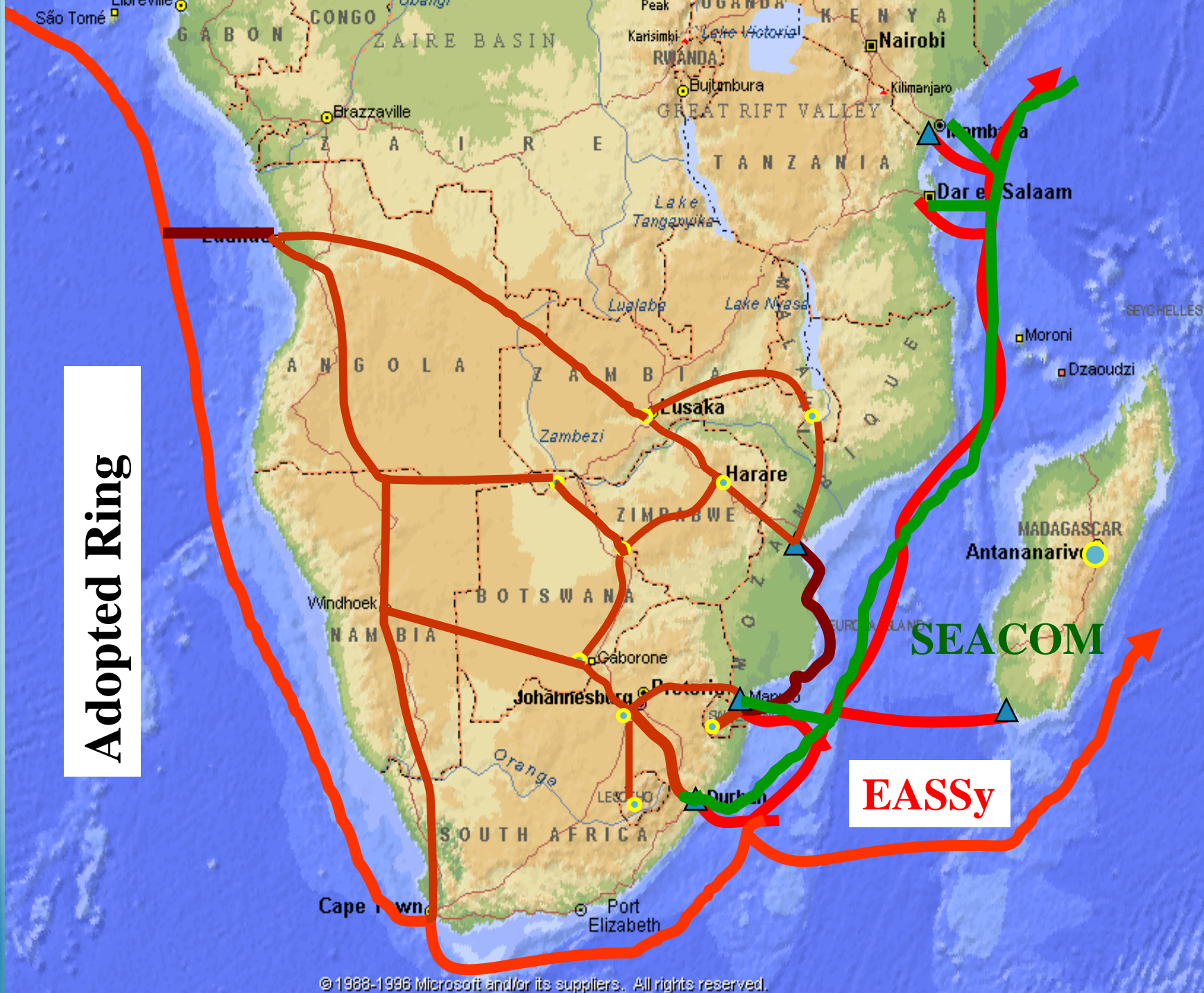


Malawi Options

EASSy

SEACOM

Adopted Ring



FTRA 2013 Recommendations

	<p>14th Forum on Telecommunications/ICT Regulation and Partnership in Africa (FTRA 2013)</p> <p><i>'Development of broadband and Investments required to support sustained growth'</i></p> <p>Victoria Falls, Zimbabwe, 3 - 6 September 2013</p>	
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RECOMMANDATIONS

1. FTRA-13 invites countries that have not yet established a national broadband plan to do so in accordance with the recommendations of the Commission of Broadband for Development Each African government should develop a National Broadband Plan or Strategy (NBP/S)which makes a statement of clear vision for the development and future evolution of broadband, both as a sector in its own right, and with consideration of its relationship with other sectors.

The process of developing the NBP/S should be participatory and should include all stakeholders of the ICT sector.
2. FTRA-13 recommended that a mechanism for consulting and agreeing on a suitable benchmark be initiated, to adopt at a Regional level a minimum baseline definition of Broadband(in terms of data capacity and speed) in order to foster aspects of regional harmonization..

Continued

3. FTRA-13 encourage and invite Governments to play a significant role in the supply and demand side of Broadband particularly in rural and remote areas. This may include providing some subsidy for access to broadband services to populations living in such areas.
4. The ITU is requested to continue to provide continuous support to developing nations in elaborating broadband plans and strategies taking into consideration that the target for all countries to have broadband plans is 2015.
5. FTRA 13 recommends that , as broadband is a fundamental right , everybody should have access to and benefit from it. In this regard It is fthe appropriate use of the universal service funds is recommended in order to avoid abuse and distraction ..
6. Regulators should conduct surveys and create a register of stakeholders and consumers (human and corporate) and commit to maintaining a database of stakeholders and to hosting at least an annual conference of consumers
7. Regulators should establish a monitoring system of control of Quality Service and QoE defined in consultation with the operators, the Consumer Associations and all stakeholders.
Ultimately, this system should allow to inform objectively, impartially, sustained and in a continuous manner. Noting that the only commercial relationship between consumers and service providers is not enough to guarantee a sufficient level of quality service to the increased use of these services, the regulator is invited to fulfil its role of defending the Consumer in terms of Quality of Service.

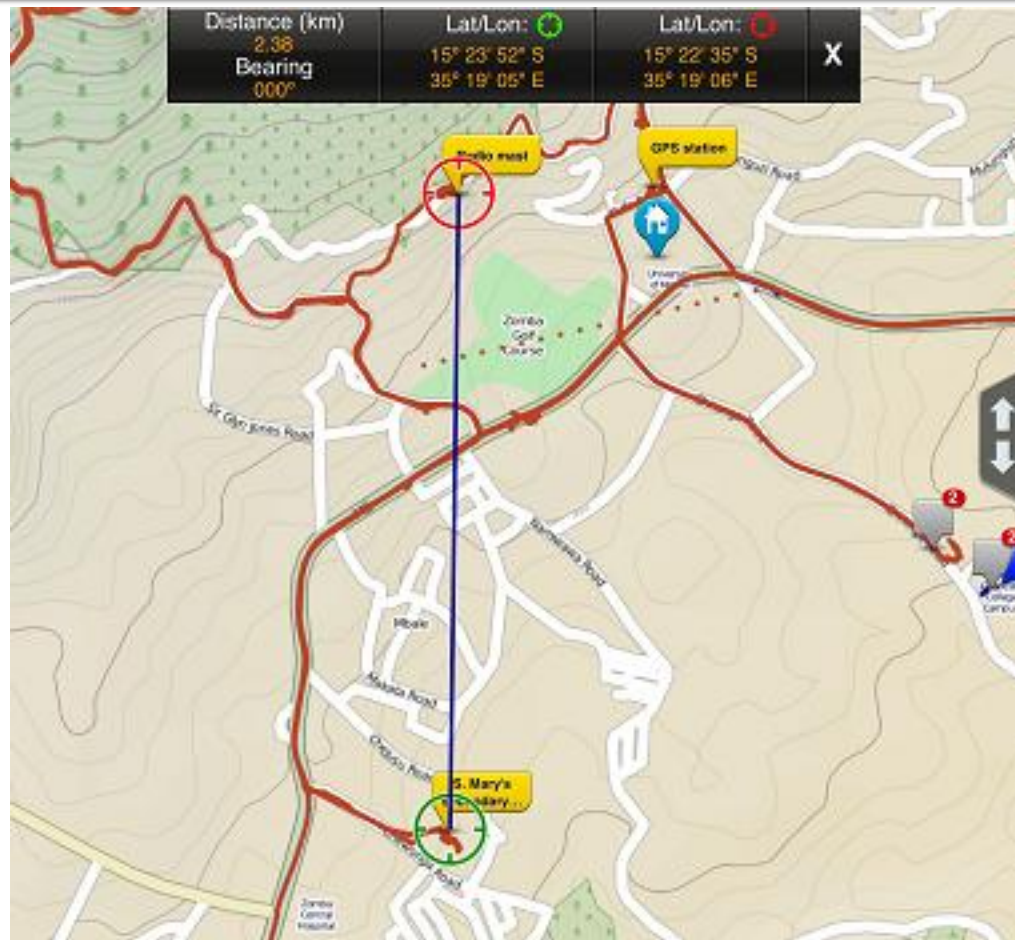
*Recommendation 9

8. FTRA 13 recommends ITU to make available a coherent picture of terrestrial fibre infrastructure in Africa
9. FTRA 13 encourage regulators to explore the potential of "white spaces" technology for affordable rural broadband and establish a policy and regulatory framework. The forum emphasized the need to have the regulatory framework harmonised.
10. FTRA 13 encourages Policy makers and Regulators to revisit universal access and service policy to extend universal service fund to broadband networks deployment as well as ICT applications and services, thus aiming at providing access to the digital world to all.

Coming Up Next

Actual Deployment of the Malawi Pilot TVWS Network

Highlights on Malawi White Space Deployment: CPE at St. Mary's Girls Secondary School

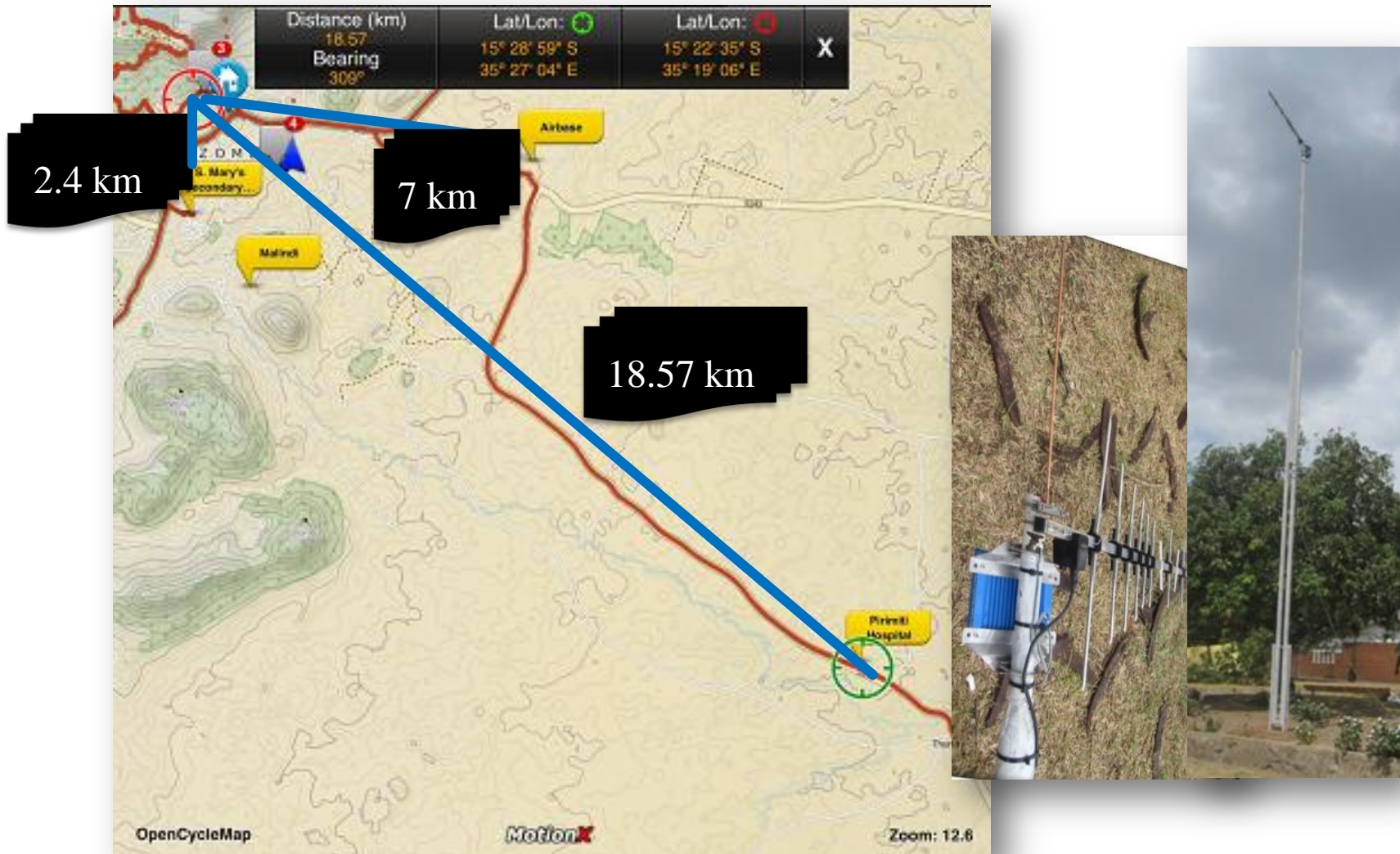


The Monopole for TVWS BS



TVWS Base Station Mounting at FM Radio Mast

GPS, St. Mary's and AirWing & Funds Available Pirititi



In Search of a TVWS Signal at 554 MHz (CH31) Using a Mobile Pole Mount Yagi-Uda Antenna

*18.57 km from the F

A brighter tomorrow with
TVWS



2013年11月14日(木)

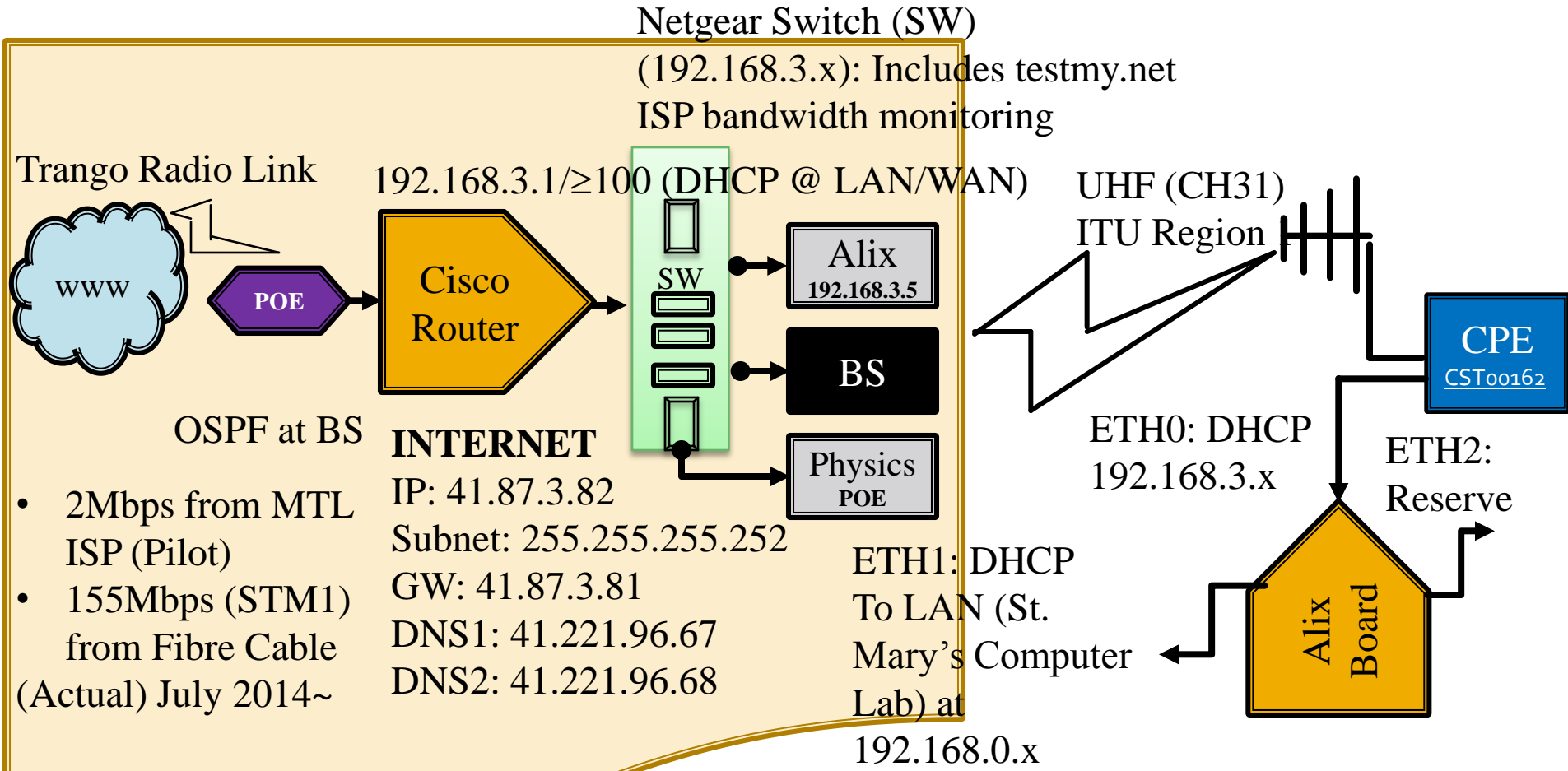
Dr. Chomora Mikeka, Director for Malawi White Spaces Project

Coming Up Next: Possibly of Great Interest to UC2013, Kigali (Rwanda)

Summary of the Malawi TVWS Pilot Network, Applications and Performance

Malawi TVWS Pilot Network:

Showing Only One Client Station (St. Mary's Sec School)



Note: - Alix Boards Configured Using Voyage Linux
- Python Script on Alix for Throughput Monitoring

Monitoring from OMC Window and Station Nomenclature

The screenshot shows the OMC web interface with the following elements:

- Navigation Bar:** Includes "Welcome, intern02!", "Sign out", "Change password", and "Support" buttons.
- Header:** "Operation and Management Center" with the CARLSON logo.
- Stations Section:** A "Register Station" button and a "Drag a column header and drop it here to group by that column" instruction.
- Table:** A table with columns: ID, Name, Guid, Description, Rbt, After-boot system, Last reported, Controllable, and Versions.
- Summary Table:** A table summarizing terminal and station information.

Terminal	Description	Station Name
<u>CST00162</u>	ICTP CPE 162	St. Mary's Sec School
<u>CST00163</u>	ICTP CPE 163	AirWing
<u>CST00164</u>	ICTP CPE 164	GPS (Seismology Dept.)
<u>CSB00490</u>	ICTP Base 490	ZA TVWS Basestation

ID	Name	Guid	Description	Rbt	After-boot system	Last reported	Controllable	Versions
960	CST00164	09eff88f-1460-4410-8246-23c4cbe75bb4	ICTP CPE 164	✗		Less than 1m ago	✓	Firmware: 17738 Variant:CWT4Terminal Built:at 12:51:08 on Apr 15 2013 by JENKINSSSLAVE1:JENKINSSSLAVE15 Fpga: 15a Variant:NMAC180213_1505 Name:fpga2 Stack: null
1041	CSB00128	329a2c7a-fbad-4c34-a288-c38438cd2d11	ICTP Base 128	✗	UMS 2013W43	Less than 1m ago	✓	Firmware: 19577 Variant:CWT4BSC Built:at 12:49:26 on Oct 2 2013 by LEGACYJENKINSSL:LEGACYJENKINSSL5 Fpga: 15b Variant:NMAC170513_0936 Name:fpga2 Stack: 0.0.5042.8516
1043	CST00163	120ac43d-4ebf-41ce-8ec5-e2c783c8af75	ICTP CPE 163	✗		Less than 1m ago	✓	Firmware: 17738 Variant:CWT4Terminal Built:at 12:51:08 on Apr 15 2013 by JENKINSSSLAVE1:JENKINSSSLAVE15 Fpga: 15a Variant:NMAC180213_1505 Name:fpga2 Stack: null

Malawi TVWS Network Infrastructure

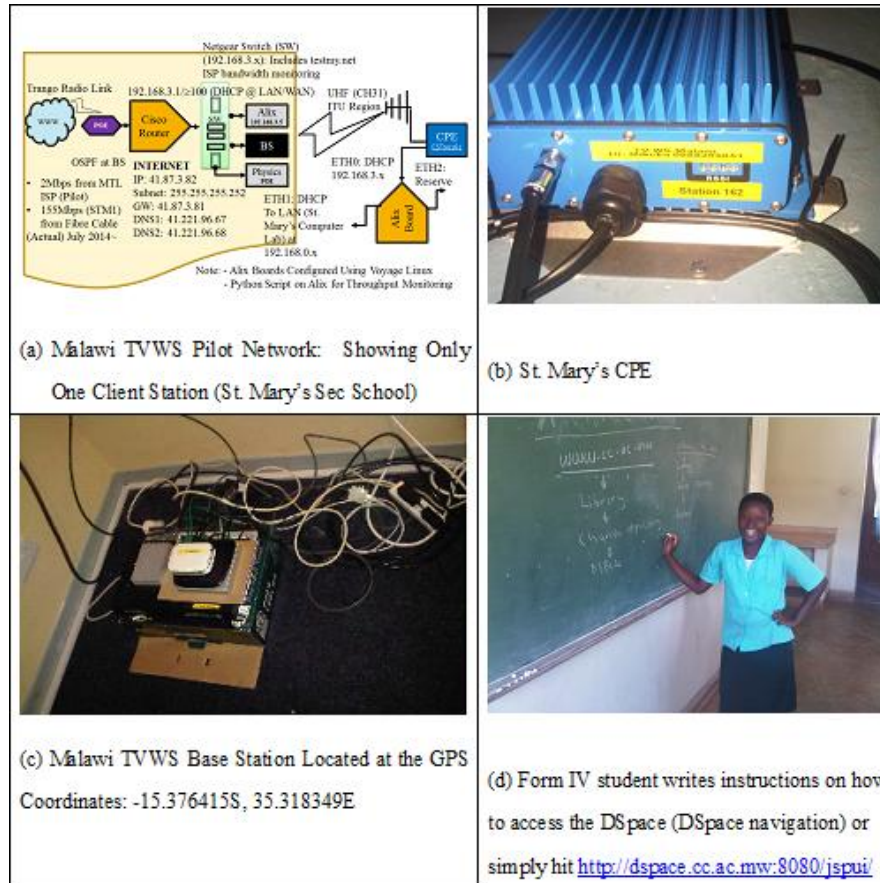


Figure 1: Malawi TVWS pilot network diagram and deployment scenario at one station (St. Mary's Sec., School)

Access Environment for the TVWS Internet

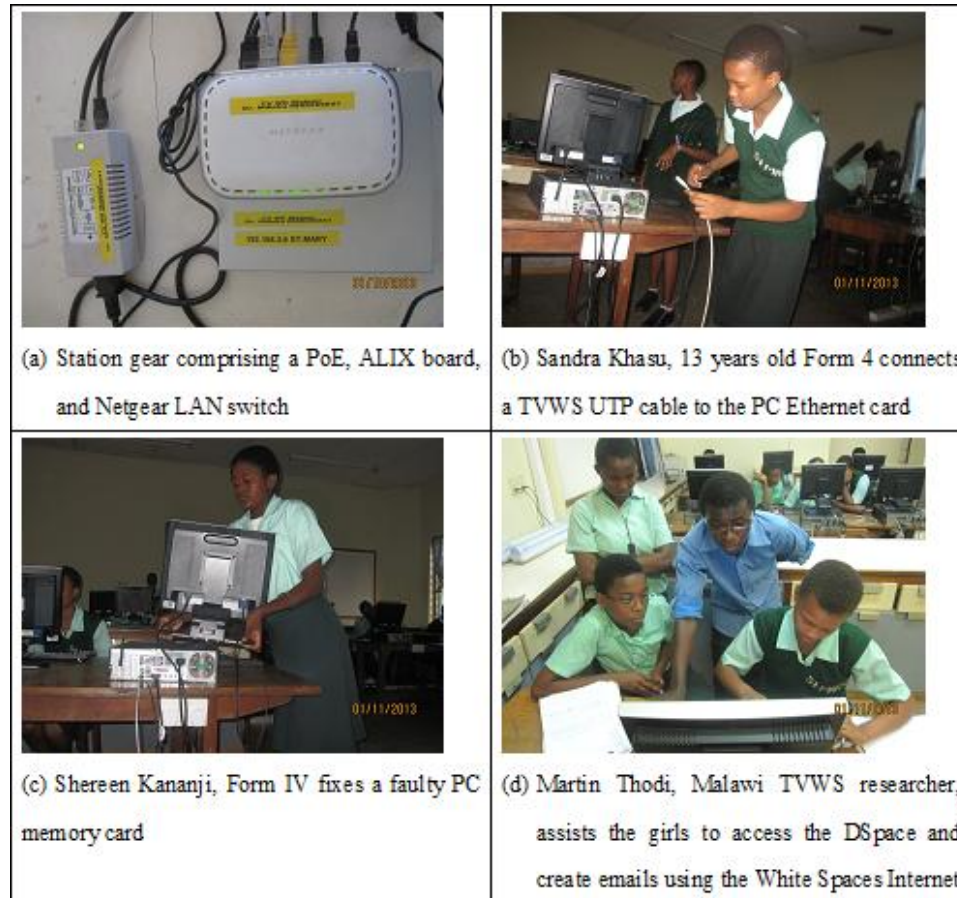
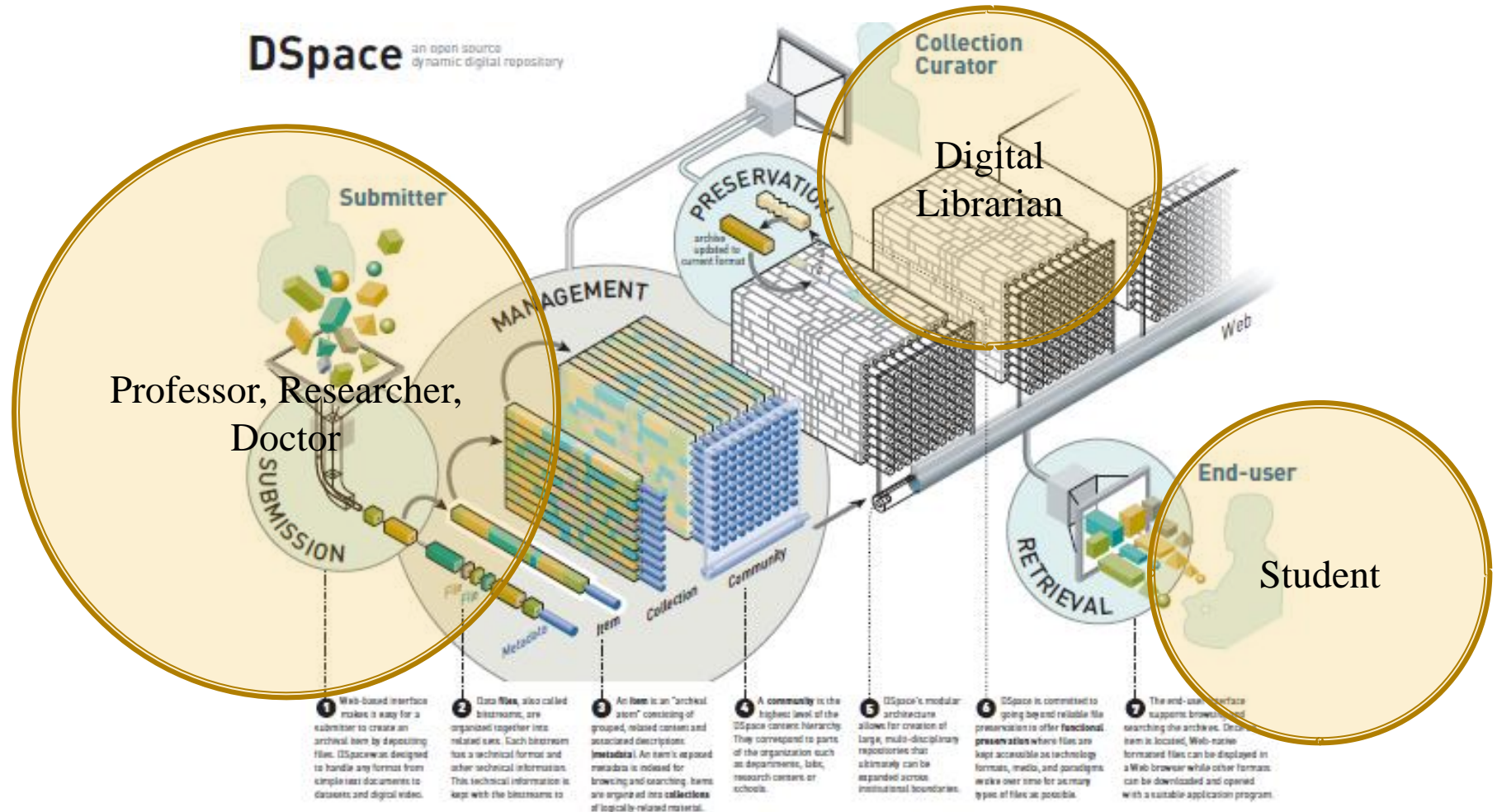


Figure 2: TVWS station at St. Mary's Girls Secondary School deployed in the computer laboratory

DSpace Architecture: St-Mary's Sec., School Linked to University and National Library Digital Repositories Using the TVWS Infrastructure



<http://dspace.cc.ac.mw:8080/jspui/>

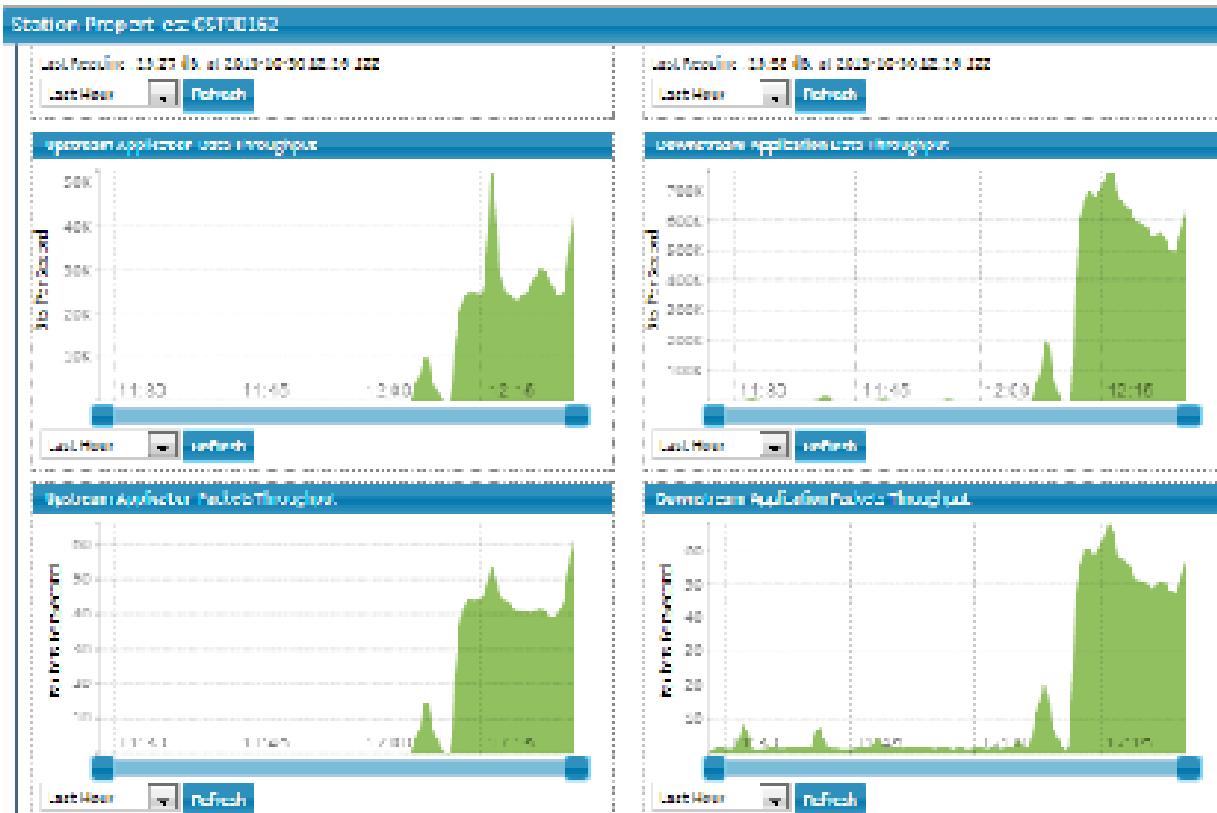
Visual Explanation by **Dynamic Diagrams**

Coming Up Next

TVWS Network Performance: *OMC and Python*

Measured Performance from OMC

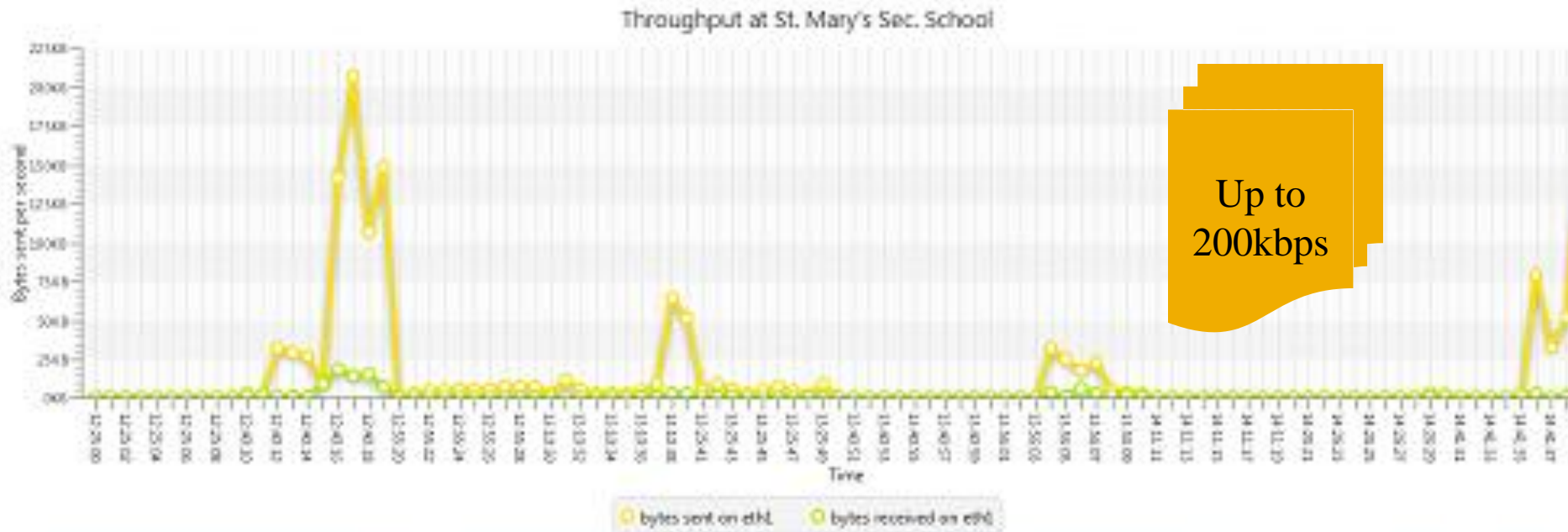
Up to
700kbps



(a) Using the Operation and Management Centre (OMC) for Neul and now migrated to Carlson

Figure 3: Performance metrics (SNR, Throughput and Packet Rate) using python and OMC

Measured Performance by Python



(a) Using python net-monitoring (netmon) script (netmon.py) running at the station ALIX board

Coming Up Next

User Benefits: Beneficiary Comments (Form IV Students)

User Benefits

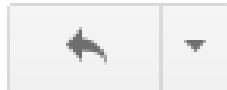


Chomora Mikeka Wow, glad to read your email Sandra. F  Nov 2 (2 days ago) 



elizabeth kananji

Nov 2 (2 days ago) 



to me 

we enjoy very very much and i have all the hope that it will be helpful to our school because as for me i am already seeing the change in my studies.

i actually have a question like can a computer use more than one mouse?

On 10/31/13, Chomora Mikeka <_____@gmail.com> wrote:

- > Dear Sandra and Elizabeth,
- >
- > How do you enjoy our TV White Spaces Internet connectivity at your School?
- > You think, it can improve your studies?
- >
- > --
- > *Chomora MIKEKA, PhD
- > **Post:* Lecturer in Physics & Electronics, Founder and Coordinator for
- > eCRG

Seven Economic Benefits of TVWS

- Reduced cost on BS equipment cf. FBWA and mobile broadband solutions (3G, LTE)
- Option for license exempt or cheaper license than FBWA and mobile broadband or licensed wireless spectrum in general
- If internet bandwidth provisioning could be possible directly from sub-marine cables e.g. (SEACOM and EASSy) then user tariffs would be much lower:-current transiting costs are obscenely high and prohibitive
- Robust and reliable propagation and steady data rates at UHF band than in higher microwave and millimeter-wave bands
- Prospect of building our own WSD (radios) and accessories (antennas) will reduce the hardware cost. We now seek partners and sponsors.
- Traffic offloading solutions from Cellular networks.
- **What else?**

Conclusion

- A typical application has been demonstrated **i.e. White Spaces for Dspace.**
- Future efforts will expand on this and we call for partners.
- Other apps in health, security and navigation will be explored.

Publications on Malawi TVWS Pilot

- **TV White Spaces, I presume?**

M.Zennaro, E.Pietrosemoli, A.Arcia-Moret, C.Mikeka, J.Pinifolo, C.Wang, S.Song
TV White Spaces, I presume?, in proceedings of the Sixth International Conference on
Information and Communication Technologies and Development (ICTD2013)

- **An Assessment Study on White Spaces in Malawi Using Affordable Tools**

M.Zennaro, E.Pietrosemoli, JSP Mlatho, M.Thodi, C.Mikeka An Assessment Study on White
Spaces in Malawi Using Affordable Tools, in proceedings of the IEEE Global Humanitarian
Technology Conference 2013 (**Award Paper**)

- **Piloting White Spaces for DSpaces in Malawi, Ubuntu-Connect (UC2013)**

- **[TH2-SE02-09] Low Cost Data Communications for Sustainable and Environment Sound Development**

Session Leader: Prof. Ermanno Pietrosemoli, Abdus Salam International Centre for Theoretical Physics, Italy & Fundación "EsLaRed", Venezuela / Co-Session Leader: Dr. Chomora Mikeka, Chancellor College, University of Malawi

What are the most cost effective and environment friendly technologies to provide data services in underserved areas?

Data communications is intensively used for environmental data gathering, disaster prevention and mitigation, health provisioning, education and training as well as productivity enhancement.

Scientific Committee

UNESCO Chair in Technologies for Development: What is Essential? 4-6 June 2014 | EPFL, Lausanne, Switzerland Core Area: ICT for Development