Piloting the use of TV White Space for Community Networks in Rural Tanzania

Mr. Jabhera Matogoro
Assistant Lecturer
College of Informatics and Virtual Education
The University of Dodoma
jaberamatogoro@udom.ac.tz
About University of Dodoma

Source: www.udom.ac.tz
A story from one of the Headmistress in Kondoa

- I have to travel at least twice a month to Kondoa town located 40 km from here just to access an Internet in order to undertake administrative responsibilities including uploading and downloading school financial reports. The bus from Pahi to Kondoa town start its journey around 0600 AM early in the morning and would be back around 0100 PM afternoon. This is costing me money, time and a number of risks associated with travelling. Generally, I spend at minimum 7 hours in a trip…I wish I would have Internet access in my school or just in village office where office work would have be completed with just a single click of button and spend more time delivering teaching and learning activities to my student. If Internet is available in my school, student and teacher would have access to online library and address student to book ration. Teachers would be connected with their peers around the globe…
Background Information on Internet Access in Tanzania

• According to Tanzania Communications Regulatory Authority (TCRA) statistics, there are 40 Million voice telephone subscriptions as of December, 2017 and only 23 Million Internet users in Tanzania (TCRA, 2017).

• It is further reported that the Internet penetration trend in Tanzania is only 45%.

• Furthermore, a study that was carried out by Research for ICT Africa (RIA) reported that 86% of rural dwellers in Tanzania remain unconnected to the Internet compared to 44.6% in urban areas (RIA, 2017).

• When comparing Internet access in term of gender then fewer women than men have access and use of Internet in Tanzania (RIA, 2017).
Why Broadband Matters?

• Broadband Internet is Key:
  – For ICT based economic development.
  – Bridge the rural and urban divide.
  – Access to modern services including education, health, jobs, agriculture, etc
  – Work from anywhere
  – Home entertainment and connectivity

• A study by World Bank concluded that a 10 percentage point increase in fixed broadband penetration would increase GDP growth by 1.21% in developed economies and 1.38% in developing ones.
Some Initiatives to Address Broadband Communication in Tanzania

Source: nictbb.co.tz

Source: http://www.ucsaf.go.tz/

Source: https://www.tcra.go.tz

Source: Google

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Wired vs Wireless

• It is always a debate whether wired broadband solution is better when compared to wireless solution.

• To participate in such debate, a number of parameters need to be considered such as budget, mobility requirement, maintenance and installation cost, terrain profile, etc.

• In most cases, studies have reported that wireless broadband solution is affordable and recommended alternative for developing countries.

• However, when both options are used to supplement each other is always a better option, taking strength and weakness of each technology.
What is TV White Space?

- Licensed but unutilized television (TV) band spectrum is called as TV white space in the literature.

- TV white spaces are the unused portions of spectrum allocated for TV broadcasting in continuous or discontinuous manner or in geographical setting, also referred to as interleaved spectrum (ITU, 2012).
EXPERIENCED GAINED FROM
KONDOA COMMUNITY NETWORK
What has been done to date!

TCI Spectrum Monitoring Systems from TCRA

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Results and Major Observation from the Quantitative Assessment of TV White Space in Tanzania

• Two approaches were used; pollution and protection viewpoints and experimental spectrum measurements based on energy detection principle.
  – More than 120 MHz is available as white space in various locations in Tanzania when pollution and protection viewpoint was used
  – About 184 MHz are available as white space in Dodoma urban using experimental spectrum measurements and
  – Almost 100% of the available frequencies are not used in Dodoma rural.

• Both approaches revealed that there is low spectrum utilization in both urban and rural areas.

• Therefore presents a best case towards development of dynamic spectrum access technologies in Tanzania.

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What has been done to date!
Design and Implementation of a National Geo-location Database (N-GLSDB) for Television White Space in Developing Countries

• The University of Dodoma has developed a geo-location database to allocate free channels to white space devices.

• The developed database is currently hosted at National Internet Data Center (NIDC) in Dar es Salaam.

• A geospatial database tracks the available spectrum and make this information available to devices.

• This approach shifts the complexity of spectrum-policy conformance out of the device and into the database.

• This approach also simplifies adoption of policy changes, limiting updates to a handful of databases, rather than numerous devices.
Piloting the use of TV White Space for Community Networks in Rural Tanzania

• The overarching objectives of this paper is three-fold;
• Firstly, is to guide a range of stakeholders so as to increase the use of the currently underutilized TV UHF spectrum band;
• Secondly, to attract more Research and Development (R&D) investments on both dynamic spectrum access using TVWS and Community Networks
• Thirdly, necessitate the discussion to establish a sound technical and legal framework to embrace both dynamic spectrum access paradigm and Community Network towards affordable broadband communication.
Community Network

• Community Network is a bottom-up approach and feasible alternative to connect the unconnected.
• It is an approach to empower the community in addressing their own local challenges related to connectivity.
• Community members are empowered to own the network are responsible in deciding the pricing of Internet access and hence create business viability in rural area.
• In most case, commercial Internet Service Providers and mobile operators are reluctant to invest in rural area due to the fact that return on investment is not realized in short time of period in these areas.

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Network Architecture for KCN

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Gen3 RuralConnect Base Station
Broadband solutions to serve non-line-of-sight customers

• Great NLOS throughput & low latency for video streaming/gaming & VoIP
• Much lower CAPEX than 900 MHz or Fixed LTE networks
• Large & ubiquitous NLOS coverage areas
• Unlicensed & uncongested spectrum in rural markets
• Single base station serves hundreds of subscribers
  – Aggregate throughput of 96 Mbps per base station
  – 32 Mbps combined DL/UL per subscriber
  – Very low latency (25 to 35 ms round trip) for video streaming, VoIP, and gaming
  – Delivers sustained rate of 10/1 Mbps for up to 30 subscribers
  – Optional second radio module per CPE doubles the subscriber’s throughput
  – OTA data rate of 24.0 Mbps using 64 QAM 5/6
  – OTA data rate of 14.4 Mbps using 16 QAM 3/4

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Link Planning at Kondoa Community Network

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Link Profile to Ula Secondary

Profiles Between halotel_tower and ula_secondary_9 (291.32° magnetic azimuth) at 474 MHz for K=1.333

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Link to Kondoja Girls High School

Profiles between halotel_tower and kondoja_girls_school_6 (309.04° magnetic azimuth) at 490 MHz for K=1.333

- Apparent terrain profile
- End to end straight line
- Apparent earth's bulge
- 60% of First Fresnel Zone

Height in meters referenced to Radio Line of Sight between halotel_tower and kondoja_girls_school_6

From halotel_tower to kondoja_girls_school_6: 4.06 km

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Internet Speed: One time results

Bustani Teacher’s College

Ula Secondary School

Kondoa Girls High School

Study Zone Computer Centre

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Challenges Facing Rural Broadband

- Lack of affordable backhauling solution
- High broadband cost
- High co-location fees
- Lack of stable power solution
- High rate of illiterate rate in rural Tanzania
- Lack of local content in rural Tanzania context
- Lack of policy favoring the use of TV White Space for rural broadband
- Lack of policy favoring the community network for rural broadband
Sustainability

- Engage SME and Business Partners operating in Kondoa to pay for connectivity.
- Host educational institution will be engaged to take the project forward after project funding expires.
- A discussion to Universal Communications Service Access Fund to take forward the project.
- A community around each host educational institution will be engaged to take forward the project.
- More partners will be attracted to the project.
- Encourage Individuals using community network especially after class hours to pay a token fee for Internet usage.
- Leverage to Ujamaa concept (Socialism) where a certain group and/or individual community members can pay for the service to benefits other community members who are not able to pay for communication service.

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Project Members in Group Photo with Kondoa Girls High School Students
Technical Team Installing TVWS Antenna at Bustani Teacher’s College
When I noted that all target Schools were connected!
This project was made possible in part through a donation from the Internet Society and the University of Dodoma.
Asanteni Sana