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This edition of GISWatch came into being alongside a brand new baby boy. Welcome to the world, Ronan Diga!

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The University of Dodoma, College of Informatics and Virtual Education; Internet Society

Jabhera Matogoro in conversation with Jane Coffin and Colin Muller

<https://www.udom.ac.tz>; <https://www.isoc.org>

Introduction

The Kondoa Community Network (KCN) is the first community network to pilot the use of television white space (TVWS) in a rural area to address the issue of the internet gap in Tanzania. Jane Coffin and Colin Muller from the Internet Society spoke to Jabhera Matogoro, assistant lecturer at the College of Informatics and Virtual Education of the University of Dodoma, who set up the network. The overarching objectives of this project are two-fold: firstly, to pilot the use of TVWS as an alternative solution to deliver wireless broadband in rural Tanzania; and secondly, to encourage a bottom-up approach to connect the unconnected in Tanzania through the community network model.

Colin: Could you tell us how long the Kondoa Community Network (KCN) has been operating and how long it has been an idea of yours and everyone else working on it?

Matogoro: Actually we started working on TV white space (TVWS) concepts in 2014, and then in 2017 we undertook experimental spectrum measurement to understand how the ultra high frequency (UHF) spectrum band is being utilised in Tanzania, especially after analogue to digital migration. In early 2018, a team of two members from the University of Dodoma visited Kondoa District to engage the community in setting up a community network to connect the unconnected in the district. The team conducted a sensitisation and awareness workshop with community members around Kondoa so that they could own the project and later be able to sustain it in the future. So, in short, studies on TVWS started in 2014 but the official operation of KCN started in May 2018. The official operation in this context means when internet access was made available to KCN. In a measurement study¹ that we

conducted it was found that there is a huge potential for using the UHF spectrum band, especially in rural areas where no transmission is currently available. The installed wireless link achieved an internet speed of 4.53 Mbps and 4.83 Mbps for download and upload respectively.

Colin: So it started as an idea in 2014, and then did you give it a name and formalise it later on? Could you say when you applied for the two-year authorisation letter² for experimentation?

Matogoro: Yes, it started as an idea in 2014 when I was working on my PhD research and was later formalised in 2017. It was soon after that that we applied for authorisation. The name was given in our first stakeholder meeting for KCN that was held on 5 March 2018 at Golden Apple Hotel in Kondoa.

Colin: What areas did you survey before you decided on Kondoa, and how far is this area from the closest large city?

Matogoro: Kondoa District is located around 140 km from Dodoma City; it is almost a two-hour car drive from Dodoma to Kondoa. Before selecting an area to host this project, a physical visit was made to three districts in Dodoma, namely, Bahi District, Chamwino District and Kondoa District. During the physical visit, it was found that Bahi and Chamwino Districts had better road and communication infrastructure compared to Kondoa District. The better infrastructure was partly because they are both located near Dodoma City, around 60 km and 20 km for Bahi and Chamwino respectively, but Kondoa District was very much isolated due to poor road infrastructure, which makes it unattractive for many businesses and hence led to a digital divide. It should be noted that more than three years ago, one would spend four to six hours in the car to drive from Dodoma City to Kondoa District.

Colin: Could you give a physical description of Kondoa District? Is it mountainous? Is it flat? And how many people live there?

Matogoro: It is a mountainous area and has around 269,704 people – 136,518 are male and

¹ Matogoro, J., Mvungi, N. H., Justinian, A., Karandikar, A., & Singh, J. (2018). *Towards Affordable Broadband Communication: A Quantitative Assessment of TV White Space in Tanzania*. <https://www.springerprofessional.de/en/towards-affordable-broadband-communication-a-quantitative-assess/15909208>

² An authorisation letter was required because the UHF spectrum band is licensed spectrum and therefore, for the university to transmit in this spectrum, we needed to have permission from the Tanzania Communications Regulatory Authority.



Kondoza Girls High School teachers, students and project team members.

133,186 are female.³ KCN will connect three educational institutions to the internet. The first school was connected in May 2018. The school is a girls-only secondary school with around 810 students and 46 staff. Teachers and students are now connected to high-speed wireless internet delivered using TVWS technology. Kondoza Girls High School is located 4.6 km from the base station which has a backhaul connection. Teachers are very comfortable and are able to access materials online, undertake school management online tasks, and can access results online.

Colin: You have suggested some reasons – such as Kondoza’s isolation – but can you say more about why you wanted to start the community network initiative?

Matogoro: A big motivation was proving that TVWS could work. We started the community network initiative because we believe it is among the feasible solutions to connect the unconnected. KCN is piloting the use of TVWS for community networks in rural Tanzania and addressing the current internet gap. A number of initiatives have been undertaken by various stakeholders in Tanzania to connect the unconnected using the traditional approaches. However, only 23 million users⁴ have access to the internet and half of Tanzania’s population remains unconnected. We believe that a community network initiative and the use of unused UHF spectrum will

be a feasible solution to address internet connectivity issues in Tanzania.

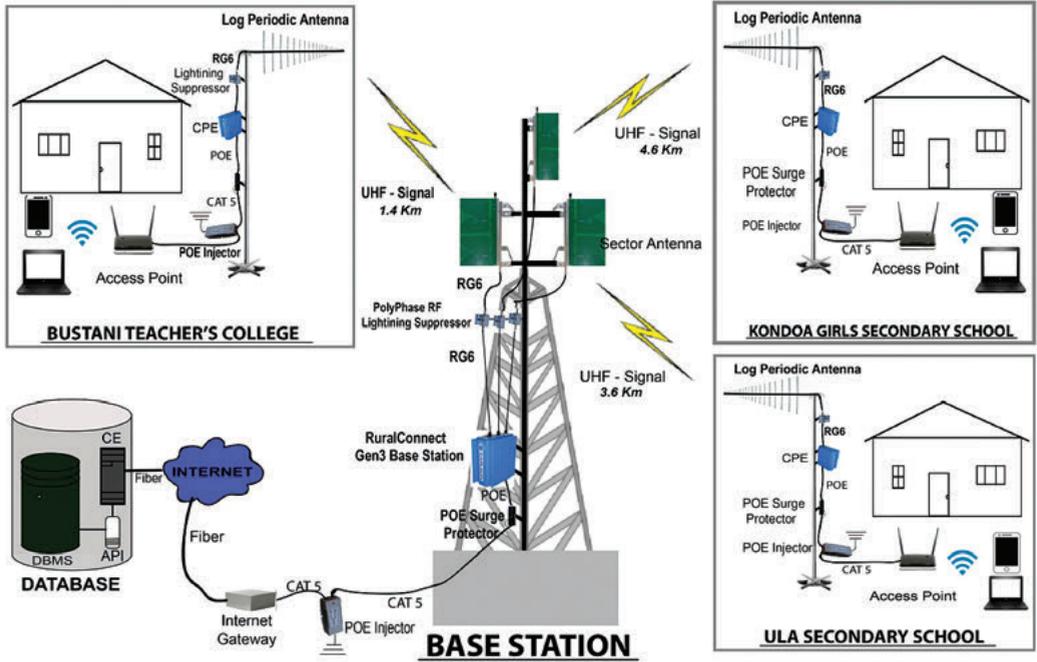
Colin: Where did you get the idea of using the community network model? Did you maybe learn from other people also using the community network model or get advice from someone? Or did it just seem intuitively like the right way to go about connecting?

Matogoro: I came across the idea when I was working on a paper that was reviewing different approaches to connect the unconnected. It is from conducting a literature review that I found that a community network initiative could also be used as an alternative to connect the unconnected. In that direction we also tried to find out a feasible technology to connect the unconnected in rural Tanzania. We initially thought about using fibre, but it is very expensive and may not be feasible in places like Kondoza which is a mountainous area; hence laying fibre can be difficult and will be more expensive. Then we thought of Wi-Fi but we found that Wi-Fi can hardly cover an area of around 200 metres. In rural, mountainous areas like Kondoza, Wi-Fi could not be a feasible solution because you might need a lot of access points to cover a larger cell size. But with TVWS technology in the UHF spectrum band, you can penetrate mountains, trees and buildings with a good antenna gain. It is also a feasible solution in a rural area because no one is transmitting in this band. So that was the idea behind it, and we are very excited that our community network has managed to use TVWS to connect the unconnected in rural Tanzania.

³ United Republic of Tanzania. (2013). 2012 Population and Housing Census.

⁴ https://tcra.go.tz/images/documents/telecommunication/TelCom_Statistics_March_2018.pdf

FIGURE 1.



The network has four main parts: the transmitter (base station); the receiver (CPE installed at school); the geo-location spectrum database (hosted at the National Internet Data Center in Dar es Salaam); and the communication channel (UHF signal) and 2.4 GHz for end-users to access the internet using their laptop and/or smartphone.

Colin: Did you encounter any challenges in using TVWS?

Matogoro: In piloting the use of TVWS for the community network, KCN connected three educational institutions, namely Kondoa Girls High School – which I mentioned earlier – Ula Secondary School and Bustani Teachers College, which are located 4.6, 3.6 and 1.4 km from the transmitter. In the literature it is reported that UHF spectrum has good propagation characteristics to penetrate walls and trees, but in reality for that to happen one needs to have an antenna with good antenna gain. A 4 dBi antenna gain failed to establish a connection to Bustani Teachers College, which is just about 1.4 km from the transmitter. This failure is partly because between Bustani Teachers College and the transmitter there is a heavy forest which is also the source of water for Kondoa District. The team is working to replace this antenna with an 8 dBi antenna gain. So we can see that sometimes if there is a heavy forest, one may face challenges in establishing the link between the transmitter and receiver. However, TVWS remains a feasible and affordable technology in rural areas similar to Kondoa.

Jane: Is it a TVWS solution with a mesh network?

Matogoro: Yes, it is TVWS with a mesh network.

Colin: It definitely seems like TVWS is the good technology to use in the terrain you've described. Could you talk about the people that were initially involved in starting the community network, and maybe the motivations that brought you and others together to start the network?

Matogoro: The University of Dodoma⁵ is leading the project from the technology side – but actually it is a project with a number of expert international team members. The project has the following team members: Jabhera Matogoro from the Department of Computer Science; Prof. Justinian Anatory from the Department of Telecommunication Engineering and Dean of the School of Informatics; Prof. Nerey Mvungi from the Department of Electrical Engineering at the University of Dar es Salaam;⁶ Prof. Ermanno Pietrosemoli, a senior project researcher from the International Centre for Theoretical Physics

5 <https://www.udom.ac.tz/home>

6 <https://www.udsm.ac.tz>



Technical team members from KCN install equipment at Bustani Teachers College in Kondoa.

(ICTP)⁷ in Italy; Dr. Marco Zennaro, also a senior project researcher from ICTP; Abibu Ntahigiye, the chief executive officer of the Tanzania Network Information Centre (tzNIC)⁸ and ISOC Tanzania Chapter chairman; Nazarius Kirama, ISOC Tanzania Chapter secretary; and Rebecca Ryakitimbo from TechChix and an ISOC Tanzania Chapter member. Community members are represented in this project by the steering committee, which represents various stakeholders in Kondoa. I have worked with Prof. Anatory and Prof. Mvungi as research advisor at the University of Dodoma; I met Prof. Ermanno and Dr. Marco in a wireless tutorial class in Lusaka, Zambia during an African Network Operators Group (AfNOG)⁹ workshop in 2013; I have also worked with Abibu, Nazar and Rebecca when I served as ISOC Tanzania Chapter secretary from 2015 to 2017. It is a team of dedicated people who are happy to lead the project.

Colin: Could you say more about what efforts you are making to discuss the community network

and get involvement from community members, and maybe community members that don't have the same level of expertise as the researchers you are working with?

Matogoro: Yes, it is true that community members may not have same level of expertise, but we have found that most community members even in rural areas know what they expect from the internet. We have also found that in communities there are people who are naturally interested in some of these technical issues, and they are well known by most community members because of their involvement in undertaking similar technical activities. For instance, in Kondoa, we found that there are a number of youth who are able to install DSTV antennas. This made it easy to receive recommendations from community members forming the steering committee on who could help us. We managed to engage these youth in installing TVWS antennas. In short, we are trying to learn from community members in Kondoa and identify the local skills available and we build on this to train them on relevant skills to support the installed network. We have also found that the best approach to achieve technical

7 <https://www.ictp.it>

8 <https://www.tznic.or.tz>

9 <https://www.afnog.org>

sustainability in these communities is to adopt a learning-by-doing approach. This becomes interesting to them and they are happy to take the initiative forward.

Colin: Could you discuss the structure of the steering committee, who is on it, and how decisions are made?

Matogoro: The steering committee has members representing government, religious leaders, political leaders, educational institutions, youth and women around Kondoa District. The decisions are based on consensus among the steering committee members.

Colin: How do you think the approach to building this network differs from when a private company decides to deploy some kind of telecommunication infrastructure in a region?

Matogoro: The only difference and uniqueness of this approach is that this is a kind of bottom-up approach. You know, for the private company, deploying a network, in most cases, it's top down. They set the price and then people pay for it. But for the community network, the members of the community network have the power to set the price.

Jane: What advice would you give to someone who would like to start up a project like this?

Matogoro: One piece of advice is that the community network is the best approach. And having TVWS as the technology for the middle and last mile makes it a more feasible alternative to connect the unconnected, especially in hard-to-reach environments and rural areas with mountainous terrain similar to Kondoa. I know that there is still a challenge on the technical know-how, but let us work together to make sure that more communities are

impacted and contribute to the digital economy. I am aware that most countries – especially developing countries – do not have policies supporting the operation of both community networks and TVWS, but that should not be an obstacle in exploring the benefit from these approaches. However, policy makers and government should create a favourable environment for community members to explore the potentials of these technologies. We need to have policies and regulations that favour this kind of technology and to develop capacities among community members. Generally, recommendations for the technologies to be used might be diverse depending on the community, but for the person who is working in a community like Kondoa, the community network is the best approach. But it is very important to make sure that the community members own the project.

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¹⁰ <https://www.csir.co.za>

¹¹ www.uhuruone.co.tz

Community Networks

THE 43 COUNTRY REPORTS included in this year's Global Information Society Watch (GISWatch) capture the different experiences and approaches in setting up community networks across the globe. They show that key ideas, such as participatory governance systems, community ownership and skills transfer, as well as the "do-it-yourself" spirit that drives community networks in many different contexts, are characteristics that lend them a shared purpose and approach.

The country reports are framed by eight thematic reports that deal with critical issues such as the regulatory framework necessary to support community networks, sustainability, local content, feminist infrastructure and community networks, and the importance of being aware of "community stories" and the power structures embedded in those stories.

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2018 Report

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