

Building an argument for Internet expansion in Dwesa-an under-serviced rural community in South Africa

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Abstract.

The purpose of this paper is to present research findings that investigate the extent of Internet usage as well as options for extending the current reach of the wireless network in Dwesa, a rural area in South Africa's Eastern Cape Province. A mix of methodologies, encompassing ethnographic and quantitative approaches, is used to study the need to expand connectivity in Dwesa and the social impact of providing Internet connection to this rural area. Our findings confirm the need to connect more areas of the Dwesa community - particularly active ICT champions and households of some stakeholders who are willing to use their homes as a central hub for other community members. We also suggest the option of running parallel network links to connect two broadband islands that exist in SLL in order to provide improved redundancy in the network, should one of the satellite links fail. The network will be expanded using wireless mesh technology. In addition, we also propose to make use of TV white space technology – wireless communication making use of unused portions of the TV spectrum – for one of the parallel links connecting the broadband islands.

Keywords: Eastern Cape, Dwesa, Internet, rural communities, television white spaces, Siyakhula Living Lab, South Africa

1. Introduction

Lack of sufficient fixed-line telecommunication infrastructure in rural areas, especially in developing regions such as Africa, makes wireless connectivity the only effective and affordable solution for broadband access. In the past decade, mobile penetration in Africa has been growing with an average rate of 6% per year compared to 3.7 % in developed regions. In contrast, fixed-broadband penetration has been growing at less than 1% in Africa compared to 27.2% in developed regions between 2008 and 2013 [1]. Despite the growing number of global mobile subscribers - reported to be at around 7 billion users [2] - the number of rural users with access to broadband Internet remain low; in 2013 16% of the population in Africa had broadband access compared to over 75% in Europe and 61% in the Americas [1].

Providing broadband access or Information and Communication Technology (ICT) infrastructure to deeply marginalized rural communities remain a challenge to most governments in developing regions [3]. This is due to a complex mix of lack of technical skills (know-how), low economic activity, poor education level and a cultural disconnect with Western thinking embedded within technology and business models for Internet service provision [4]. Access to computers and Internet access in education can have a profound positive effect on the quality of education provided for a learner when coupled with sufficient computer literacy training for teachers and learners. With the current low Internet penetration rate in rural areas of South Africa and Africa, rural schools lack the ability to provide communities with access to the same quality of education experienced by their urban counterparts [5]. The Dwesa community and the Siyakhula Living Lab (SLL), studied in this paper is one successful case study of incorporating Internet access, computer labs and ICT skills development for educators and the wider community of Dwesa to improve the quality of their education and increase the level of economic activity in the area.

Purpose of the research

The purpose of this research study was to investigate expansion of the SLL community network to other community centres (schools and clinics) and households, using alternative solutions such as the television white space (TVWS) and Wi-Fi mesh technology. The study also investigated the effects of providing Internet access to rural communities like Dwesa.

Research Methodology

A mix method approach was used in this research incorporating an ethnographic style of research, qualitative research and technical analysis. This combination of these complementary research methods resulted in a more holistic multi-disciplinary analysis of the community.

Incorporating the ethnographic style

The research team spent a week in Dwesa communicating with various stakeholders in the SLL project and the fact that we stayed in the community, we were in a better chance to understand the daily experiences of the people living in this community. Staying in the community enabled us to glance to some socio-economic factors shaping the lives of the Dwesa citizens and this was also helpful for analysis.

Qualitative approach

During the research we conducted a series of interviews with various stakeholders including principals and teachers from schools, community health care workers, students attending the computer training course, and executive committee members.

Paper Outline

The remainder of this paper is arranged as follows. Section 2 briefly presents introduction of the Siyakhula Living Lab (SLL), Section 3 present our findings from the interviews conducted with selected community members in Dwesa community. Section 4 presents a proposed SLL community network expansion and potential benefits to the community. Section 5 analyses the societal dynamics of rural wireless networks. Section 6 concludes the paper.

2. The Siyakhula Living Lab Community Network

Siyakhula Living Lab (SLL) project is an initiation by people from the University of Fort Hare (UFH) and Rhodes University (RU) which are both situated in the Eastern cape province and both these are steering the project and are engaging with multiple governmental and industrial stakeholders in order to provide sustainable Internet access by involving the local community in the process as much as possible [6]. The notion of community engage aims at involving the community members so that the knowledge and technical knowhow of the project can be passed to the community as they will be driving the process in a long run [7]. The universities have been conducting the project in cooperation with local chiefs and communities from the beginning to instil the notion of taking ownership of the project.

The approach used in this project puts the community as the central point of project direction as the main beneficiaries of the project. For example, the committee composed of active community members have common meetings where they decide who is going to be in charge for a certain part of the maintenance, and when and where should the training take place.

The SLL project is run in the Dwesa region of Mbashe municipality close to the Wild Coast Dwesa-Cwebe Nature reserve and this project is run with full participation of the community and the beneficiaries are the people within the jurisdictions of the Mbashe municipality. Most of the community members own mobile (smart) phones, and only few of the community members own laptops (especially the working class such as teachers and principals). The people of Dwesa subsist on government grants, some crops they grow, livestock and seafood when they can access it [6].

The SLL project is organized along the lines of the emerging Research Development and Innovation processes (RDI) Living Lab methodology of which the underlying principle is co-creation of solutions with empowered users. It demonstrates in a practical manner how marginalized rural communities that are difficult to access can be joined with the greater South African, African and global communities for the economic, social and cultural benefit of all (more information about SLL can be accessed from: www.siyakhulall.org).

3. Findings from Dwesa Community Interviews

As already alluded in the introductory section, the research was driven by three main questions, this section is meant to present findings to answer the three research questions.

3.1 Needs Assessment for Network Expansion

The study found out that there is a great need for providing Internet connection in this community and this finding is based on the responses from different stakeholders which including principals and teachers from schools, and some community members engaged including the executive committee members. Our general finding of the need to connect rural community was informed by the perception that of the schools that were already connected on the Internet, there has been extensive use of the Internet. According to the information we got from teachers and principals in the connected schools, students use the Internet for searching for past question papers, getting information for science expo projects and other educational related material. This finding shows that connecting rural schools on the Internet provides the students with the opportunity to get useful educational content on the Internet and ultimately improving the level of education for the rural schools. The advantage of connecting new schools is that it will increase the impact of the SLL project as a whole as more people in the community especially students, will have access to information through the Internet. The disadvantage is that most of the schools at Dwesa do not have computer labs; if these schools are connected it may create an expectation that the SLL project will also buy computers and build computer labs for these schools.

We also found out that connecting schools also needs to be preceded by a vigorous computer literacy and ethical Internet use program and connecting students to the Internet creates additional strain on already limited resources to carry out these programs. The consequences of not running these programs was demonstrated at one school that had an open Wi-Fi access point that was used to download large amounts of music, videos and pornography – reaching the very small aperture terminal (VSAT) of 3 gigabyte cap for the month within the first few days. Although this could be avoided with improved access control – it is better to guide students towards positive use of the Internet rather and teach them to be responsible Internet citizens than have a heavy handed dictatorial approach.

3.2 Connecting other Schools, Clinics and Households

Our finding revealed that in connected schools students were benefiting from the Internet provided, and therefore the students in the schools which are not connected were not benefiting. This therefore means that by expanding the connection to the non-connected schools will also provide the opportunity of ICT benefits to these students and as a result creating a strong ICT platform for improving the quality of education in Dwesa.

Our finding did not only point to the need for connecting schools only, but we also found a big need to connect the clinics and other community members who were willing to use their homes as a central point for community members who want to use the Internet. When we asked the clinic personnel if their scope of work or that of their colleagues requires the use of Internet they all responded by saying there is a very serious need for clinics to

be provided with Internet connection as this will help them with their work in various ways. For example the anonymous nurse at Gwadu clinic mentioned that they deal with statistics and ART treatments, therefore if they can be connected to the Internet and be provided with ICT resources like computers, then their work will be made easier. Another senior nurse at Msendo clinic also mentioned that patients sometimes come with sicknesses which they as nurses do not understand; therefore if they have access to the Internet they can “Google” the symptoms and even get knowledge on possible treatment. These clinic personnel also mentioned that they need to keep reporting the statistics to Department of Health, and since they do not have computers they have to do the work manually and submit the hard copy to the department.

If clinics can be connected there will be lots of efficiency in administrative work and record keeping. For these clinics, using ICT services and getting connected on the Internet may help the community health care workers track the records of patient’s clinic attendance and medication provided to these patients. For example if a patient decides to go to another clinic, the nurse on that particular clinic may refer to the database and see what medication was last given to that particular patient. There is a very serious need to connect the clinics on the Internet.

It also came out in the interviews that in other occasions the community health workers go out door to door in order to inform the community about services. There is also the use of notes which are pasted in public areas to send the message across the community. One of the nurses also mentioned the fact that public gatherings like funerals and weddings are also used to pass messages to the community. If clinics and community members can be connected, the connection may also be used to communicate messages to different parts of the community through emails and other electronic means of passing messages.

When we asked the community health care workers about who else needs to be connected to the Internet in the Dwesa community, one community health worker said there is a need to connect the community members especially metric students.

Our findings also pointed to the need to connect community members and chiefs. However, this may be a task which will cause societal division and questions around how were the selection criteria for determining which community member should be connected. In our understanding of Dwesa as a traditional community led by a chiefs, connecting the chiefs will be the easiest way to get around the questions of how the selection criteria was decided upon. In terms of connecting other community members; only the households of executive committee members will be connected, however the requirement is for the executive committee member to allow his/her house to become a central point for community members who want to access the Internet.

3.3. The social impact of providing internet connection to rural Dwesa

There was no empirical evidence of social impact which was noted during this study, however, since social impact is a gradual process and observed over a period of time; there is anticipated change which is hoped to be seen with the continuous use of the Internet connectivity in Dwesa. For a community like Dwesa specifically, the anticipated social impacts are the building of an ICT information society and helping students develop 21st century skills.

Traditionally, information society is known to be a society where information flow is done through economic, cultural and political activities and these are often regarded as agents of social change. The anticipated social impact for Dwesa community is the use of ICT platform to leverage the social agents of information flow in the community.

For Dwesa, which is characterised by scarcity of resources; 21st century skills are essential for the students in this community. 21st Century skills are regarded as essential competency areas such as collaboration, digital literacy, critical thinking, and problem-solving, skills which are believed to be acquired at school. Having students with 21st century skills is another anticipated social change for the Dwesa community

4. Proposed Network Expansion and Solutions for Dwesa Community

The existing SLL network is built based on the premise that the local communities will be responsible for the safety and use of the equipment, and that the schools would become centres that provide access to computers and the Internet [8]. However, over the past few years (especially after the year 2010) the Dwesa community is being electrified and the majority, if not all, of the members have access to the electricity grid. Furthermore, the Dwesa area has many clinics which serve the community on daily basis. Thanks to the computer literacy training offered to the community by the SLL, most of the community members (teachers, nurses and students) are computer literate and have email addresses. Therefore, the possibility of expanding the SLL network beyond the schools (to the clinics and some community leaders) seems to be realistic.

4.1 Proposed Network Expansion

The proposed network extension solution that has the potential to address the current needs in SLL and the community at large is shown in Figure 1. A redundant link to the existing Wi-Max network is created by connecting Badi and Ngwane School. Firstly, the longest link (about 10 km), between these two schools will be created on the ultra high frequency (UHF) band especially that the WiBack supports experimental communications at 760 to 780 MHz frequency. This UHF is currently being used for television (TV) broadcasting.

There have been several studies which found that the TV band is not adequately used [9] [10] [11] [12], and hence there are initiatives to utilize portions of this unused TV band for providing broadband connectivity in rural areas [13] [14] [15]. These unused TV spectrum band is commonly known as TV white spaces or TVWS. WiBack, which stands for wireless backhaul, is a Fraunhofer Fokus technology used to provide carrier-grade service over a larger areas using low-cost wireless technology [16].

Secondly, another redundant link (to the existing Wi-Max) between Badi and Ngwane will be created on a 5 GHz band via Mevana school's Principal, Nqabara School and then to Ngwane School. This link will allow a performance study on multi-hop links. The choice for 5 GHz band is mainly because it is comparatively cleaner and has lower signal interference when compared to the 2.4 GHz band. In addition to providing home Internet to the Principal (because of his commitment to the SLL project), the principle's home plays an important point as a repeater to link the SLL executive chairperson as well as Gwadu clinic because he is located on a high site.

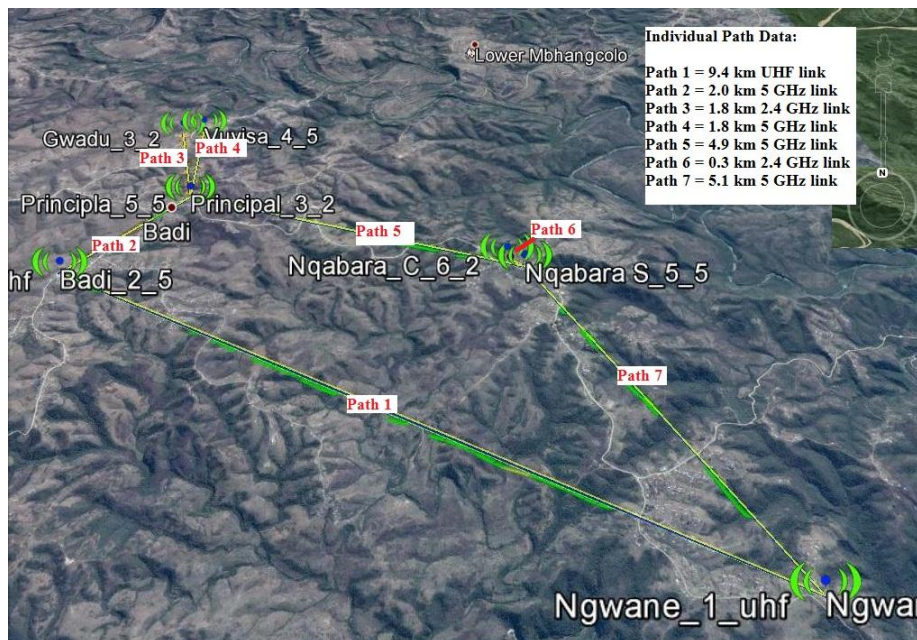


Figure 1: Aerial view of the proposed SLL network expansion

Nqabara School is already connected to the existing network and also has a 2.4 GHz radio installed (in addition to the Wi-Max node). The WiBack link will be used as a redundant link to the nearby Nqabara clinic will also be connected through the 2.4 GHz Wi-Fi. The proposed expansion will not only allow the trialling of WiBack technology, but will also create opportunity for lots of interesting research, for instance we can study the performance of white space over 10km, compare this with the existing WiMax and multi-hop 5GHz. Another possibility from this proposed link is that we can add a routing rule that switches the Badi cluster to Ngwane's VSAT when the 3 Gigabyte cap is reached at Badi VSAT. Furthermore, these three installations (to the schools)

do not come with any requirement from extra computers or local champions within SLL as would be the case if few schools were connected. Link profiles for the proposed WiBack network is provided in the following subsection.

4.2 Local Cloud for Community Data Storage

The study found that the majority of community members use their mobile phones to take photos but often have no way of storing these images on a computer and do not upload them to any central storage service. The community members often end up with a revolving set of best photos on their phones by deleting some photos to make room for new ones. In another interview with a data capturer (Clerk) at Ngwane school, it was found that she uses a laptop to capture the data in the school, but does not have any other means to save the data as a back-up, thus if something happens to her laptop, the entire school dataset will be lost. Providing a local cloud storage service in the community would add a large amount of value to current broadband island concept in SLL. This can be used both to back up content from people's mobile phones and laptops as well as share content freely within the local community. Backup from the local cloud to global cloud service located on the Internet could occur during periods when the network is not being extensively used such as the early hours of the morning.

4.3 Possible Solutions and Benefits for Connecting Clinics

During the interviews it emerged that the community health workers at the clinics have to use their personal cell phones to communicate to the doctor. If these clinics can be connected it would be very easy to communicate to the doctors without having to use airtime from their personal cell phones. One possible solution is to install a VoIP phone that makes use of the existing SLL wireless networks and a dial out service such as Google voice or Skype out to connect to the doctors and hospitals – a set of fixed numbers can be pre-programmed into the VoIP phone to avoid abuse of the service for personal use by clinic staff.

5. Societal Dynamics of Rural Community Networks

Connecting a rural community like Dwesa to the Internet, provides the community members with the advantage of being part of the global connected community and provides different stakeholders with opportunities for technological know-how. But there are dynamics around the unintended consequences that comes with using the Internet and the most important factor is the societal acceptance of the use of technology. Providing Internet connection to rural communities may bring unintended consequences which may shape societal attitude towards the use of technology in these communities.

During our interview with Babalwa Dudumashe known as Babes she mentioned that there were cases in the community where students were demon possessed and when the follow-up was made on the matter it was

realized that these students subscribed to an Internet site where they interact with evil spirits and these spirits possessed their lives. Dwesa is a traditional and spiritual community and the Internet could be associated with negative influences in the community causing a backlash against its expansion. Connecting rural communities into the Internet brings about the need to educate these people about the ethical and responsible way of using the Internet. The consequences of not running these programs was demonstrated at one school that had an open WiFi access point that was used to download large amounts of music, videos and pornography – reaching the VSAT 3GB cap for the month within the first few days. Although this could be avoided with improved access control – it is better to guide students and community members towards positive use of the Internet rather and teach them to be responsible Internet citizens than have a heavy handed dictatorial approach.

In conclusion, it is crucial to connect rural communities on the internet since this is one way of increasing literacy level in a community and providing a platform which has the potentiality to improve the level of education in the rural schools. However, the use of internet can bring unintended consequences like students using the internet for pornography and other unlawful exercises.

6. Conclusion

This paper presents key research findings and possible solutions for expanding SLL community network and services in Dwesa, Eastern Cape Province in South Africa. Connecting schools on the low-cost bandwidth has the potential to provide students in marginalized rural areas with an opportunity to incorporate ICT in their daily learning activities and ultimately improving the level of ICT know-how and the quality of education. However, there is a need to expand the network to community members and other community centres like the clinics. If the clinics are connected this will make the local health system work efficiently as patient information can be made electronically and easily accessible. The use of TVWS technology to expand the SLL network promises to connect more community centres and households despite the geographical setup (such as sparsely populated and mountainous topology) of Dwesa community. Future work includes the actual implementation and testing of TVWS connectivity using the Wi-Back technology.

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