

# Deployment and Extension of a Converged WiMAX/WiFi Network for Dwesa Community Area South Africa

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**Abstract** - As demand for new, reliable, flexible and relatively inexpensive internet access in marginalized rural areas in developing countries increases, there is a need to amalgamate broadband technologies such as WiMAX and WiFi so as to extend the coverage area. Consequently, this will enable provision of high-speed mobile data and telecommunications services. This paper describes how WiMAX and WiFi can be merged together, with VSAT technology offering backhaul internet connectivity to provide ever present broadband access. We also look at their respective network applications and how there are going to be used to help support ICT4D activities in these marginalized areas.

**Index Terms:** ICT for Development, WiFi, WiMAX, VSAT

## I. INTRODUCTION

Providing internet access to the entire country and even to the previously isolated marginalized rural areas is seen as a major boost to the ICT4D activities in every developing country [1, 2]. Establishing and setting up wireless broadband access in these areas would mean a great investment in the e-commerce, e-learning, e-judiciary and other economic activities [1, 3]. As result, almost every government is striving to make this a reality, so as to change their emerging economies [3]. The network to be deployed is part of the Siyakhula Living Lab (SLL) network, which is located in the Dwesa-Cwebe community area and is one of the disadvantaged communities in Eastern Cape. SLL is currently comprised of four schools that are Ngwane, Nqabara, Mpume and Mtokwane. The three schools have WiMAX already deployed except for Nqabara [2].

Deployment of a converged Wireless Fidelity (WiFi)/ Worldwide Interoperability for Microwave Access (WiMAX) network by creating WiFi hotspots around schools and integrating them to the WiMAX backbone, will allow people and organizations to communicate and access services in a geographic-independent fashion e.g. in Dwesa where we have already deployed a VSAT which acts as backhaul to the WiMAX in the provision of the internet to the area [2, 4, 5, 6].

## II. AIM OF THE PROJECT

The main objective of this project is to deploy and extend the converged WiMAX/ WiFi network to other parts of the community by establishing WiFi hotspots around each school since they are the main centres of internet access [6]. WiMAX would be extended to Nqabara School. WiFi and

WiMAX, with VSAT offering backhaul connectivity, have been identified as the most suitable technologies to be deployed in Dwesa since they have proved to be the most cost-effective, sustainable, and easily deployed (in similar or in most rural terrains) [2, 7].

This work would provide the back-haul connectivity for this multi-purpose ICT platform. This will enable the community to participate in the global knowledge economy, subsequently leading to an overall improvement in the quality of life since they will have access to the internet closer or in fact in their homelands [1, 8].

## III. ACCESS TECHNOLOGIES

The desired network will comprise of these three major wireless fixed broadband access technologies. Firstly, we have the Very Small Aperture Terminal (VSAT) which has a very small satellite transmitting and receiving station that will be transferring data, voice and video via the satellite [7]. It will be the backhaul to the internet connectivity. Secondly, we have the WiMAX which enables the delivery of the last mile wireless broadband and at the same time provides backhaul connectivity to the WiFi access points [4, 5]. It is the backbone to the internet and provides up to 3Mbit/s broadband speed without the need for cables. Lastly, we discuss WiFi which connects to the internet at speeds up to 54Mbps [4]. WiFi enabled devices uses radio technologies based on the IEEE 802.11 to communicate data anywhere within the range of an access point and also operating in the unlicensed spectrum [6].

## IV. NETWORK ARCHITECTURE

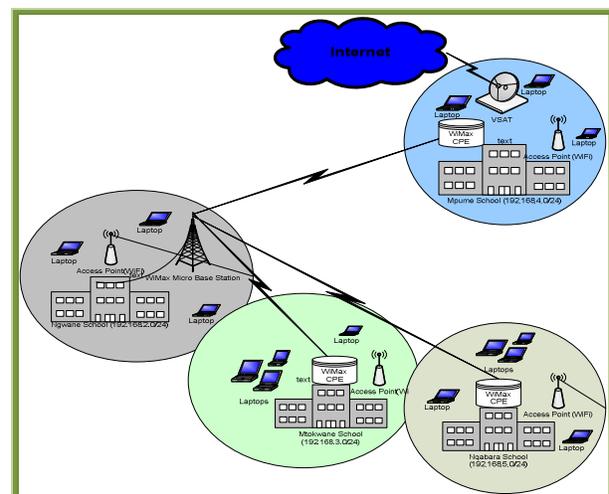


Figure 1: Proposed network design.

Figure 1 above depicts the layout of the network. Initially, we will start by extending the existing network by setting up WiMAX customer premise equipment (CPE) at Nqabara. Afterwards, we will create WiFi hotspots by deploying access points around each and every school to cover the air space at the edges of the network, but manage them centrally at controllers. These WiFi hotspots created will provide high speed wireless access services for users within the coverage area [4]. As a result we intend to make it possible that users in nearby schools like Ngwane and Mtokwane can enjoy supplementary services like seamless switchover and load balance [6, 8]. Consequently, there is no need to go back checking each and every access point after they have been all installed. These access points will provide high speed wireless access services for authenticated users within its coverage [4].

To avoid obstructions, in form of obstacles and signal interference, we are going to deploy repeaters around each access point [4]. Repeaters will amplify the signal so that the wireless coverage is extended and at the same time enhance signal quality [6]. These repeaters will promote flexibility in the network by allowing users who are further away from the access point to be connected to the WLAN [8]. They serve as a two-way relay station for WiFi signals [4, 6]. They do this by picking up and reflecting signals from the access point. The network performance of devices connected through a repeater will generally be lower than if they were connected directly to the primary base station. Figure 2 below shows how the repeaters will be incorporated into our converged wireless network.

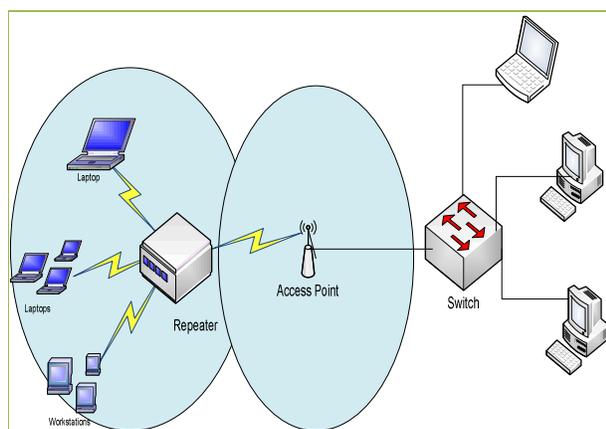


Figure 2: Repeater amplifying signals in the network.

## V. WORKDONE AND FUTURE WORK

WiMAX CPEs have already been deployed in Mpume and Mtokwane. We put the WiMAX base station in Ngwane, which supports Point to Multiple Point (PTMP) and a Non Line of Sight (NLOS) connection to other CPEs already deployed in other schools. We used BreezeMAX 3500 system from Alvarion for our network [5]. We have again deployed a VSAT at Mpume which offers backhaul internet connectivity [2, 7]. This network deployment has led to the number of projects being initiated, as well as the provision of Internet connectivity to a multi-purpose ICT platform. This platform is being used to build e-commerce applications that can eventually empower people.

For the future, we intend to monitor the traffic routed to all access points and at the same time evaluate the effectiveness and robustness of this extended converged WiMAX/WiFi network. The network would be monitored remotely and alerts used, in form of emails that will be sent to the administrators to notify them of any network failure occurrence.

## VI. CONCLUSIONS

Marginalized rural areas present a risky market for ICT projects. Their demand from the people living in rural areas is low as it is characterized by low levels of literacy. The success of this project will open ways for major investments using ICT in marginalized regions, with most of the projects initiated involving the Dwesa community members. Consequently, this project will provide the ICT industry with information on deployment of such networks in remote rural areas. Internet connectivity will be beyond the traditional roll out allowing Dwesa people to remain connected using WIFI enabled devices. This will provide more insight into approaching that market.

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