

An Investigation of the Viability of Mobile WiMAX in Rural Context

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Abstract- Poor or lack of internet connectivity is one of the characteristics of rural areas in developing countries. Research is being undertaken in many countries on how to connect rural areas to the global knowledge society in order to reduce the effects of the digital divide. There is an ICT for Development intervention, called Siyakhula Living Lab (SLL), which is undertaken in Dwesa. The intervention is focused on bringing Internet to the Dwesa marginalized community. Currently WiMAX is used to provide the wireless backbone for the Dwesa network and Very Small Aperture Terminal (VSAT) provides the backhaul connectivity to the Internet. In this research we are looking to investigate the viability of Mobile WiMAX (IEEE 802.16e) for network services provisioning in rural areas. The research will also investigate the application level technologies that can leverage the availability of Mobile WiMAX in rural marginalized areas.

Index Terms— ICTD, Siyakhula Living Lab, WiMAX, Mobile WiMAX

I. INTRODUCTION

Many rural areas lack network connectivity due to many factors such as low income, low population density, cost of current technologies and infrastructural constraints [1]. Dwesa is one of the marginalized rural areas situated in Transkei which also lacks this technological infrastructure. There is an Information Communication Technology for Development (ICT4D) intervention in Dwesa called Siyakhula Living Lab (SLL) which started in 2005. In SLL, WiMAX based on 802.16d (Fixed) is used to provide the last mile connectivity. With the applications that are deployed and underway, Fixed WiMAX proved to have short fall in not providing mobility and therefore not taking advantage of mobility applications. On the other hand Mobile WiMAX was introduced to address the issue of mobility. In this paper we are investigating if the new IEEE 802.16e (Mobile WiMAX) is effective in the rural framework.

II. TECHNOLOGICAL REVIEW

A. WiMAX

WiMAX- Worldwide Interoperability for Microwave Access based on IEEE 802.16 Air Interface standard is a

wireless technology that provides broadband connections [2]. WiMAX provides high throughput over long distances of up to 50 KM in Line of Site (LoS) and 10KM in Non Line of Site (NLoS) [3] With this range WiMAX may be used to provide data and telecommunications services (e.g. VoIP, IPTV, etc) and can also operate as a possible replacement to cellular technologies such as Global System for Mobile Communications (GSM), Code division multiple access (CDMA). WiMAX can therefore be overlaid to increase capacity and connectivity [3].

B. Mobile WiMAX

Mobile WiMAX- is a broadband wireless solution which makes use of Orthogonal Frequency Division Multiple Access (OFDMA) to provide both mobile and fixed broadband network connectivity [4]. It defines an all-Internet Protocol (IP) end-to-end network architecture [4]. Mobile WiMAX covers 5, 7, 8.5, and 10 MHz channel bandwidths for worldwide licensed spectrum allocations in the 2.3 GHz, 2.5GHz, 3.3 GHz and 3.5GHz frequency bands [5].

III. PROBLEM STATEMENT

Figure 1 shown below is the current network infrastructure of the SLL. Fixed WiMAX is used to deliver the last mile. This allows the users broadband access from three schools which are currently connected, Mpume, Ngwane and Mthokwane. This means users need to walk to the Digital Access Nodes (DANs) for access and service consumption.

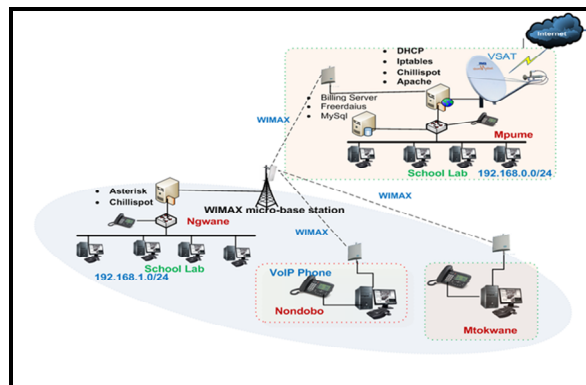


Figure 1: The current network infrastructure in SLL, Dwesa

There are many applications that have been deployed and some are still to be deployed, meant to support the socio-economic activities of the people around SLL. The projects range from eServices, Services Oriented Architecture (SOA), Semantic Web Services, to Telephony based services. All of the deployed services are available on the network and are accessible through the DANs which are located at the schools.

There is a project underway which focuses on deploying and extending the converged WiMAX/ WiFi network. However Wi-Fi has limited range of approximately up to 100 meters, the issue of mobility is not well addressed. Mobile WiMAX is a recent technology offering the mobile devices the ability to hand-over from one base station to another [6, 7].

In this research we are investigating if Mobile WiMAX can be used to provide connectivity in rural areas and also the type of applications that can be best provided over Mobile WiMAX

IV. OBJECTIVES AND METHODOLOGY

In this research we are aiming at investigating the viability of WiMAX (IEEE 802.16e) technologies as an option of disadvantaged communities. This will be achieved through performing feasibility study of mobility technologies such as dongles, WiMAX cell phones, Customer Premise Equipment (CPE). We will also investigate the potential benefits of Mobile WiMAX, determining if time and other resources will be able to help reducing the digital divide gap. Mobile WiMAX base station will be deployed in Dwesa network. Lastly, investigation of what type of applications that can be provided over Mobile WiMAX will be carried out.

V. CURRENT AND PROPOSED FUTURE NETWORK INFRASTRUCTURE

Currently there is already WiMAX (Fixed) network running and there is project focusing on deploying a WiMAX/Wi-Fi converged network. Figure 2 below gives a picture of our current use of WiMAX and what we are looking forward to achieve.

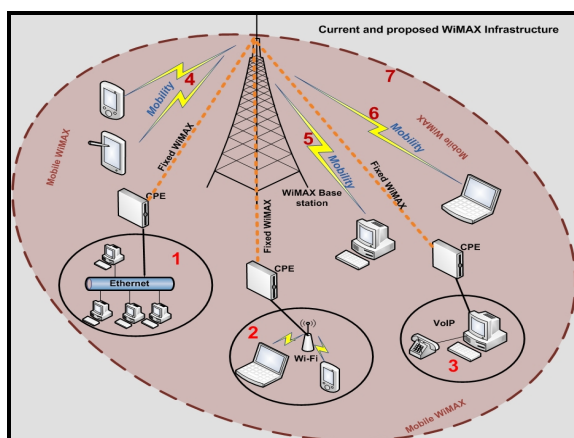


Figure 2 : Mobile WiMAX

Numbers 1, 2 and 3 (DANs at schools) is the current Fixed WiMAX. Number 7 is when Mobile WiMAX is deployed which will result in devices communicating with the base station as long as it is in the range. Number 4, 5 and 6 shows the devices connecting direct to the base station.

The WiMAX Forum is currently working on the Fast Mobile (IEEE 802.16m), which is faster and efficient than IEEE 802.16e [8]. IEEE 802.16m will meet the cellular layer requirements of IMT-Advanced Next Generation mobile networks [8].

VI. CONCLUSION AND FUTURE WORK

WiMAX technology can deliver high throughput, while reducing cost due to its ease deployment. The need for cables over long distances is reduced especially when it comes to rural settlement planning in developing countries. As it stands WiMAX is emerging as one of the important wireless standards, however its effect in the world of consumers and internet users is not yet reflective but in future we better expect it to be the dominant technology on data transfer as the Forum is working on IEEE 802.16m which is more efficient than the current 802.16e. We are looking forward to implementing it if IEEE 802.16e gives us satisfying results.

VII. REFERENCES

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Shumba Zvabvira Tawanda received his undergraduate degree in 2009 and Honors in 2010 from the University of Fort Hare and is presently studying towards his Master of Science degree at the same institution. His research interests include Wireless Networking, Security and Telecommunication engineering