An Investigation of Mobile WiMAX Feasibility for Service Provisioning in MRA/ICT4D Contexts

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Abstract - Since the emergence of ICT for Development initiatives, countless interventions have been undertaken around the world. The Siyakhula Living Lab (SLL) is such an intervention that is taking place in Dwesa. It aims to bring Internet connectivity and basic e-services to the Dwesa community. Currently fixed WiMAX is used for the backbone to connect the Digital Access Nodes (DANs), with VSAT providing backhaul connectivity to the Internet. WiFi hotspots have also been deployed around each DAN to provide wireless connectivity and network mobility. This research is undertaking a study to investigate the feasibility of a Mobile WiMAX (IEEE 802.16e) network in Marginalized Rural Areas (MRAs) with Dwesa community as a field site. It will outline the feasibility metrics for this particular area and similar environments. It will also state evaluation standards for such metrics and look at new possibilities that could be enabled by the deployment of a mobile WiMAX network in Dwesa.

Index Terms— Mobile WiMAX, Information and Communication Technologies for Development, Wi-Fi, Siyakhula Living Lab, Rural Connectivity

I. INTRODUCTION

Information and Communication Technology for Development (ICT4D) is a general term that is used to refer to the application of Information and Communication Technologies (ICTs) for socio-economic development of communities [1]. "Detailed analysis of experience around the world reveals sizable evidence that, used in the right way and for right purposes, ICT can have a dramatic impact on achieving specific social and economic development goals" [2]. The real benefit though is not from provision of technology per se, but rather in its application to create powerful social and economic networks by dramatically improving communication and the exchange of information [2].

Wireless networks have become the technology of choice for providing access to Internet services in developing countries, with WiMAX specifically as a preferred choice of technology because of its capabilities [1]. WiMAX (IEEE 802.16) and Long Term Evolution (LTE) are described as 4th Generation (4G) technologies that share a number of key characteristics but with differences in implementation however only WiMAX is available today [3].

WiMAX is an acronym for Worldwide Interoperability for Microwave Access and it is a standard ratified by the Institute of Electrical and Electronics Engineers (IEEE) committee [3, 4]. It is a standards based protocol that provides fixed and mobile internet access [4]. WiMAX's original focus was on fixed radio location which is based upon IEEE standard 802.16-2004 specification. This has been revised since its original development. Another type of WiMAX is described in the IEEE 802.16e-2005 specification and is known as mobile WiMAX [5]. It "is a broadband access technology that enables low-cost mobile Internet applications and realizes the convergence of mobile and fixed broadband access in single air access and network architectures" [6].

Mobile WiMAX networks are mostly deployed in metropolitan areas and are at an early stage for rural and marginalized areas. Hence that motivates a validation of the applicability of mobile WiMAX technology for marginalized rural environments. This research therefore will perform an investigation of mobile WiMAX feasibility. It will first define and investigate feasibility metrics with which mobile WiMAX will be validated. This research will be undertaken through literature review and field surveys. It will also investigate feasibility evaluation techniques through literature review and carry out the evaluation processes. The technology will be deployed and further tests will be conducted as part of functional and technical validation. Finally, opportunities and future enhancements that may be offered by its deployment will be discussed.

II. THE SIYAKHULA LIVING LAB

Back in 2005 Siyakhula Living Lab (SLL) a body that comprise of academia (i.e. Fort Hare University and Rhodes University), private sector, public sector and the community took an initiative in support of the concept of using ICT4D. This initiative saw the deployment of a fixed WiMAX network, each node with Wi-Fi hotspot that operates over VSAT as a backhaul. Currently the network consists of five nodes situated in the local schools. The schools were chosen merely because they were community centers with electricity. Internet can be accessed through the labs and the hot spots, which offer coverage area of about 100m all around. These hot-spots were meant to extend the labs (i.e. DANs). This is a disadvantage to the community because it means limited access to the Internet and other offered e-services in the following manner; in order for a user to be

able to access the Internet they must be within the covered area. Again, the labs are within the school premises, which then deprive the community the freedom of using the labs during school hours. This study then investigates the feasibility of the deployment of mobile WiMAX, which presumably would enable the network to be spread across the Dwesa area and therefore allow access to these services to a greater range.

III. FEASIBILITY METRICS

These are the factors that will help in determining whether the mobile WiMAX can be deployed in Dwesa and other similar environments or not.

A. Technical Feasibility

This research will investigate technical capabilities of mobile WiMAX technology, through literature review and actual deployment. This will help to fully understand its' limitations and strengths.

B. Physical Feasibility

This research will study the test bed and investigate it for any physical obstacles that may exist. Also any other physical factors that might affect the deployment of the technology will be investigated.

C. Socio- technicality

In this section, the research will cover the social status of the Dwesa community, studying their willingness to accommodate this technology and also it will investigate their financial status studying closely their level of financial freedom, whether they can afford to buy gadgets that are WiMAX enabled and business opportunities it may provide.

D. Sustainability

A study to investigate services and applications that make use of the technology, which may be developed and deployed in the network so as to sustain its full functionality, will be done.

IV. PROPOSED NETWORK ARCHITECTURE

Figure 1: Mobile WiMAX [7]

From the above diagram, number 1, 2 and 3 indicate the current fixed WiMAX DANs connected to the base station

via CPEs. Numbers 4,5, and 6 indicate the possibilities enabled by the deployment of mobile WiMAX, where now the end user devices anywhere within the area indicated will be able to communicate with the base station.

V. DISCUSSIONS AND CONCLUSION

This research will discuss whether the Dwesa community needs this technology and the alternatives to mobile WiMAX should it be evident that it is not feasible in Dwesa. Marginalized and rural areas had been previously isolated in the information globalization due to high deployment and maintenance costs and low demand of ICTs because of low literacy levels of occupants. However emergence of WiMAX can offer an opportunity to eliminate such boundaries and contribute in the initiatives towards globalizing information society and therefore improving socio-economic levels in developing countries.

REFERENCES

[1] Smith, Matthew, Angler, Nathan J., Christian, Gideon, Gigger, Kathleen, Rashid and Ahmed (2008). "Open ICT4D" Wired. pp.38

[2] Mrayati, M. (2002). Prepared for the Forum on Technology, Employment and Poverty Alleviation in the Arab Countries.

[3] Myung, H.G. and Goodman, D.J. (2008). Single carrier FDMA: a new air interface for long term evolution, vol.9, Wiley.

[4] Des Territoires N., Image Sources, Licenses and Contributors. WiMAX Notes, pp.41

[5] Burbank, J.L. and Kasch, W.T. (2007). WiMAX Past, Present and Future: An Evolutionary Look at the History and Future of Standardized Broadband Wireless Access, WiMAX: applications, 3, pp1.

[6] Etemad K., 2008. Overview of mobile WiMAX technology and evolution. Communications Magazine, 46(10), pp. 31-40.

[7] Shumba Z.T., Thinyane M., Sibanda K: An Investigation of the Viability of Mobile WiMAX in Rural Context, South African Telecommunications Network Applications Conference, Western Cape, South Africa(2010).

Nombulelo Twele received her undergraduate degree in 2009 and Honors in Computer Science in 2010 from the University of Fort Hare and currently studying towards her Master of Science degree at the same institution. Her research interests include 4G wireless networking technologies, development in MRA's, and mobile e-services.