Improving the robustness and effectiveness of the wireless telecommunication infrastructure in Dwesa South Africa

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Abstract—*In this paper we discuss robustness and effectiveness issues in wireless telecommunication networks, particularly rural networks, with the view of planning work to increase the availability of the wireless network deployed in the rural community of Dwesa, South Africa. The network is central to a relatively large project focused on the introduction of ICTs in rural areas, run there by two South African universities, Fort Hare and Rhodes.*

Keywords- network design, network robustness, rural telecommunication, wireless network, Wi-Fi, WiMAX.

I INTRODUCTION

Wireless networks have attracted the attention of many researchers seeking to provide ICTs in marginalized communities. This is mainly due to the fact that wireless networks are flexible, quicker to install and generally cheaper than wired networks [5].

As the use of wireless networks and expectations increase, there develops the need for the existing network to be more robust and effective. The University of Fort Hare together with Rhodes University Center of Excellence (CoE) in e-commerce have deployed Virtual Aperture Terminal Satellite (VSAT) to bring Internet connection to rural communities in Dwesa and a Worldwide Interoperability for Microwave Access (WiMAX) local loop to extend the network so that it spreads across 40 square kms to link up various nodes in this community. WiMAX builds on the experiences and problems of 802.11 wireless networks, commonly known as Wi-Fi. It was developed to solve most of the wireless LAN shortcomings such as quality of service (QoS), high-speed data rates and long distance connectivity coverage and security [3, 7].

The use of technologies like Third Generation (3G), General Packet Radio Service (GPRS) has also been tried but only in small ways up to now [5,7].

Providing resilience against failure is an important requirement for many networks [1]. In Dwesa the amount of disruption caused by the network outage has become more significant over time.

II AIM OF THE PROJECT

The work described in this paper is aimed at improving the robustness and effectiveness of the wireless network deployed in Dwesa, paying particular attention to scalability, manageability and adaptability of the overall network.

III PROPOSED METHODOLOGY AND DESIGN

One way of improving the robustness of a network is to redundant routes which supply two diverse network connections to critical parts of the network. While one connection is used to route traffic, the second connection is in hot-standby, ready to route traffic in the event of a problem on the first route. (The alternative route might have lower speed than the main route.) The change-over to the hot-standby circuit should happen automatically without any changes to the network configuration [4, 9].

An obvious candidate to create redundant connections would be point-to-point Wi-Fi to cope with WiMax failure, or GPRS to cope with VSAT failure [2]. GPRS could also be used to replace WiMAX to link the various nodes, if Wi-Fi is not available, but routing local traffic through GPRS would have a higher cost. Once we have introduced redundant routes, we will use the spanning tree protocol to eliminate routing loops [6].

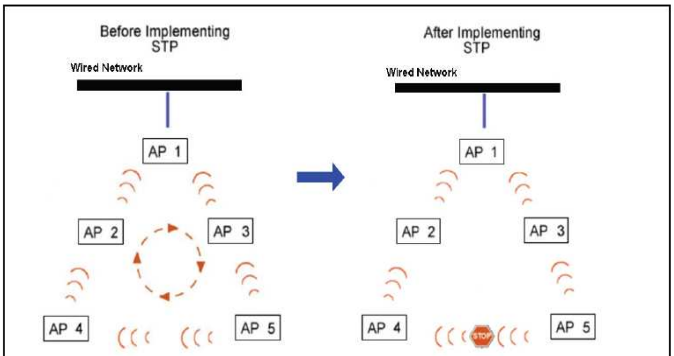

Figure 1: **Spanning Tree**

Spanning Tree Protocol forces redundant data paths into a standby state, Figure 1. If one network segment in the Spanning Tree Protocol becomes unreachable, or its cost changes, the spanning tree algorithm reconfigures the spanning tree topology and reestablishes the link by activating the alternative path [8].

There is also a serious need for us to have some of the critical network elements - the WiMAX base station, routers and several servers – duplicated, so that we reduce the risk of not having a running network in the event of any of them malfunctioning. Of course, redundancy implies higher costs, so it must be weighted against considerations such as how critical a system is, how expensive it is and how likely it is to break.

As a way of making sure that the network availability is not affected by unreliable supply of electricity, a problem in rural areas, we plan to introduce other sources of electricity, such as solar panels and batteries, From the experience on the field, however, there are also low-tech, organizational measures that should be taken: for example, a system should be in place that guarantees that prepaid meters feeding critical network elements never run out of credit.

Apart the reliability of the supply, another problem is the quality of the electricity. Most of the equipment, has already suffered for it, and a cost effective solution should be found [9].

Of course, no matter what measures are taken, problems will always occur. So, one subsystem that needs to be added into the network is a good monitoring system, able to send alerts to people that can take corrective measures. While for complex problems these people might be located far away (at the universities taking part in the project, for example), simpler problems might be corrected by an appropriate person residing locally. This implies the training of local people. The impression, to be validated during this research, is that simple training on the trouble-shooting of basic networking problems might be very effective in increasing the availability of the network.

IV Diagram of the current network

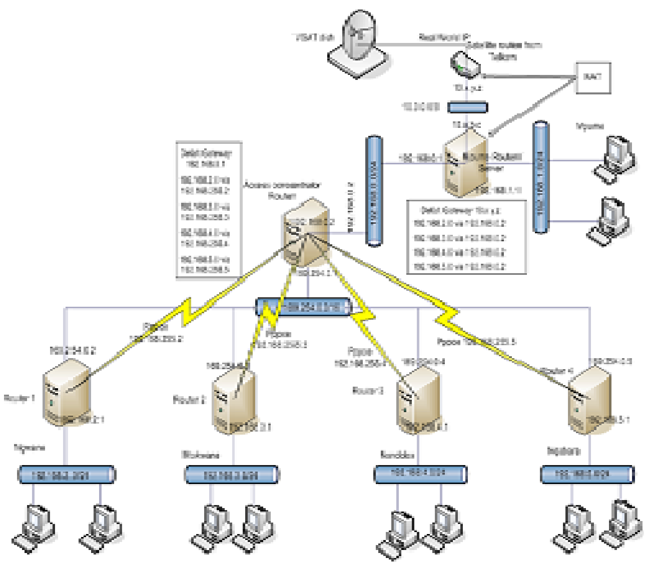

Figure 2: Dwesa Networking Diagram [10]

V Conclusion

At the end of the research the network in Dwesa will hopefully offer higher availability than it does now. Also, a blue print to make similar installations more robust and effective will be made available.

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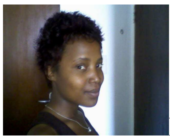

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