Models of Internet Connectivity in Previously Disadvantaged Secondary Schools in the Eastern Cape

Ingrid Brandt, Cheryl Hodgkinson, Alfredo Terzoli
Departments of Computer Science and Education
Rhodes University, Grahamstown
ings@rucus.ru.ac.za, C.Hodgkinson@ru.ac.za, A.Terzoli@ru.ac.za

***Abstract*— Computers are increasingly considered a valuable tool in Education, not only for the purpose of administration but also for teaching and learning. This project aims to model Internet connectivity to previously disadvantaged schools in the Eastern Cape by investigating known networking technologies in the context of such schools. We look at wired and wireless technologies, while bearing in mind issues such as cost, organisation capacity and such like.** [1]

I. Introduction

As technology advances, computers are increasingly considered as valuable tools in Education, not only for the purpose of administration but also for teaching and learning. "It is felt that [computers] can increase not only the effectiveness of the educational process but also its overall efficiency, whether in terms of classroom activities or administration. The possibilities they offer have the potential to transform the organization and structure of schooling and may promote the development of higher cognitive processes" [1]. In a recent survey undertaken in this country, which was conducted by the Education Policy Unit of the University of the Western Cape and the International Development Research Centre, it was found that, no matter what the country's stage of development, factors which accompany successful implementation of ICTs in schools include network connectivity and structured and continuous programmes that work to educate and train teachers to make effective use of the technology for teaching and administrative purposes [2].

II. Factors Affecting Computers and the Internet in schools

There are a number of factors which hinder schools in South Africa joining the Information Age. More notably, a large number of schools do not have electricity or telephone lines. There is also an alarming number of schools that do not have proper building infrastructure and are being taught in shacks or even outside [3]. To this one should add that the costs incurred in obtaining and maintaining computers and teaching, training and supporting teachers is more than the majority of schools can afford. Naturally these factors become more prevalent the more rural a school is.

Sixteen thousand rural schools in South Africa lack electricity, placing a large barrier to the universal introduction of computers in schools [4]. South Africa also has an alarmingly low teledensity in some of the more rural parts of the country being less than 5% in certain rural areas [5], making it difficult to connect schools which do have computers to the Internet, even in the simple manner of a dial-up link.

[1]This work was undertaken in the Distributed Multimedia CoE at Rhodes University, with financial support from Telkom, the Business Connexion, THRIP and the NRF.

III. Goals of Research

The aim of this work is to find the best methods of connecting previously disadvantaged schools to the Internet. It aims to investigate various methods of connecting schools, taking into account issues of cost, infrastructure and in particular looking for methods of getting around issues such as low teledensity in the majority of the rural areas in the country [5]. The investigation focuses on previously disadvantaged secondary schools in the Eastern Cape. According to the 1996 SA Connectivity Review [6], only 1% of South African schools have an Internet connection of some kind, of this 1% the Eastern Cape comprises 18%. In [2], it was noted that the number of schools in the country with at least one computer was 2311. Of this number, 212 schools were within the Eastern Cape. There were 5880 schools in the Eastern Cape at the time of the survey, meaning that 3.6% of the Eastern Cape schools had at least one computer.

This research focuses on the schools in the Makana, Alice and Kingwilliamstown districts in the Eastern Cape, with a view to creating a set of generic models that can be applied to other schools to produce the best outcomes for them, based on their current situation and their needs. The work of this project will also be contributing to another project, which is looking at the strategic issues that need to be addressed to ensure that Secondary Schools in the Makana District can successfully integrate ICT into their curriculum. This project is being conducted by the Rhodes University Education Department.

IV. Method

In order to produce models of Internet connectivity, networking technologies must be tested and deployed in schools. An analysis of costing as well as investigation into factors that hinder integration of computers into schools will be conducted.

A. Wired Internet Solutions

Examples of wired network technologies are dial-up, ISDN, Digital Subscriber Line (DSL), Telkom's Diginet, Leased Lines and Fiber. The most common of these solutions in South Africa is dial-up. While dial-up access for Internet

connectivity is being phased out in first world countries to be replaced by broadband technologies, such as DSL, cable modems and suchlike, it remains the main form of Internet connectivity in South Africa [7].

There are disadvantages in using wired solutions to more rural and remote areas. The most obvious of these is that the more rural areas do not have any wired telecommunications infrastructure i.e. low teledensities and copper/fiber would have to be put into the ground and exchanges built. The costs incurred in laying new copper/fiber and building such exchanges is high compared to potential revenue and so unattractive to telecommunication companies.

A further disadvantage of wired Internet connections in disadvantaged areas of the country is the high probability of bad quality copper, which results in bad data lines.

Solutions like DSL have their own disadvantages, in that they are obviously more expensive and in the case of DSL it has a maximum distance of approximately 5km, which limits it to use in urban areas or areas very close to an exchange [8].

The main disadvantage of dial-up is that it is narrow-band communication with a maximum download speed of 56Kbps and maximum upload of 33.6Kbps. Also, if you make substantial use of your Internet connection then you will be paying more than you would with an “always on” broadband Internet connection [9]. ISDN improves upon dial-up and you can get up to 128Kbps full duplex (2 x 64Kbps channels), paying the same price per call as you do on a normal phone line [10], but your rental will be higher than dial-up over POTS.

B. Wireless Solutions

Examples of wireless technologies are Satellite [11], Mobile Terrestrial network standards and Wi-Fi. Within the broader category of Satellites we will be investigating LEO, MEO and GEO technologies [12], [13], looking more closely at the LEO technologies and VSAT technologies [14], which work together with GEO satellites. Mobile terrestrial network standards, include technologies like GPRS, UMTS, W-CDMA. Both these examples of wireless technologies are best suited for Wider Area Networks (WANs).

Wi-Fi, such as 802.11b or 802.11g and Motorola’s Canopy Wireless Broadband Platform [15], are technologies particularly suited for the local area networks (LANs).

Wireless technologies can be easily deployed in areas where teledensity is low and so wireless can be used to connect the most rural schools to the Internet. Wireless technologies can circumvent the majority of the problems posed by wired technologies, but often at a cost. At the moment wireless can not offer the bandwidth that wired technologies can.

In areas where broadband access to users is beyond the reach of a terrestrial network, satellite networks become a very attractive solution to provide communication. Furthermore, satellite networks support data, audio and video streaming; bulk data transfers such as software update or dissemination of Web caches; and applications involving limited interactivity such as distance learning [16] (this refers mainly to GEO satellites, interactivity will not be limited with LEO), all of which are attractive to previously disadvantaged schools where wired Internet access is limited. Satellite networks remain an important component of the global network infrastructure for both developing and developed countries [11]. This project will be investigating various satellite options, particularly LEOs.

This project will also include an investigation into using the mobile terrestrial network standards as a means of connecting rural areas to the Internet, as Sentech does for its MyWireless product [17]. Sentech uses UMTS, which is a 3G technology that will deliver broadband information at speeds up to 2Mbps/sec.

For wireless LAN technologies connecting local schools to each other, this project will investigate 802.11b and 802.11g technologies as well as Motorola’s Canopy Wireless Broadband platform [15], which is being used in the Ulwazi Project in Mamelodi [18]. While 802.11 technologies remain a firm favourite, as they are IEEE standards and cheaper than proprietary technologies, Motorola’s Canopy is specifically designed for wider LAN networks and does not experience the interference problems that 802.11 technologies do when trying to use them as a wider LAN network medium [15]. Motorola use several methods in order to ensure that they overcome interference issues, such as Dynamic Time-Synchronized Spreading (DTSS) - allowing for a low C/I ratio and the Global Positioning System (GPS) as a timing mechanism, making their network much like a time-slotted network [19], [20].

C. Cost Factors

The project will investigate the overall costs incurred in providing Internet connectivity to previously disadvantaged schools. The costs incurred by schools for such projects is often the primary reason for schools not connecting to the Internet. The project will look for appropriate and innovative ways of reducing such costs, while still getting to schools the necessary equipment, training and support [21].

D. Organisational Factors

The project will also investigate the organisational factors that hinder the adoption of computer facilities, networks and Internet connectivity within schools. Such factors include schools without sufficient buildings, electricity, low regions of teledensity, lack of training and support for teachers, high crime rates and suchlike. These factors are constraints in achieving networking for previously disadvantaged schools. We also realise that problems surrounding adoption of computers in schools is not just confined to lack of funds or infrastructure but that if they are not supported by teaching staff, school governing bodies and the community then there will be under-use and possible theft, thus addressing these factors is of utmost importance in integrating computers in schools and encouraging teachers to make use of the Internet in teaching their classes.

V. Conclusion

The work of this project will be undertaken during the course of this year and next and will be completed in 2005. The results will contribute to related work being done by the Education Deparment of Rhodes University and as such hopefully contribute to education policy regarding ICT in schools in the Eastern Cape.

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