The Deployment of an e-Commerce Platform and Related Projects in a Rural Area in South Africa

LORENZO DALVIT[*]
Department of Education
Rhodes University, Grahamstown, South Africa.

HYPPOLITE MUYINGI
Telkom Centre of Excellence,
University of Fort Hare, Alice, South Africa.

ALFREDO TERZOLI
Telkom Centre of Excellence,
University of Fort Hare, Alice, South Africa.

MAMELLO THINYANE
Department of Computer Science,
Rhodes University, Grahamstown, South Africa.

_____

In our paper we describe the development and deployment of an e-commerce platform in Dwesa, a rural area in the former homeland of Transkei in South Africa. The system is designed to promote tourism and advertise local arts, crafts and music, and it entails a number of related projects. Deployment of infrastructure, technical support, promotion of the initiative and teaching of computer literacy take place during monthly visits of approximately one week, and involve young researchers from two universities (one previously disadvantaged; the other historically privileged). This ensures a synergy between technical expertise and understanding of the local context. Findings so far emphasise the importance of contextualising the intervention to suit local needs and adjust to the local context. The platform is currently being extended to include e-government, e-learning and e-health capabilities. If proven successful, this model can be exported to similar areas in South Africa and in the rest of Africa. This could open up potential opportunities for the still unexplored market for ICT in rural Africa.

Categories and Subject Descriptors: K.4.m [**Computers and Society**]: Miscellaneous; K.4.4 [**Computers and Society**]: Electronic Commerce; J.1 [**Computer Applications**]: Administrative Data Processing -- Business, Education, Government.

General Terms: Information and communication technology for development, sustainable rural development, ecommerce applications.

_____

1. INTRODUCTION

In this paper we describe the deployment of ICT in Dwesa, a rural community in South Africa. This involves the implementation of an e-commerce platform which can make a contribution to rural development and poverty alleviation in the area. The novelty of our approach is its sensitivity to the context and its emphasis on the promotion of active participation of the community and sustainability. We will start with a description of Dwesa and of the various stages of deployment. We will then describe the e-commerce platform and its related projects. We will end with a discussion of future developments and possible implementations.

2. BACKGROUND

Dwesa is a rural community located on the Wild Coast of the former homelandi of Transkei, in the Eastern Cape Province of South Africa (see Figure 1). In many ways, it is representative of many rural realities in South Africa and Africa as a whole. As noted by Palmer, Timmermans and Fay (2002), its 15000 inhabitants are traditionally subsistence farmers who depend on the land for their livelihood. The region features a coastal nature reserve and it was the site of one of the first restitution projects in post-apartheid South Africa. The region has a high potential for both eco and cultural tourism due to the rich cultural heritage and the marine conservation project undertaken at the nature reserve.
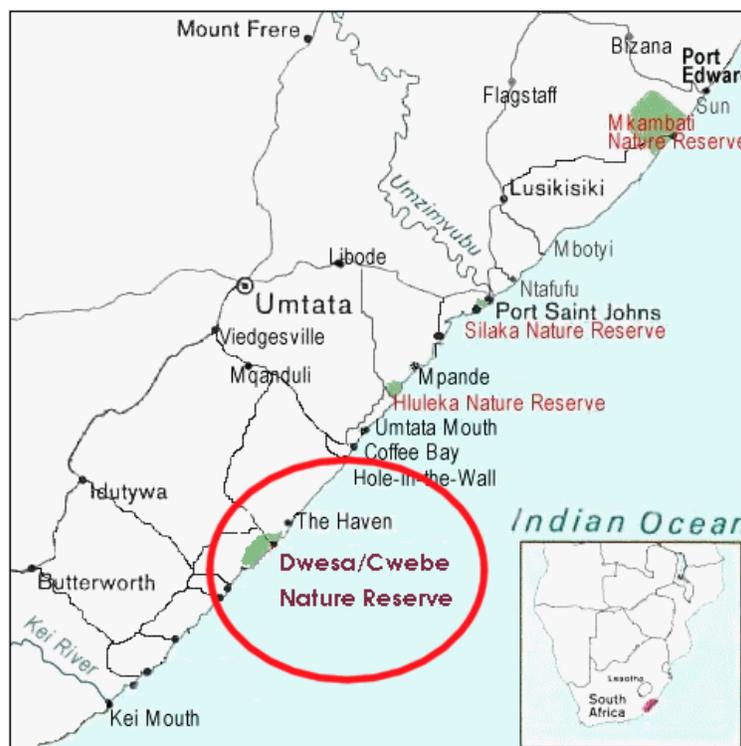
Figure 1- Transkei and the Dwesa region

The nature reserve is a catalyst for tourism, which together with government subsidies, is the main source of money for the local community. Tourism is seasonal (almost exclusively during school holidays) and visitors are mostly South Africans. At the moment, the revenues are redirected to the administrative government offices in Bisho and do not benefit the community directly. The only way tourism benefits the community is by promoting local arts and crafts. There are a number of activities ranging from basket-making to wood-carving. Moreover, Transkei is the site of conservation of the traditional culture of the

Xhosa people, and Dwesa has much to offer to tourists and to the outside world in terms of preservation of traditional customs and ceremonies, dances and, especially, music.

Unfortunately, like many rural areas, Dwesa is characterised by lack of infrastructure in terms of road and electricity, widespread poverty, lack of services and isolation (Human Sciences Research Council, 2005). Isolation is probably the main reason for young people leaving Dwesa for the cities, a typical phenomenon in rural areas (Salt, 1992). This deprives the community of fresh energies and of the primary force for change and innovation. Even worse than the physical isolation is isolation in terms of knowledge and information. Flor (2001) discusses and highlights the centrality of the link between access to information (or lack of it) and poverty. Access to relevant information has become one of the discriminating factors between the rich and the poor communities in the world. Some popular views have it that up-to-date and readily-available information is not a crucial concern for communities which struggle to satisfy more basic needs such as clean water and electricity. Government sources (Department of Education and Department of Communication, 2001) have highlighted that ICT has a key role to play in contributing to improving the situation of communities which are already disadvantaged in so many other ways.

The project was initiated at the beginning of 2006, and it is partly sponsored by Telkom South Africa. It is a joint venture of the Telkom Centres of Excellence at the University of Fort Hare (a previously disadvantaged university) and Rhodes University (an historically "white" institution). The driving force of the project is a group of young researchers from both universities. This kind of cooperation, still relatively rare in South Africa, ensures a combination of technical expertise and understanding of the territory. Members of the group pay regular monthly visits to Dwesa, and stay there for approximately one week each time.

The points of presence so far are four schools: Mpume, Ngwane, Ntokwane and Nodobo (see Figure 2). The equipment deployed is:
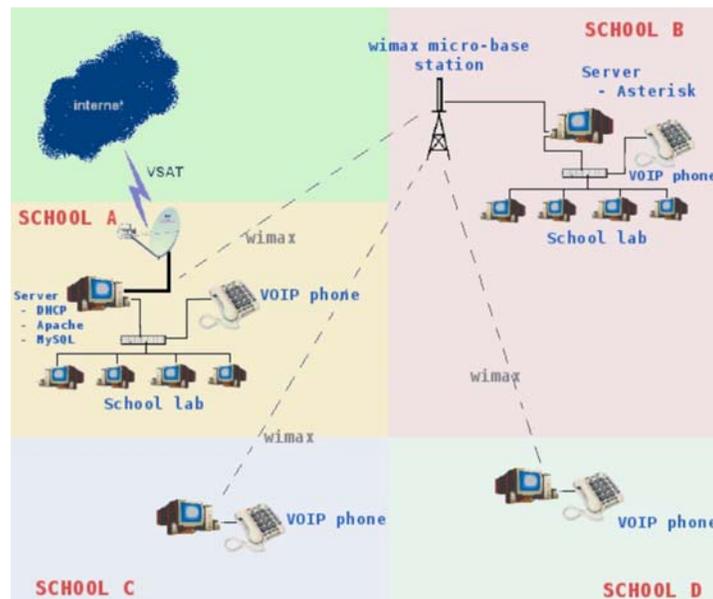
Figure 2 - Project Infrastructure

Mpume (school A): this is the first school that was identified as a point of presence for the project. Due to its location and the availability of electricity, it was selected as the ideal site for the installation of the VSAT[ii] connection (satellite dish, indoor unit and cabling). Other equipment include:

- WiMAX[iii] (Alvarion Breezemax CPE outdoor unit, and CPE indoor unit, wall mounting)
- A server (LTSP, HTTP, MySQL)
- 6 client PCs
- An 8 port DLink switch

- A VoIP[iv] phone

Ngwane (school B): this school is in line of sight from Mpume and has been identified as one of the points of WiMAX installation. Unlike other schools, Ngwane managed to source their own lab (approximately 20 PCs) and a printer. The additional equipment deployed there was:
- WiMAX (Alvarion Breezemax Microbase station, antenna and wall mounting)
- Switch rack (wall mounted) and a 24 port switch
- A server (Asterisk, DHCP)
- A VoIP phone

Ntokwane and Nondobo (schools C and D): these schools are also in line of sight from Mpume, which allows us to provide VoIP and Internet to them. The equipment deployed in each school is minimal:
- WiMAX (Alvarion Breezemax CPE outdoor unit, and CPE indoor unit)
- A client PC
- A VOIP phone

Client PCs and servers alike have 2.67 Celeron processors, 512 MB of RAM, a 40 GB hard disk and CD ROM reader (Thinyane, Slay, Terzoli and Clayton, 2006).
The two prerequisites for the e-commerce platform to be effective are Internet connection and basic training in computer skills. Internet connectivity is provided to Mpume via VSAT and then extended to the other schools via WIMAX. Computer training has been run by the members of the team at the various schools.

3. E-COMMERCE PLATFORM AND RELATED PROJECTS

The e-commerce platform is designed as a web application that allows local entrepreneurs to engage in trade activities. The platform is designed and developed by members of the research group (i.e. it does not use off-the-shelf applications). This allows for customisation to meet the specific needs and profiles of the local users. The platform is designed as a sort of virtual mall in which local entrepreneurs can manage virtual stores. There are three levels of usage. The administrator is responsible for the overall maintenance of the platform and the subsequent management of stores on the e-mall. The store owners have access to the management of their individual stores. Customers can access the platform over the Internet to purchase goods and services (Njeje, Terzoli and Muyingi 2006).

The e-commerce platform is flexible enough to accommodate a variety of goods and services. The areas where Dwesa has most to offer are tourism, arts and crafts. Different businesses can spin off from tourism: services (e.g. accommodation and catering) and entertainment (e.g. cultural tourism, horse riding, etc.). Recorded music and traditional artefacts can also be made available for purchase on the e-commerce platform.

Requirements elicitation is the study of the needs of the prospective users of the system. This was important in order to inform the development of the e-commerce platform. In a rural African context, new methodologies and techniques need to be experimented with. The novelty is to adapt established practices to a new and partly unresearched context. This involved extensive interaction with the local community. In many cases, educating the prospective users in ways in which ICT could be integrated into their activities and used to promote their businesses was an integral part of the elicitation process (Isabirye, Roets and Muyingi, 2006)

Recording and on-line selling of local music: Transkei is the heartland of traditional Xhosa music, and Dwesa has a rich and long musical tradition. An experimental music studio has been set up to record locally produced music, synthesise it and store it in electronic format. Music samples can be made freely available on the e-commerce platform to wet the appetite of tourists and potential customers. Music can then be purchased and downloaded on demand (Ndlovu, Terzoli and Pennels, 2006).
Determining a community cost-sharing model**: one of the main considerations in the implementation of a development project of this nature is to ensure long-term sustainability. The running costs of this project include electricity, Internet connection, maintenance and equipment. These are all costs that have to be shared among the different users of the solution. The billing system collects usage information from the

network as well as the amount of sales from the electronic shopping mall's database. The essential system components, presented in Figure 3, are:

- Network Layer: captures, tracks and records usage of resources (metrics);
- Session control layer: ensures Authentication, Authorization and Accountability on network resources;
- Mediation Layer: formats data provided by meters and forwards it to the accounting layer IPDR [8];

Accounting Layer: sorts the collected data into accounting records;

Charging / Pricing Layer: assigns prices to records to come up with costs of usage;

Billing Layer: compiles all charges for a customer over specific period.
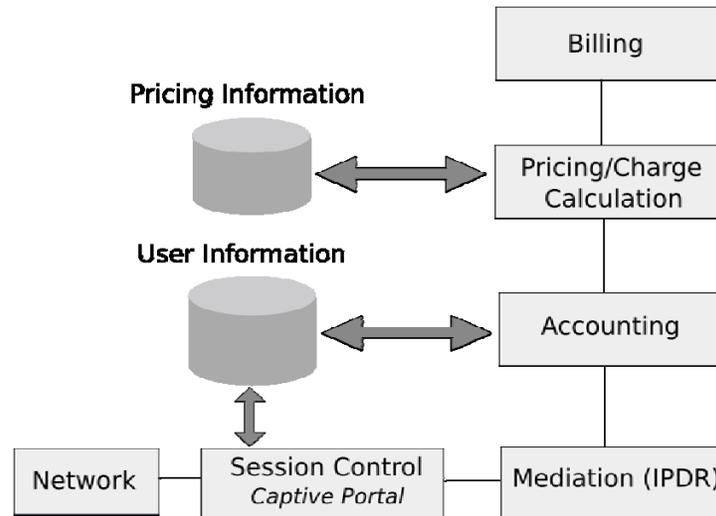

Figure 3- Cost sharing system

The end of this research is to propose a cost-sharing framework for the Dwesa community based on the consideration of the different costs and revenue streams (Tarwireyi, Terzoli and Muyingi 2006).

Experimenting with a multilingual approach: many projects involving the implementation of ICT in rural areas in Africa have failed because of the language barrier posed by the use of English. In our project we experiment with the use of both English and isiXhosa, the local African language. This includes three interventions:

- The localisation of the user interface of both the e-commerce platform and the computers in the laboratories into isiXhosa;
- The development and use of teaching material in isiXhosa, to be used alongside the existing material in English;
- The implementation of a text to speech and screen-reader in isiXhosa, as an attempt to tackle the problem of illiteracy or low literacy.

The future plan is to work together with Translate.org.za, an NGO dedicated to the localisation of free/libre open source software (FLOSS) in the 11 South African languages (Translate.org.za 2006), as a test site. Our hope is that this will guarantee access to a larger number of users, and contribute to a sense of ownership in the community.

Implementation of wireless networking: the ICT infrastructure that is to be deployed in Dwesa is built on top of networks that support the interaction between the different stakeholders in Dwesa. So far, four schools in strategic locations have been connected using WIMAX. Community members can access the network from the computer laboratories, through WIFi hotspots linked to the WIMAX base or directly through WIMAX. The new development in wireless networking in terms of range and bandwidth has made it possible to link up and connect regions that would otherwise be too remote to access with traditional wireline technologies (Mandioma, Rao, Terzoli and Muyingi, 2006). This research provides the infrastructural basis for the effective, efficient and far reaching deployment of the e-commerce platform.

Deploying a VoIP PBX system: the availability of a local network will allow for the deployment of a VoIP (Voice over Internet Protocol) telephone system. An experimental version has already been developed and deployed at Rhodes University (Penton and Terzoli, 2004). Its name is iLanga ("sun" in isiXhosa) and it is basically an internal phone system, like the ones used by firms and academic institutions. Four VoIP phones have been deployed at the four schools, and an experimental asterisk server (on top of which iLanga is run) has been deployed at Ngwane. The purpose is to improve communication within the community and with the outside world (Wittington and Terzoli, 2006). Its Web interface has already been localised in isiXhosa (Dalvit, Alfonsi, Mini, Murray and Terzoli 2006) but further customisation is needed to adapt it to the Dwesa context.

Best practices for teaching computer literacy in rural communities: this research is concerned with finding new and effective ways of teaching members of a rural community how to use computers. As pointed out by Czerniewicz (2004), the digital divide begins when one is connected to the Internet, since connectivity and availability of infrastructure by themselves do not guarantee access. In order for the inhabitants of Dwesa to enjoy the advantages of the Internet connection and of the new technologies in general, it is essential to develop a basic level of computer literacy in the area. At the beginning we focused especially on the training of teachers, hoping they would help to promote computer literacy in the school and in the community.

Figure 4 - Computer Laboratory Training

Our software of choice is Edubuntu (Figure 5), the educationally-flavoured version of the Ubuntu Linux distribution (Alfonsi and Dalvit, 2006). Edubuntu is specifically designed for use in schools, and offers a capturing user interface as well as the best available free and open educational software.

Our starting point was the OpenICDL manual, which was considerably shortened and summarised. The three main lessons learnt were:
We had to re-think our classification of what constitutes beginners' level material and what is advanced. This entailed a constant process of contextualising and, in some cases, rewriting the teaching material.

Some basic technical expertise in loco had to be created. In case of system failure, someone in Dwesa had to have sufficient technical understanding to be able to explain what the problem was over the phone, and possibly be able to tackle the more trivial issues.

Motivating and activating the teachers and the community at large was a key point. From the very beginning, we tried to present our intervention as a two-way stream, encouraging the community to take ownership of the initiative. The idea was that, building on African rural tradition, everybody will be looking out for what is perceived as common property.

Investigating resistance to the adoption of Information and Communication Technologies (ICT) in rural communities: this project seeks to identify the specific issues that hinder the proliferation of the deployment of ICT solutions in rural communities. In particular, it focuses on the resistance to the

adoption of ICT among old people. This group is particularly interesting because younger people tend to leave to go and work in the cities, and old people are the driving economic force of Dwesa. An interesting finding was that, unlike in many other settings, women are the primary driving force in the adoption of ICT. This might be an attempt to acquire status in a patriarchal society. Another finding was that level of education greatly influences adoption. Uneducated people find it hard to find meaningful ways of integrating ICT in their daily lives. Moreover, given the status associated with technology, it is generally accepted that computers were meant mainly for educated people. This generated some power dynamics which could potentially hamper the adoption of ICT in the area (Mapi, Dalvit and Terzoli 2006).

Figure 5 - Edubuntu operating system

4. FUTURE PLANS

Expansion of the system: the system is currently being expanded to include e-government, e-health and e-learning capability. As far as e-government is concerned, the transfer of personal data will demand extensive work on security. We will experiment with smart cards to try and solve this problem (Nkomo, Terzoli and Muyingi, 2006). The delivery of health information is a crucial problem in rural areas. The use of ICT might contribute to cut the cost of printing and circulating paper-based material. E-learning could make a great contribution to rural areas. Since schools are our primary point of presence and teachers are one of the driving forces of the project, we feel that focus on e-learning is very important.

Additional projects: while some of the sub-projects (i.e. investigation of adoption of ICT in rural communities) have been concluded, some others (i.e. deployment of a VoIP system) are still at the experimental stage. The extension of the system with e-government, e-health and e-learning capability mentioned above will result in several additional projects. Java mobile and 3G applications will be developed for deployment in the infrastructure.

A BingBee kiosk (Slay and Wentworth, 2006) will be deployed outside some of the computer laboratories. The distinctive feature of this kiosk is a low-cost touch pad keyboard which enables users to operate a computer kept behind glass. This makes it possible to access the Internet even when laboratories are closed with no security risks.

Additional steps need to be taken towards contextualising the system. One of the many ways of doing this is through more extensive use of multimedia, adding more audio and visual components. This could contribute to make the use of computers more meaningful also to people with low levels of literacy.

Involving the community: as mentioned above, promoting ownership of the project among the community is a crucial factor. Strategies to include the community range from organising public meetings to promote the initiative to running computer literacy training. One possibility would be to institute a committee, elected by the community itself, to promote and organise the initiative locally.

5. CONCLUSIONS

In this paper we described a developmental e-commerce platform and related projects deployed in Dwesa, a rural community in South Africa. The novelty of our approach is its strong emphasis on adjusting to the local context and involving the community. Responsiveness to local needs will be the guiding principle in the future developments of the project.

We hope that our intervention will prove to be a successful example of ICT implementation in a deep rural setting in Africa. Our goal is to come up with a pervasive and highly distributed ICT solution whose model might possibly be replicated in other parts of Africa.

REFERENCES

ALFONSI R.M. AND L. DALVIT (2006). "Edubuntu Linux nelle scuole del Sudafrica", Scienza e Pace, University of Pisa, Pisa, February 2006. (Accessed 15 June 2006): http://www.scienzaepace.unipi.it/modules.php?name=News&file=article&sid=203

CZERNIEWICZ L. (2004). "Cape of Storms or Cape of Good Hope? Educational technology in a changing environment". British Journal of Educational Technology, Vol. 35, Issue 2, Pp. 145-158.

DALVIT, L., R, ALFONSI, B. MINI, S. MURRAY AND A. TERZOLI (2006). "The localisation of iLanga, a next generation PBX". SATNAC conference, Cape Town, South Africa. ISBN 0-620-37043-2.

DALVIT, L., R. ALFONSI, N. ISABIRYE, S. MURRAY, A. TERZOLI AND M. THINYANE (2006). "A case study on the teaching of computer training in a rural area in South Africa". 22nd CESE (Comparative Education Society of Europe) conference, Granada, Spain,

Department of Education (DoE) and Department of Communication (DoC) (2001), Strategy for Information and Communication Technology in Education, Government Printer, Pretoria.

DWESA PROJECT. (Accessed 15 June 2006): http://www.dwesa.org

EDUBUNTU LINUX OPERATING SYSTEM. (Accessed 15 June 2006): http://www.edubuntu.org/

FLOR A.G. (2001), "ICT and poverty: the indisputable link", 3rd Asian development forum on 'regional economic cooperation in Asia and the pacific', Asian development bank, Bangkok.

Human Sciences Research Council (2005). Emerging Voices: A Report on Education in South African Rural Communities. Cape Town: HSRC Press/Nelson Mandela Foundation.

iLANGA. (Accessed 15 June 2006): http://pbx.ict.ru.ac.za/

ISABIRYE, N., R. ROETS AND H. MUYINGI (2006). "Eliciting user requirements for e-commerce applications for entrepreneurs in rural areas". SATNAC conference, Cape Town, South Africa. ISBN 0-620-37043-2.

MANDIOMA, M., K. RAO, A. TERZOLI AND H. MUYINGI (2006). "A feasibility study of WiMax implementation at Dwesa-Cwebe rural areas of Eastern Cape of South Africa", Submitted to IEEE TENCON 2006.

MAPI, T., L. DALVIT, AND A. TERZOLI (2006). "Adoption of Information Communication Technologies and computer education in a rural area in South Africa". Kenton conference, Southern Cape, South Africa.

MATHIAS C. (2006), Mobile home for open source, Electronic Engineering Times, Issue 1426, pp. 60-60. (Accessed 15 June 2006):http://search.epnet.com/login.aspx?direct=true&db=aph&an=21156235

NDLOVU, G., A. TERZOLI AND G. PENNELS (2006). "Indigenous knowledge: a pathway towards developing sustainable ICT solutions". SATNAC conference, Cape Town, South Africa. ISBN 0-620-37043-2.

NJEJE, S., A. TERZOLI AND H. MUYINGI (2006). "Software Engineering of a Robust, Cost-effective E-commerce Platform for Disadvantaged Communities", SATNAC conference, Cape Town, South Africa. ISBN 0-620-37043-2.

NKOMO, P., A. TERZOLI AND H. MUYINGI (2006). "An open smart card infrastructure for South African e-services". SATNAC conference, Cape Town, South Africa. ISBN 0-620-37043-2.

Palmer R., H. Timmermans and D. Fay (2002), "From conflict to negotiation: nature-based development on South Africa's Wild Coast". Pretoria: Human Sciences Research Council; Grahamstown: Institute of Social & Economic Research, Rhodes University.

PENTON J. AND A. TERZOLI (2004). "Ilanga, A next generation VOIP-based, TDM-enabled PBX", SATNAC conference, Drakensberg, Spier, Stellenbosch, South Africa. (Accessed 15 June 2006): http://www.ru.ac.za/research/pdfs/RESEARCH_REPORT_2004.pdf

SALT J. (1992), The Future of International Labour Migration, International Migration Review, Vol. 26, No. 4. pp. 1077-1111. (Accessed 15 June 2006): http://links.jstor.org/sici?sici=0197-9183%28199224%2926%3A4%3C1077%3ATFOILM%3E2.0.CO%3B2-H

SLAY, H. AND P. WENTWORTH (2006). "BingBee: a contactless information kiosk for social enablement". User Interface Software and Technology Conference, Montreaux, Switzerland.

TARWIREYI, P., A. TERZOLI AND H. MUYINGI (2006). "Design and Implementation of an Internet Access Cost Management system for disadvantaged communities", SATNAC conference, Cape Town, South Africa. ISBN 0-620-37043-2.

THINYANE, M., H. SLAY, A. TERZOLI AND P. CLAYTON (2006). "A preliminary investigation into the implementation of ICT in marginalised communities". SATNAC conference, Cape Town, South Africa. ISBN 0-620-37043-2.

TRANSLATE.ORG.ZA. (Accessed 19 December 2006): http://translate.org.za

WHITTINGTON, B AND A. TERZOLI (2006), "A low cost, IP-based access loop for consumer telephony in rural communities", ICTe Africa conference, Nairobi, Kenya.

BIOGRAPHY

Lorenzo Dalvit (Laurea in Sociology UNITN, Italy; MA Linguistics Rhodes, South Africa) is currently a Doctoral candidate in the Department of Education at Rhodes University. His main area of academic interest is access to Education for members of marginalised communities, with a particular focus on language issues and ICT Education. Mr Dalvit has published several articles and has presented several conference papers both in South Africa and internationally.

Mamello Thinyane (MSc Computer Science Rhodes, South Africa) is currently a Doctoral candidate in the Department of Computer Science at Rhodes University. His main areas of academic interest are knowledge representation, knowledge based applications, developmental ICT and the integration of indigenous knowledge networks into ICT.

Hyppolite Muyingi (PhD Electrical Engineering Brussels, Belgium) teaches in the Department of Computer Science at the University of Fort Hare. His main areas of academic interest are power utilities communications and ICT for development. Prof Muyingi has a long experience in teaching and research and he is the Head of the Fort Hare Centre of Excellence in Developmental e-Commerce, one of the prime sponsors of the project.

Alfredo Terzoli (Laurea in Physics UNIPA, Italy) is the co-ordinator of the Fort Hare Centre of Excellence in Developmental e-Commerce. His main areas of academic interest are voice over IP telecommunication and ICT for development. Prof Terzoli has a long experience in teaching, research and postgraduate supervision. He is also the Project Director of the Rhodes Centre of Excellence in Distributed Multimedia, co-sponsor of the project.

[1]   A homeland is the concept of the territory to which one belongs; usually, the country in which a particular nationality was born. [...] In apartheid South Africa the concept was given a different meaning. The white government transformed the 13% of its territory that had been exempted from white settlement into regions of home-rule. Then they tried to bestow independence on these regions, so that they could then claim that the other 87% was white territory. See Bantustan.

[1]   According to Wikipedia, a **Very Small Aperture Terminal** (**VSAT**), is a 2-way satellite ground station with a dish antenna that is smaller than 3 meters. VSATs are most commonly used to transmit credit card or RFID data for point of sale transactions, and for the provision of Satellite Internet access to remote locations.

[1]   **WiMAX** is defined by Wikipedia as **W**orldwide **I**nteroperability for **M**icrowave **Acc**ess by the WiMAX Forum, formed in June 2001 to promote conformance and interoperability of the IEEE 802.16 standard, officially known as WirelessMAN. The Forum describes WiMAX as "a standards-based technology enabling the delivery of last mile wireless broadband access as an alternative to cable and DSL".

[1]   According to Wikipedia, **Voice over Internet Protocol**, also called **VoIP**, **IP Telephony**, **Internet telephony**, **Broadband telephony**, **Broadband Phone** and **Voice over Broadband** is the routing of voice conversations over the Internet or through any other IP-based network.