The cellular phone economy in the SADC region: implications for libraries

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Keywords

Telephones, Mobile communications, Libraries, Southern Africa

Abstract

A review of relevant literature reveals a great deal of information on the possible use of cell phones for Internet access via the emerging wireless application protocol (WAP) technology, but little information if any exists about the link between cell phones and libraries. Going by the wide use of wireless networks in libraries especially in Western countries, it is possible that as cell phone technology continues to evolve and mature it could have a significant impact on libraries in the same way the Internet did. Ironically, today, a review of cell phone use in libraries only reveals efforts that are being made to dissuade users from making or receiving calls on their handsets within libraries. Few efforts are geared towards exploring ways that cell phone technology could be used to enhance library operations. Attempts to demonstrate that cell phones may in future provide solutions to libraries´ problems of connectivity especially in the remote areas of the Southern African Development Community member states.

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Background

The Southern African Development Community (SADC) was formalised as a regional political and economic bloc in 1980. Before then, it was known as the Southern African Development Coordination Conference (SADCC). The SADCC was born during the 1960s out of the need for close cooperation among the governments and peoples of Southern Africa in their quest for political self-determination and collective action against racism and colonialism. On attainment of independence the need to work together among the countries of the region became increasingly apparent in an attempt to enhance political survival, and economic and social advancement. The SADC was born through the Lusaka Declaration of April 1980, through which member states committed themselves to implement economic integration by among other things development of: information technology, communications infrastructure and human resources (SADC, 2000)

The SADC region has a total population of about 200 million people with 70-80 per cent of them living in rural areas. During the late 1990s the region experienced a technological advancement in the telecommunications sector – the cellular communication revolution. Today most parts of the SADC region that do not have single fixed line telephones have access to cellular communication networks. The prospect of the region's countries participating in the digital global economy looks more real than ever before.

During the last decade, the Internet was exalted as the technology that would revolutionise and democratise communication access because of its ubiquity and lower cost of access. However, despite the unprecedented impact of Internet technology in the last decade, its widespread use was hampered by the lack of quality telecommunication infrastructure, especially fixed telephone systems on which its operation is predicated. Cell phone adoption and use now exceeds the Internet in terms of penetration not only in the SADC region, but worldwide. Cell phone penetration in most countries of the region far exceeds the fixed

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line teledensity, yet cellular technology only took root in the region during the late 1990s as compared to landline telephony, which has had a presence on the continent for over 50 years.

Introduction

Cellular phone technology was invented in 1940 and became commercially available in the 1970s. In 1999 it was estimated that by the year 2001, the number of cell phone users worldwide would reach 640 million and hit the 1 billion to 2 billion mark by the year 2003. In 1990 there were just 11 million cellular subscribers worldwide and the number reached 35 million in 1994. In 1998 the figure had jumped to 320 million and today the estimates of cell phone users worldwide is almost 1 billion (*Sunday Times Business Times*, 2001a). Cellular phone use has exceeded that of the Internet which until recently had an estimated 420 million users worldwide, in a remarkably short period of time.

Asia has the world's largest user base of wireless phones, estimated at over 250 million and this number is projected to reach 600 million users by the year 2005 (http://www.economictimes.com). China, Hong Kong, Japan, South Korea, Taiwan, Singapore, Thailand and Malaysia have numbers of wireless phones exceeding the fixed lines. China has the biggest mobile phone market in the world with the number of cell phone users estimated at 212 million and projected to rise to 370 million by the year 2005 (*The Economist*, 2001). Other leading countries in mobile phone technology include the Nordic countries with cellular phone penetration recorded at 60 per cent by September 1999. Other economies like Brazil, South Africa, Spain and the UK have impressive mobile phone densities. In the UK 40 million people own cell phones (Green, 2001).

In Africa during the year 2000 the telecommunication industry grew by 50 per cent. Despite this remarkable growth most of the countries in sub-Saharan Africa have the lowest fixed line teledensity in the world. This is attributed partly to the use of old technology, high tariffs, difficult terrain for laying cables, poor regulatory frameworks, bureaucracy, political instability, etc. Within the SADC region, most of the countries have poor or less developed infrastructures and the cell phone is the ideal technology for communication in such an environment. The cell phone industry is revolutionising communication within the SADC in the same way as happened in Venezuela, where there was no traditional phone infrastructure, but mobile phones spread much more quickly than in the USA (Hodge and Miller, 1997). Cellular telephony represents the best opportunity to bring the power of telecommunications to economically disadvantaged or isolated communities in the SADC region.

Telecommunication infrastructure in the SADC: an overview

The telecommunication infrastructure in many countries of the SADC region remains poor with several countries in the region still having far below the minimum 1 per cent teledensity recommended to make an impact in economic development. A survey of the SADC region in 1999 revealed that Angola had a teledensity of 0.47; DRC, 0.08; Malawi, 0.34; Tanzania, 0.3 and Zambia, 0.86 (http://www.nw.com). The low teledensity in the region is partly attributed to rigid regulatory policies. For example whereas telephone calls costing US$0.10 per minute using the Internet are already being offered to the public in Europe and North America, almost all the countries of the SADC region have restricted or banned Internet telephony (VOIP). In addition, most of the telecommunication providers in the SADC region are still largely state owned although in general the monopoly is on the decline. Liberalisation in most countries of the region and Africa as a whole is considered a risky business by governments who look at basic networks and infrastructure as sources of both revenue and employment.

A cursory look at some SADC telecommunication sectors shows a great deal of variation in telematics infrastructure. In Angola, a long period of war devastated the infrastructure resulting in limited service links outside the capital city Luanda. Most lines outside Luanda remain broken. Whereas in Botswana the telecommunications sector was liberalised in 1996 with the formation of an independent regulator (the Botswana

Telecommunications Authority (BTA)). This ended the monopoly of the national operator – Botswana Telecommunications Corporation (BTC) – although BTC remained the sole provider of telecommunications services especially in the fixed line segment (Tsimane, 2000). In the Democratic Republic of Congo the telecommunications infrastructure is the least developed of the SADC region. This is attributed to long-standing internal conflict. The country has an old, poorly maintained analogue network with very limited circuits. Most public offices do not have phone lines, and the few that exist are not operational at all (Egunjobi and Sigonyela, 2001). In Malawi, the Malawi Posts and Telecommunications Corporation (MPTC) is the sole provider of basic telecommunications services. Malawi has one of the poorest telephone infrastructures in Africa with unreliable links between cities. The availability of new lines is low, with a waiting time of about two years. The MPTC is still in the hands of government, though it is undergoing a slow pace of privatisation. In Mauritius, Mauritel/MTS currently has a monopoly but has been engaged in a slow process of liberalisation that is expected to be completed by the end of 2004 (http://ncb.intnet.mu/mtit/whitepap.htm). Mauritius has Integrated Services Digital Network (ISDN) infrastructure, relatively short waiting times for the installation of new telephone lines and a rapidly emerging range of data communications services such as the Internet, X.25, EDI and fibre optic rings. The government of Mauritius privatised its telecommunication monopoly in 1999. Mozambique was engulfed in 20 years of civil strife and the infrastructure remained devastated for a long time (http://www.tdm.mz). Mozambique has a very limited telephone network outside the major cities though the infrastructure is rapidly expanding and the country is reputed to be one of the few countries in the world to be devoting 5 per cent of its GDP to telecommunications investment.

In Namibia, Telecom is the sole provider of basic telecommunications services. Namibia has a relatively well-developed telecommunications network and X.25 service. The X.25 packet switched network, called SWANET, has local access points in several major cities such as Windhoek, Swakopmund, and Oshakati. The telecommunication company has installed fibre-optic cable. In the Seychelles the government is responsible for regulation of the telecommunications sector. Cable & Wireless Seychelles plc, a subsidiary of the British C&W group is currently the sole telecommunications operator, but plans are underway to end its monopoly. The Seychelles is one of the few countries in the SADC region with a relatively advanced telecommunications infrastructure.

South Africa has the most sophisticated telecommunication infrastructure in the SADC region. The Independent Communications Authority of South Africa (ICASA) is responsible for regulating the telecommunications sector and broadcasting services. The telecommunication operator, Telkom, was partially privatised in 1997 but retains its monopoly on basic services until May 2002. Telkom has achieved connectivity to all 14 SADC member countries and 30 other African countries. Telkom's expansion into several African countries has made it easier to reroute most of the African countries' communication traffic that was previously relayed through Europe to be channelled through South Africa. Telkom has funded connectivity projects in Lesotho and Zimbabwe using the latest fibre optic and terrestrial microwave in order to overcome congestion. It has also provided links in Namibia, Botswana, Swaziland, Lesotho and Mozambique. Through cooperative initiatives, Telkom is assisting African countries to migrate to IP technologies. Telkom is also involved in an ambitious global project that will achieve global connectivity through laying under sea fibre-optic cable that will run from Malaysia via West Africa to Portugal connecting 40 countries, the majority of which are in Africa (http://www.doc.org.za/docs/legislation/telecommunications%20acr.txt; http://www.sptc.co.sz; http://www.icasa.org.za).

Swaziland has a limited telephone network. The Swaziland Posts and Telecommunications Corporation (SPTC) is the sole provider of basic telecommunications services. The *1998 ITU World Development Report* showed that Tanzania had an average of more than ten years waiting time for a fixed phone in 1996 (*The East African*, http://www.telkom.co.za). The Tanzania Communications Commission (TCC) was established in 1995 to regulate the

telecommunications and broadcasting sector while the Tanzania Telecommunications Company (TTCL) provides basic fixed services on the mainland.

In Zambia, the Zambia Communications Authority is responsible for the regulation of the telecommunications sector. Restructuring of the telecommunications sector with a privatisation of the national telecommunications operator has been going on. The Zambia Telecommunications Company (ZAMTEL) is the sole provider of basic telecommunication services. Microwave links are being upgraded to digital and a new earth station is being commissioned to replace one of the two standard satellite stations. In neighbouring Zimbabwe, there is currently no separate regulator and the telecommunication sector is the responsibility of Ministry of Information, Posts and Telecommunications. The government is in the process of establishing a regulatory authority, which would regulate and license telecommunication systems and postal service providers. The Zimbabwe Posts and Telecommunications Corporation (ZPTC) is the sole supplier of basic telecommunications. Zimbabwe has limited but a slowly improving telephone network (http://www.sadc.int/theme.htm).

Most countries in the SADC region are undertaking privatisation or have put in place plans to privatise their telecommunication services. Malawi, Zambia, Namibia, Botswana and South Africa will be offering shares in their telecommunications companies between 2002 and 2003.

Cellular phone connectivity in SADC

The cell phone revolution is being perceived as the panacea for the poor telecommunication infrastructure that characterises the SADC region. With the region having low fixed line teledensity, emphasis is shifting to wireless telephony (Gartner Group, 2000). South Africa has less than 4 per cent Internet penetration and a population of over 40 million people, so mobile communication is becoming a major force in the economy. Demand in South Africa is expected to be strong as the cell phone market expands to reach saturation at 21 million users.

Cell phone country profiles of the SADC region reveal variations in the levels of cell phone infrastructure. In Angola, an analogue cellular phone network currently supports about 7,000 subscribers. Angola Telecom operates a GSM network in a joint venture. In Botswana, the cellular phone industry was introduced in March 1998 when Vista and Mascom started operations in the country. Today there are about 300,000 users of cell phones in the country (Mmegi/*The Reporter*, 2000). In the DRC, Telecel provides local cellular connections in competition with Comcell. A third cell company was recently granted a license to provide services. In Lesotho, Vodacom in partnership with the Lesotho Telecommunication Corporation has since 1995 been providing cellular phone services using a GSM network. In Malawi, Telkom Networks and Celtel Malawi are the main providers of cell phone services. Celtel is expanding its coverage to connect Malawi's principal cities of Blantyre, Lilongwe, Mzuzu and Zomba. In Mauritius, cellular telephony has been provided since 1999 by Cellplus Mobile Communication and Emtel (http://www.webtld.com/emtel). In Mozambique, M-Cell, a GSM cellular provider, provides mobile telephone services and has coverage extending to the major cities of Maputo and Xai Xai. The government of Mozambique is in the process of opening up the cellular phone market for competition. In Namibia GSM cellular services are well developed since services were introduced in the country in 1995. The country has two cellular mobile phone providers. In Zambia, there are three mobile phone service providers: Telecel Zambia, Zamtel and Zamcell. Telcel Zambia officially launched its GSM system in Lusaka with the Voka prepaid programme on 6 September 2000. In Zimbabwe, Econet Wireless and the ZPTC are the main providers of cell phone services. Econet Wireless provides high-speed bandwidth to large corporate clients through its digital microwave network and earth station while the ZPTC operates a small GSM cellular service (http://www.sadc.int/theme.htm).

Mobile phone penetration in the SADC region as in the whole of Africa is growing significantly. In 1998 Africa had 3.5 million mobile phone subscribers with 70 per cent of them in South Africa. Today there are 32 million cell phones in use in Africa with 9 million subscribers in South Africa alone. In

1998, whereas Europe had 37 fixed line phones for every 100 people, Africa had only two. Mobile phones are filling the vacuum. Today, 40 million people in the world are estimated to be on waiting lists for fixed line telephone connections, the majority of them from the least developed countries, which are in Africa. Mobile phones could resolve the lengthy waiting time that has characterised fixed lines on the African continent (Hodge and Miller, 1997).

Mobile phones within the SADC have had the effect of transforming and empowering people who were on the verge of digital isolation. Fierce competition among multinationals and the use of prepaid phone cards has placed the cell phone devices within the reach of many people. Within the region, the number of mobile phone lines within five years has on average surpassed the number of fixed lines installed over four decades. There are now more than 10 million cell phone subscribers in the SADC region against 9 million fixed lines. South Africa boasts more than 9 million cell phone subscribers (Gordon, 2000). South Africa has over 7 million fixed lines, expected to reach 11 million in the year 2005. Apart from South Africa, other countries in the SADC region have shown a significant growth in cell phone penetration. In Botswana the number of cell phone subscribers is estimated at 300,000 giving a teledensity of 18 per cent (*The Botswana Gazette*, 2001). In the DRC where there is on-going civil strife, there is only one landline telephone for every 2,500 people and mobile phone uptake is tremendous. It is predicted that in the next five years, the DRC's cell phone market will be second to South Africa within SADC region.

The growth pattern in teledensity among some SADC member states between 1995 and 2000 is summarised in Table I.

In 2002, SADC member states are expected to experience further growth in the cell phone industry because of new licenses that are set to be issued and the increasingly popular prepaid service. Prepaid services account for 90 per cent of the subscribers within the region. It is projected that the region's cell phone growth will reach 37 million by the year 2005. In South Africa, a third cell phone licence has been issued to Cell C and a second fixed line operator is expected to be licensed by ICASA in May 2002. In Mozambique, the government is set to issue two licences while in the DRC the government will issue four licenses in a bid to revive its telecommunication industry and stimulate the country's growth. In Angola, the cell phone market has been deregulated and it is expected that new entrants will be licensed to operate cell phone services alongside Angola Telecom, which offers both fixed and cellular services. In Tanzania, cellular phone services are provided by Vodacom Tanzania, which operates GSM 1800, and GSM 900 frequencies. Another cellular operator, Tanzania ABN Analogue Cellular Network operates exclusively in Zanzibar. Vodacom Tanzania became operational in August 2000, and connected 50,000 customers in four months of commercial operation after projections in 1999 estimated 10,000 customers within two years (Reuter and Sapa-AFP, 2000). Today, Vodacom Tanzania alone has attracted 80,000 subscribers in a country of 33 million people. The company hopes to reach 270,000 subscribers by the year 2003.

Cellular phone standards

Cell phone technology is developing at a rapid speed and wireless communication standards and capabilities are evolving rapidly across the spectrum. For example in 1979, there was the first generation, 1G (voice only) standard. The second generation, 2G standard (Global

Table I Cellular and fixed line teledensities 1995-2000

Country	Cell phones 2000	Cell phones 1995	Fixed line 2000	Fixed line 1995
Angola	25,800	2,000	69,700	52,740
Botswana	200,000	–	150,000	59,673
Namibia	82,000	3,500	85,714	78,499
South Africa	7,000,000	535,0000	4,002,180	4,961,743
Tanzania	180,000	3,500	173,591	90,270
Zimbabwe	340,000	–	241,000	152,473

Source: Ashurst (2001)

System for Mobile Communications, GSM/ Time Division Multiple Access, TDMA with speeds of 14.4Kbps) emerged in 1992. TDMA is a technology for delivering a digital wireless service using the Time-Division Multiplexing (TDM) technique. TDMA works by dividing a radio frequency into time slots and then allocating slots to multiple calls. TDMA is used by the GSM digital cellular system. In this way, a single frequency can support multiple simultaneous data channels. On the other hand, GSM is one of the leading digital cellular systems. GSM uses narrowband TDMA, which allows eight simultaneous calls on the same radio frequency. GSM has become the *de facto* standard in Europe and Asia.

In 2001 the 2.5G standard known as General Packet Radio Service (GPRS), with speeds capable of 115Kbps, was developed. During the year 2002 it is expected that another standard, the Enhanced Data GSM Environment (EDGE) will emerge. EDGE is a faster version of the GSM wireless service. EDGE enables data to be delivered at rates of up to 384Kbps on a broadband channel. The standard is based on the GSM standard and uses TDMA multiplexing technology. Although the third generation mobile telephony standard (3G) is already available it is yet to take root. The 3G technology is the convergence of different devices, networks and content (http://www.economictimes.com). The 3G telephone will enable users to access not only voice and data, but also video. The 3G cellular technology has Internet-enabled accessibility (known as Wireless Application Protocol (WAP)) (http://www.webopedia.com). The 3G uses the Wideband Code Division Multiple Access (WCDMA) technique. WCDMA is basically a high-speed 3G mobile wireless technology with the capacity to offer higher data speeds than Code Division Multiple Access (CDMA). WCDMA can reach speeds of up to 2Mbps for voice, video, data and image transmission. WCDMA was adopted as a standard by the ITU under the name IMT-2000 direct spread (http://www.webopedia.com/TERM/W/WCDMA.html). On the other hand, CDMA is a digital cellular technology that uses spread-spectrum techniques. Unlike competing systems, such as GSM, that use TDMA, CDMA does not assign a specific frequency to each user. Instead, every channel uses the full available spectrum. Individual conversations are encoded with a pseudo-random digital sequence. CDMA has high security features and is generally a military technology that was first used during the Second World War by the English allies to foil German attempts at jamming transmissions. The allies decided to transmit over several frequencies, instead of one, making it difficult for the Germans to pick up the complete signal (http://www.webopedia.com/TERM/W/WCDMA.html).

Within the SADC, mobile telephony is by and large based on second generation technology that offers voice and text on handsets. Speeds on WAP are however quite low compared to speeds on landlines. In some parts of the region, analogue networks are also still common though new cheaper and efficient GSM and new digital networks are gradually replacing them. Analogue networks are voice-based, cheaper and therefore suitable for lower segments of the market. Many countries such as Tanzania, Botswana, South Africa and Namibia have moved to the GSM technology. However, in Tanzania, cell phone providers are insisting on maintaining the TACS analogue technology because the infrastructure is in place and it is cheaper to deploy. In general, most of the SADC member countries are using the 900MHz frequency band networks. This provides narrow bandwidth and thus has resulted in congestion on the networks prompting the move towards the 1,800MHz band in South Africa and Tanzania. Conventional cellular networks operate at a speed of 9,600Kbits/second which is agonisingly slower than speeds of 560Kbit/s over traditional copper wire telephone networks.

In South Africa, Telkom has introduced new communication technologies such as Dense Wave Division Multiplexing and Packet Wave Architecture that are suitable for competing in a global economy. The telecommunication operator Telkom has also upgraded its telecommunication network from analogue to digital. Recently the MTN and Vodacom cellular network providers applied to ICASA for a GSM 1800mhz spectrum to ease the problem of congestion. ICASA was expected to start issuing 1,800 MHz spectrum to operators by September 2001. The problem of congestion could also be solved by the recent launch of a satellite in South Africa. Satellite communication

provides broadband communication. The satellite is expected to provide total bandwidth of 2,100Mbps – enough to transmit 250 TV channels simultaneously (Pike, 2000). The recent satellite launch is expected to enhance connectivity in rural areas where no fixed line or GSM coverage exists. The satellite will also solve the problem of providing connectivity to rough terrains which are expensive to cover terrestrially as well as offer roaming services globally. Another mobile cellular standard that is gaining wider use is iridium. In Tanzania for example, Plantel is using iridium hand cell technology, which is capable of communicating worldwide from any location (*Sunday Times Business Times*, 2001b).

The diversity of cellular phone standards is an attempt by the industry to solve the problem of inter-network connectivity, enhance international roaming and facilitate heterogeneous connectivity among different computing and telecommunication devices. These efforts are bearing fruit. In South Africa for example some banks such as First National and Absa have managed to interface their automatic teller machines with cell phone providers. This has made it possible for account holders in these banks to use WAP and Wireless Internet Gateway (WIG) services to carry out SMS-based banking. The banking services are offered through the service provider ebucks.com site. Through this site, customers can access their accounts, check balances, make third party payments, change pin numbers and transfer funds from one account to another. First National Bank WIG-based services are available through the MTN network and the bank has currently over 70,000 online banking customers. It is estimated that within South Africa, there are over 60 cell phone models that support WIG based banking services (Stovin-Bradford, 2001).

Challenges of the mobile phone industry

SADC member states face great challenges in their quest to enhance cell phone connectivity. Political and economic instability, lack of telecommunication policies and powerless regulatory bodies, red tape and corruption are some of the problems that service providers in SADC countries face. Within most of the SADC countries, development of telecommunication infrastructure is being hampered by a poor regulatory environment, which places undue emphasis on unnecessary control and censorship. There is widespread reluctance by governments in the region to open up cell phone markets to private and foreign investors. There are also contradictions in emerging telecommunications policies within the member states. In South Africa for example, the new telecommunication bill gives the quasi-governmental telecommunications operator, Telkom and the yet to be licensed second network operator, the exclusive right to provide voice services over the Internet. At the moment such services are restricted. Furthermore, the use of old telecommunication technology in most countries in the region leads to inefficient provision of cell phone services as breakdowns force operators and technicians to spend time fixing faults. The operators have also to contend with cable theft as well as hijacking and robbery of company vehicles and staff. Within the region, regulatory policies tend to suffer from a lack of clarity as regards rights and restrictions, and consequently there are frequent litigations. In South Africa the regulatory authority ICASA has been prompted to warn that the licensing of the second fixed line operator may be delayed because of impending legal challenges.

Skills shortages are common among telecommunication operators and the emerging telecommunication authorities. BTC in Botswana has lost money for the last three years. In one year alone the corporation lost BWP40 million (US$5 million). This prompted the government to set up a commission of enquiry to look into the causes of this loss. The enquiry established that there was a serious skills shortage that led to poor management of the billing system, which consequently led to non-billing and wrong billing, etc. A foreign firm, Irish Development International, has been appointed to manage the affairs of the corporation.

SADC governments are often accused by the service providers of interference in the operations of both telecommunication regulators and telecommunication operators. Additionally, there are often misunderstandings between telecommunication authorities and telecommunication operators. The Botswana Telecommunication Authority found the

manner in which the BTC launched a new service called virtual point of presence, VPOP, unfair and discriminatory. The ruling found out that trials for the new service were carried out using only one Internet service provider (ISP), Botsnet, which is wholly owned by the BTC. According to the ruling USKO the complainant ISP felt that the BTC afforded Botsnet preferential treatment in that other ISPs were neither forewarned of the forthcoming service nor given an opportunity to test VPOP. The BTA also found that the BTC had unreasonably refused to provide leased line connections between USKO and its client, the Water Utilities Corporation. Instead the BTC offered to provide the service directly to the water corporation. Soon after the ruling, the BTC took the BTA to court claiming that the BTA was favouring ISPs (Tsimane, 2001).

Another problem that faces the provision of cell phone services within the SADC is domination by foreign companies. Local companies have problems raising the needed capital to enter into the provision of cell phone services. Consequently in South Africa the government is asking foreign companies to enter into partnership with local companies as a prerequisite to be considered for issuance of licenses to operate the cell phone services (S'Thembiso, 2001).

In general, the SADC member countries have been slow to liberalise their telecommunication sectors because of fear of backlash from the people. In Malawi people are against the privatisation process because of their experience with job losses following the recent privatisation of 36 state-owned enterprises, which resulted in redundancies among the more than 500,000 employees of the state sector (Mmegi/*The Reporter*, 2000b). In addition some of the SADC member countries have not yet put in place telecommunication regulators to lay the foundation for the liberalisation of the telecommunication sector. Those countries with regulatory bodies in place have imposed some restrictions on their independence with some governments considering such authorities as other government departments or state-owned enterprises that can be given political directives (Lekaukau, 2000)

In a number of countries within the region, reception and voice quality over cell phones are not very good. The voice is not quite clear in some places and the low bandwidth of the network technologies supported in a number of places causes congestion. In addition, the different mobile standards now in use in the region frustrate users by the fact that even though they can enjoy international "roaming" within their own region, their phones simply do not function in certain countries. Networks running a range of different systems are known to be inefficient and costly. Coupled with the high cost of cell phone services this makes it difficult to afford for the majority of poor people in the region. In South Africa local calls on the Vodacom network are chargeable at R2.75 (US$0.36) per minute during peak hours and R1.50 during off peak hours (US$0.19).

The SADC countries are also faced with other challenges relating to inadequate policies and regulatory frameworks. For example, the privatisation process of the telecommunication sector in most of the countries has no clear policies. Additionally, most countries do not have an adequate government institutional framework to manage the privatisation process. In the absence of such a broad based framework, problems of how to deal with issues such as ownership of privatised state assets and the rights of existing shareholders arise and cannot be effectively dealt with. Additionally, most regulatory bodies are facing budgetary constraints making it difficult for them to recruit and retain qualified staff. Furthermore, telecommunication regulators are generally weak in mandates to bring a greater range of communications services at affordable prices. Another challenge facing telecommunications regulatory bodies is the fact that telecommunication regulation is a relatively new phenomenon and most regulatory entities lack the experience to handle the many issues that affect them. Regulatory bodies increased from 12 in 1990 to 30 in 1994 and reached 96 in the year 2000. With such a short history of telecommunication regulation, the skills problem is critical in many countries. Lack of harmonisation of regulatory procedures for Internet provision, broadcasting and telecommunication services is a common problem within SADC member states. Other challenges include having to cope with rapid change and the use of new technology, and consumer issues such as pricing and the convergence of technologies. It is also common to find that most national telecommunication operators are the

custodians of bandwidth and are at the same time cell phone service providers. This conflict of interest leads to partiality in the way bandwidth is apportioned to competing players in the market. In Botswana the national telecommunication operator, which is also the bandwidth provider, has sought license from the Botswana Telecommunication Authority to operate cellular services (Lekaukau, 2000).

The cell phone operators face the daunting task of rolling out the network and developing infrastructure in remote areas of the SADC (Egunjobi and Sigonyela, 2001). In addition, most of the existing telecommunication network is analogue. In addition, most of the SADC member states do not have in place information technology and telecommunication policies, which are necessary to guide infrastructure development, and pricing regimes. It is only recently that some countries of the region such as Botswana and South Africa have started to contemplate putting in place legislation to bring about policy formulation in this area. Within the region, cell phone companies have been accused of paying little attention to environmental issues when laying out the networks and are being compelled by governments to mask their cellular masts as trees, windmills, billboards and other objects.

The SADC member states have been accused of interfering in the operations of cell phone services. The South African Government requires new entrants in the fixed telephone operations to build their own network and comply with stringent social obligations. This requirement is thought discriminatory, as broadband operators are not given any social obligations. The government has also introduced a controversial fixed mobile licence, which allows fixed line operators to offer mobile services, but this does not allow mobile operators to provide fixed line services. The government also insists that the second fixed line operator, which will be licensed by May 2002, must have partnership with state-owned enterprises Esi-Tel and Transtel in order to enhance maximum use of Eskom's infrastructure, which was built through government funds (Paton, 2001).

As the region continues to liberalise its telecommunication sector, new entrants into the cell phone markets are facing opposition from the quasi-governmental incumbent operators, who fear competition. In South Africa Telkom has raised objections about the new operators, citing the exclusivity privilege that the government granted it especially in the area of voice services. Telkom is against the new voice networks that new operators are set to lay in low-income areas especially cellular payphones, arguing that it stands to incur losses. Telkom is therefore contemplating court action to stop the licensing of new cell phone operators.

Impact of the cellular phone economy

The cell phone industry has had positive effects on the economic growth of many countries worldwide. The South African telecommunication industry today contributes 4 per cent of GDP with the mobile phone industry contributing 12 per cent of this growth (*Sunday Times Business Times*, 2001c). With more licences for cell phone operators being issued by governments within the region, competition is forcing costs to come down and in effect enhancing cell phone uptake by a majority of people. In addition the industry is creating new jobs in the market and therefore contributing to the economic development of the region. Cellular operator Vodacom currently employs over 3,500 people in South Africa, and 140 staff in Tanzania. In addition to creating new jobs, the cell phone sector has rolled out networks to most marginal areas of the region thus improving phone communications. Additionally, investments by cell phone companies have enhanced skills development through training of the new employees both locally and abroad. Other benefits that have accrued from the new industry are in the area of providing community services. In South Africa for example cell phone companies are required as part of their licence obligation to provide services to communities in which they operate. Consequently, cell phone operators are providing schools, clinics, roads and water services to local communities (Wood, 2000).

Mobile phones have spread within the region and reached the most previously marginalised sections of the population. In South Africa mobile phones have widely spread to townships and are being used by the youth, market traders, taxi drivers, vegetable vendors, sex workers, etc. The ubiquity of the cell phone handset has revolutionised the

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people's lives and empowered them to participate actively in national life especially in the area of business and communication.

The impact of the cellular phone industry within the SADC region has varied from country to country. In South Africa cellular networks have stimulated business for Telkom's fixed line network through the use of the latter's infrastructure. In Botswana, the boom in the cell phone industry is causing loss of business for other sectors such as the beer, food and textile industries. It is estimated that Botswanans are spending almost BWP25 million (US$5 million) a month on cell phones, reducing their ability to spend money on other items such as food, clothing and entertainment (Mogapi, 2000).

Although mobile telephony offers enormous advantages, it has been associated with a number of undesirable effects. There are concerns about the negative environmental impact, health and safety. It is believed by some that the radiation emitted by the substations of cellular networks could be detrimental. Additionally, obliteration of traffic signage by cell phone masts, antennae and billboards is reported to be contributing to motor accidents within the region. Motor accidents have also recently been attributed to drivers who talk on their handsets while driving. Consequently, the South African Government has imposed a ban on using cell phones while driving and put in place legislation that would give offenders a jail sentence of up to one year. In neighbouring Botswana, the government is contemplating putting in place similar legislation to curb the ever increasing number of motor accidents attributed to cell phone use while driving. In the rest of the world, countries such as Australia, Austria, Denmark, Hungary, Italy, Latvia, Portugal, Poland, the Slovak Republic, Slovenia, Spain and Switzerland have outlawed the use of cell phones while driving (Botha, 2000).

Potential of cell phone applications in libraries

The cell phone evolution has spawned a new generation of hybrid or convergent devices that mix and match such features as Web browsing and calling capability, organising appointments, phone numbers and addresses like personal digital assistants, and contact management. The development of cell phone technology has the potential to offer many new possibilities for accessing information from online catalogues, online databases, the Internet and virtual libraries. The wireless technologies that have been tested and proved workable in library environments include digital cellular technologies, packet radio and wireless local area networks. In Europe and the USA, there are several projects demonstrating wireless applications in library settings. The Library Without a Roof Project, at the University of South Alabama, the Wireless Andrew Project, at Carnegie Mellon University and the Ricochet Wireless Project, at the University of California (Santa Cruz) are cases in point. These projects have demonstrated that it is possible to use wireless technologies to access online public access catalogues, commercial online databases and the Internet (http://www.educause.edu/ir/library/text/CNC9640.txt). Recently, the convergence of cell phones and the Internet through the WAP standard and the tremendous growth of the Internet coupled with the proliferation of electronic information resources presents libraries with a real opportunity to deploy cell phone technology to manage their operations.

The use of cell phones in libraries could be implemented in the same way as the two-way cellular communication technology, which like voice transmission, uses analogue radio signals. In the simplest configuration, a user is able to plug a computer equipped with a modem into a cellular phone using a cellular data interface so the two can exchange data. This method was successfully used in testing wireless online searching capability. Similarly, several libraries have used existing analogue cellular voice services to connect "bookmobiles" to online catalogues. Wireless analogue cellular has been found to be the least expensive option in terms of equipment expenditure, and provides accessibility to the Internet and electronic resources anywhere. It also gives the user unrestricted mobility, is quite secure for a one-to-one connection and has great simplicity because of its single login. However analogue wireless has the problem of high transmission costs, a low speed of about 9,600Kbps and poor reliability. Recently, Microcom has been addressing the problem of speed, and has so far been able to develop a proprietary MNP 10 cellular networking protocol to be used in modems

(http://www.educause.edu/ir/library/text/CNC9640.txt).

Another development that makes the application of mobile phones in libraries possible is digital cellular technology, which was developed to overcome the shortcomings of analogue signals in delivering data. There are two major types of cellular transmission technology available for use in circuit switched networks: Time Division Multiple Access Code (TDMA) and CDMA which have already been referred to earlier in this paper. They translate analogue data into digital bits and in this way they are able to achieve great transmission speeds and greater accuracy of data. A variant form of digital cellular technology called the Cellular Digital Packet Data (CDPD) Service has also been developed. This technology translates data into digital packets and allows these packets to be transmitted over the wireless network. CDPD has the advantage of offering greater transmission data speeds and greater reliability than any of the circuit switched networks.

Packet radio communication holds much potential for data transmission though it has not received much support from the library community. Additionally, the existing commercial services such as Ardis and RAM Mobile Data offer little support for practical library applications. The potential for packet radio networks in libraries could be achieved through locally developed systems. In the mid-1980s research into the applicability of wide area packet radio networks in libraries indicated that a suitable device for library applications could be engineered and that packet radio networks held more potential for library networking applications. One of the attractions of packet radio is the ability to support TCP/IP commonly used in the wired Internet network and the minimal transmission costs once the operating equipment is put in place. However library applications through this technology are still in the formative stages and the geographic coverage is limited to line-of-sight. The other type of wireless technology that holds potential for library applications is the wireless local area network (LAN), which operates in the same way as conventional computer LANs except that there is no need to lay costly phone lines and coaxial cabling. Three types of wireless LANs that are available on the market include infrared, microwave and spread spectrum (http://www.educause.edu/ir/library/text/CNC9640.txt).

The Regional Network for Africa, RINAF (UNESCO programme), the Universal Data Flow and Telecommunication (UDT) programme for the IFLA and HealthNet have used packet radio successfully to overcome the isolation of libraries in developing countries. The RINAF and UDT programmes have used packet radio, which operates on similar technology to cell phones to create computer links among libraries where land-based communications were unreliable, underdeveloped or absent. Similarly, HealthNet, a medical information network has used packet radio effectively in Zambia, Uganda, Tanzania, Kenya, Mozambique, Malawi and Zimbabwe to provide access to health information. Use of packet radio has shown that networks based on this technology can implement either single terminal-to-host links or larger peer-to-peer networks. The RINAF data conveyance infrastructure has succeeded in bringing about basic Internet services (e-mail, bulletin boards, access to databases, discussion lists, etc.) to several African countries. Similarly, UDT has facilitated the international and national exchange of electronic data by providing the library community with pragmatic approaches to resource sharing in a number of developing countries. The programme monitors and promotes use of relevant standards and technologies to overcome barriers to the electronic transfer of data in library fields (http://www.ifla.org).

The prospects for using wireless solutions for library procedures are further enhanced by the fact that most of the providers of Local Area Wireless Network solution components are well established companies such as CISCO/Aironet Systems, Microsoft, Hewlett Packard, Compaq, NEC, Dell and Apple (http://ww.lita.org/forumY2K/Park/tsld009.htm). It is important, however, in selecting a wireless solution to automate library procedures to consider among other factors the suppliers' interest in the project; the computing potential of both hardware and software; the costs of hardware and software development; ease of operation and integration with other network devices; quality of support; costs related to upgrades

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and maintenance; reliability, ease of use; speed, etc.

The foregoing discussion of wireless technologies for library applications demonstrates that it is possible for cell phones which operate using similar technology to packet radio to be deployed for library operations. The use of wireless connectivity in libraries for searching of online catalogues, automation of inventory procedures and collection of serials usage data has been reported. If cell phones were to be successfully deployed in libraries they would facilitate direct access to library information anywhere at any time. The technology would also offer computer network access in buildings not suitable for wired networks.

Wireless connectivity has the potential to improve access not only to the library's holdings but also to information in cyberspace, online catalogues, electronic texts and other Internet resources. It is possible that the use of digital cellular and packet radio networks in libraries would offer entirely new ways of connecting computers to organisation wide mainframes and networks thus offering flexibility and cost savings.

The mobility of wireless networks would enhance the computing needs of both the busier library professional and the user on the move.

Despite the prospects of deployment of cell phones in libraries, it is important to note that wireless technologies are still in their infancy as far as library applications are concerned and a lot of research is needed to determine how they can be practically harnessed for use for library operations. Recent technological development in cell phone connectivity provides an impetus for increased research and commercial development in these areas.

The librarians and other stakeholders must take the initiative to liaise with cell phone service providers, Internet service providers, telecommunication experts and library systems developers to determine how well cell phones can be used to automate library procedures. The success of wireless networks in libraries gives hope that cell phones could be reconfigured to enhance and provide information services within the library and beyond.

Conclusion

Developments in wireless networks and WAP technology and the increasing deployment of wireless technology in libraries give more hope that the ubiquitous mobile phones could be used in the not too distant future in libraries to provide direct access to library online catalogues, commercial online databases and virtual libraries. Current liberalisation of the telecommunication sectors in SADC member states also provides a perfect opportunity for cellular connectivity to be spread to the most remote parts of the region. Some form of infrastructure consisting of telecentres and cyber cafés already exists in Zambia, Mozambique, South Africa and Swaziland and could form the basis for deploying cellular phone networks in libraries when the technology has matured. For this to happen library professionals must take the lead and initiate programmes as well as lobby their governments to consider subsidising the poorest people to have access to mobile phones or to distribute free prepaid mobile phone cards on a large scale. Such steps would give a big boost to the cell phone revolution that has so far been the privilege of a few rich people. Governments should adopt policies that would enhance adoption of telecommunication technology through the strengthening of regulatory bodies, dismantling monopolies in the telecommunication industry and encouraging cell phone providers to target areas and communities that were otherwise neglected. Governments should also be flexible in the regulation of the telecommunication sector in order to make it possible for the infrastructure and frequencies to be used for other purposes other than those for which they were licensed. The need for governments to consider zero-rating the taxation period on imported equipment to enhance uptake of telecommunication services cannot be over emphasised.

It is possible that once wireless technology has matured to a level at which it can be deployed in libraries, WAP-enabled cell phones could be effectively used to provide users with access to local public access catalogues, remote OPACs and bibliographic, full text, numeric and image databases. The

cell phones could also be used to provide interlibrary loan requesting, document delivery, cooperative and shared cataloguing, acquisitions processing, etc.

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