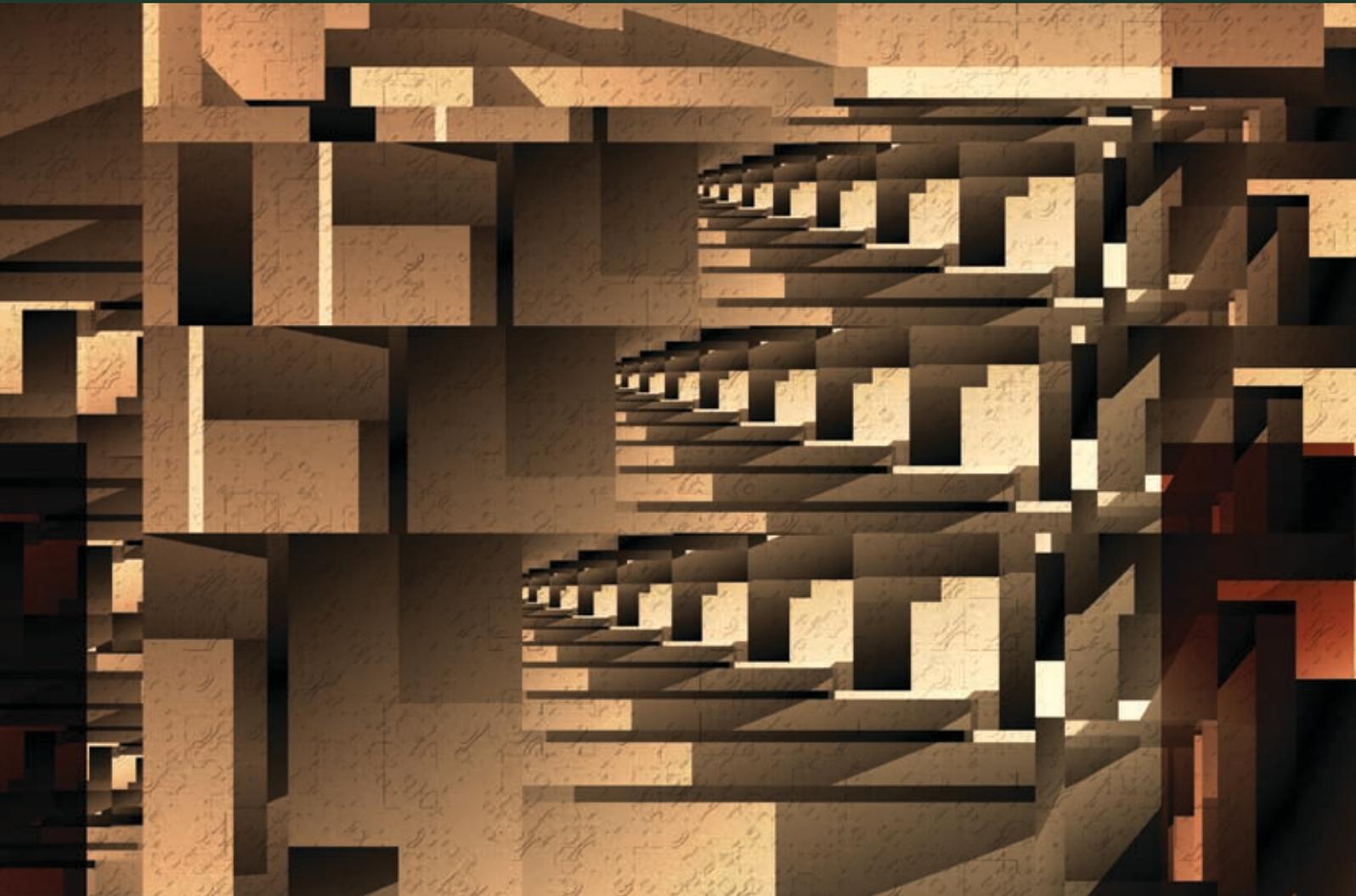




**SARUA Leadership Dialogue Series Volume 2 Number 3**

# **ICT INFRASTRUCTURE AND CONNECTIVITY: New Capacity, New Opportunities**



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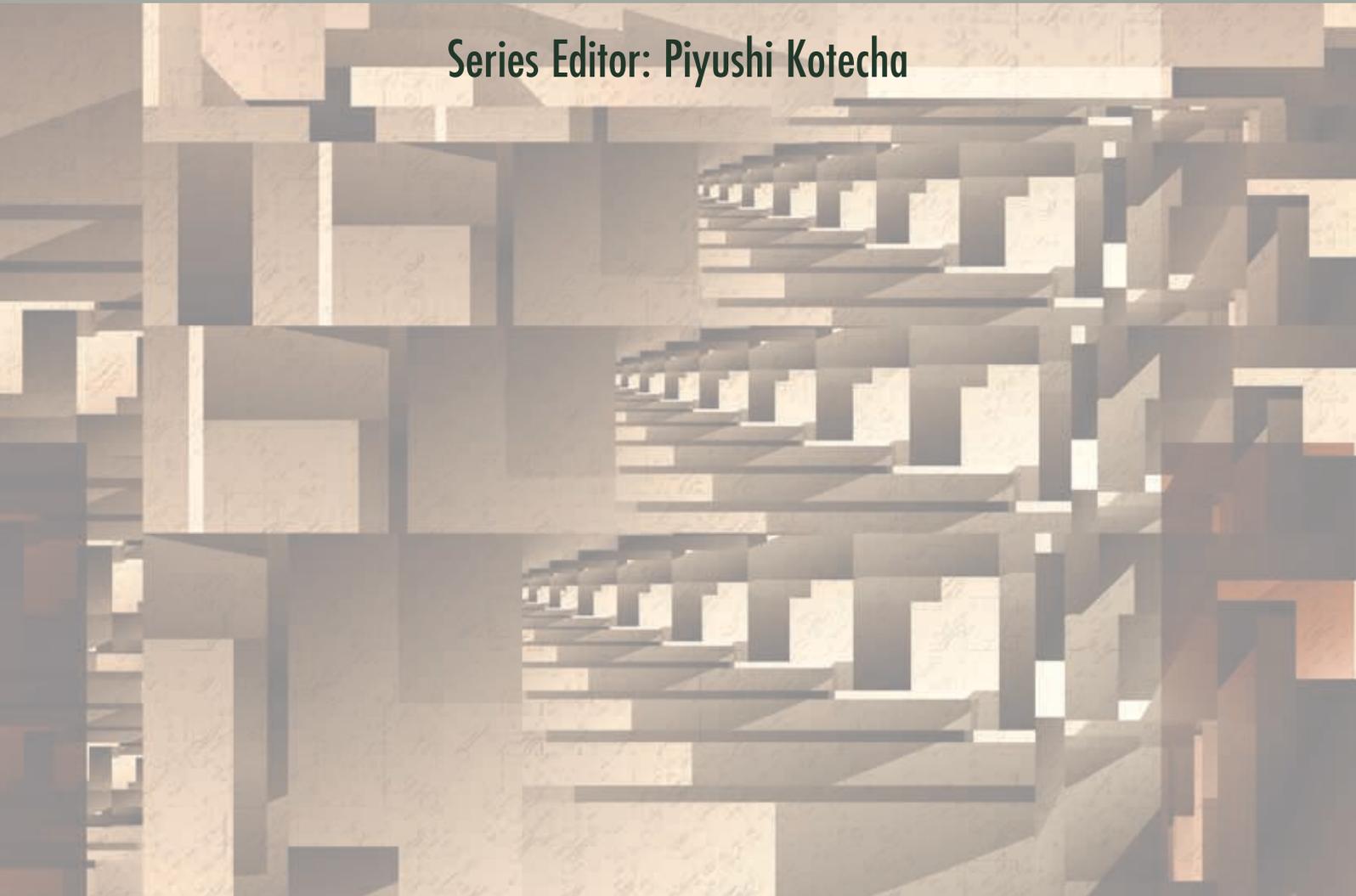




**SARUA Leadership Dialogue Series Volume 2 Number 3 2010**

# **ICT INFRASTRUCTURE AND CONNECTIVITY: New Capacity, New Opportunities**

**Series Editor: Piyushi Kotecha**







# FOREWORD

If universities in Southern Africa are to be able to truly participate and contribute to the global knowledge economy, then access to affordable high speed broad band connectivity is not a luxury; rather it is an absolute necessity. It is therefore indeed a pleasure to be the bearer of good news, and good news is what this SARUA publication, the third in the Leadership Dialogue series for 2010, undoubtedly contains.

The publication contains a selection of three papers presented to an audience of 70 senior higher education leaders, at a SARUA Executive Focus event '*ICT Infrastructure and Connectivity: New Capacity, New Opportunities*' held on 6 August 2010, at the University of Dar es Salaam in Tanzania. The conference was aimed at bringing university leaders up to date on the rapid progress in ICT connectivity that has been achieved across the region in the last 2-3 years.

In 2007 only three SADC countries (South Africa, Angola and Mauritius) had access to an international optic fibre cable (SAT3/SAFE) whilst the remaining 11 countries had to rely largely on satellite cable and dial up connections. The result was that most countries' bandwidth then was still below 100 Mbps.<sup>1</sup> Thankfully the days of agonizingly slow, hugely expensive and completely inadequate connections are hopefully about to become distant memories. As Alex Twinomugisha reports in his article, three new submarine cables along the East African coast have become operational in the last year alone, meaning that every SADC country with a coastline, save Namibia and the Democratic Republic of Congo, now has access to at least one international cable, with the latter two countries promised access by 2012 as the submarine cables on the West Coast of Africa come on stream.

Freed from the shackles of monopolistic national telcom networks and satellite service providers, Southern African universities now have a unique opportunity to use their collective purchasing power to secure previously unimagined capacity at vastly cheaper rates from various different international fibre optic cable operators, who are all in competition with one another. The route to this, for universities and research institutions, is to form their own National Research and Education networks (NRENs), which then collectively purchase capacity for all the universities in the country, hence securing the best possible price. Thereafter NREN's manage such capacity on behalf of their member institutions, ensuring everyone receives the benefits in an equitable manner.

SARUA will continue to monitor events as they develop, and through its member universities to work closely with the UBUNTUNET Alliance, national NRENS and other significant players, contributing where we can, to further positive developments in this arena.

**Piyushi Kotecha**  
**Series Editor**  
**Chief Executive Officer**  
**SARUA**

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<sup>1</sup> SARUA (2007) 'A Status review of ICT in universities in the SADC Region'

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The opinions expressed in this publication are those of the authors and do not necessarily reflect the views of either SARUA or the Netherlands Ministry of Foreign Affairs.

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# CONTENTS

<b>FOREWORD</b>	3
<b>ABBREVIATIONS</b>	6
<b>INTRODUCTION</b>	7
<b>RECENT DEVELOPMENTS IN ICT INFRASTRUCTURE AND CONNECTIVITY: NEW CAPACITIES, NEW OPPORTUNITIES - <i>Alex Twinomugisha</i></b>	8
• Abstract	8
• Introduction	8
• Review of connectivity infrastructure developments in SADC	9
– International connectivity - Connecting SADC to the rest of the world	9
– Regional connectivity	11
– National fibre backbone networks	11
• Developments in research and education networking	12
• Opportunities	13
– Research and Education networking now a real possibility	13
– Growth of mobile cellular Internet services	14
– Government focus on ICT skills development and Knowledge Society development	15
• Conclusion	16
<b>INNOVATIVE MODELS FOR FINANCING ACCESS TO BANDWIDTH - <i>Duncan Martin</i></b>	17
• Abstract	17
• SEACOM bursts upon the scene	17
• SEACOM's offer to TENET	18
• Backhaul to the campuses – SANREN	18
• Financing the purchase	19
• Consultation and decision	20
• Loan from the DBSA	20
• Is it working?	21
• The need for redundancy	21
• Conclusion: the NREN is key to sharing resources	22
<b>AFRICACONNECT: CONCRETE POSSIBILITIES - <i>John Kondoro</i></b>	23
• Abstract	23
• Introduction	23
• Efforts taken to address the problem of digital divide	24
• Education networks and connectivity in africa	25
• Genesis of AFRICACONNECT and its role	26
• Opportunities under the AFRICACONNECT initiative	27
– Good Internet connectivity	28
– Telemedicine applications	28
– Sharing High-performance Computing facilities	28
– Sharing expensive scientific facilities	28
– e-Services	29



- Challenges in the implementation of AFRICACONNECT 29
  - Capacity building 29
  - Education 30
- The way forward 30
  - Awareness, Will and Capacity 30
  - The creation of NREs 30
  - Appropriate policy and regulatory environment 30
- References 32

# ABBREVIATIONS

3G	-	Third Generation
4G	-	Fourth Generation
ACE	-	Africa Coast to Europe
AMCOST	-	African Ministerial Council on Science and Technology
ARAPKE	-	African Regional Action Plan on the Knowledge Economy
AXIS	-	African Internet Exchange System
BTC	-	Botswana Telecommunication Company
CPA	-	Consolidated Plan of Action
CEC	-	Copperbelt Electricity Company
CSIR	-	Centre for Scientific and Industrial Research
DBSA	-	Development Bank Southern Africa
DRC	-	Democratic Republic of Congo
DST	-	Department of Science and Technology
ESCOM	-	Electricity Supply Corporation of Malawi
EU	-	European Union
HPLC	-	High Performance Liquid Chromatography
ICT	-	Information and Communication Technology
IT	-	Information Technology
ITU	-	International Telecommunications Union
MAREN	-	Malawi Research and Education Network
MTL	-	Malawi Telecommunications Limited
NEPAD	-	New Partnership for Africa's Development
REN	-	Research and Education Network
S&T	-	Science and Technology
SADC	-	Southern African Development Community
SANReN	-	South African Research and Education Network
TENET	-	Tertiary Network of South Africa
WACS	-	West African Cable System
ZAMTEL	-	Zambia Telecommunications Company Limited



# INTRODUCTION

Considerable progress has been made in providing networking connectivity to universities in Southern Africa since SARUA published its groundbreaking studies on *Optical Fibre for Education and Research Networks in Eastern and Southern Africa (2006)* and *ICT: A Status Review of ICT in Universities in the SADC Region (2007)*. Since then there have been significant developments in the liberalisation of telecommunication policy, together with increased investments in national fibre backbones, and the arrival of new undersea cables the environment has changed in which universities seek to increase access and connectivity.

SARUA convened a leadership dialogue to foreground the major changes in ICT access and connectivity that have taken place over the last several years, to assess the implications thereof and to investigate the options for taking full advantage of the benefits emanating from these new developments. This publication documents the papers delivered to stimulate the discussions at the workshop held at the University of Dar es Salaam, on 6<sup>th</sup> August 2010.

The first paper, by Alex Twinomugisha, *Recent Developments in ICT Infrastructure and Connectivity: New Capacities, New Opportunities*, provides an update on the most recent developments to increase ICT infrastructure and bandwidth. The author addresses key developments in policy liberalisation, increased investments in national fibre backbone, and recent developments in the undersea cables on the coasts of Africa. The author explores the opportunities for universities of increasing capacity in this context.

The paper by Duncan Martin, *Innovative Models for Financing Access to Bandwidth*, is a case study of the Tertiary Education Network of South Africa (TENET) with a resourceful approach to developing and negotiating favourable funding terms from industry to finance access to cheaper bandwidth. TENET members now enjoy access to hugely improved bandwidth capacity at a fraction of the price they previously paid. This article, which explains exactly how they set about this, is a hugely illuminating story, not just about the technicalities of linking universities up to optical cables, but about how trust and collaboration between universities can enable them to surmount financial and technical challenges that they could never have done on their own.

Looking at the larger picture, John Kondoro's article covers a number of exciting initiatives aimed at overcoming the so-called "digital divide" that has kept Africa as a continent out of the mainstream of information and knowledge production for so long. Specifically the AfricaConnect project, part of an AU-EU partnership in Science, Information Society and Space, has the immediate objective of facilitating a regional Research and Education Network (REN) connected to GEANT under the auspices of the UBUNTUNET Alliance.

**August 2010**

# RECENT DEVELOPMENTS IN ICT INFRASTRUCTURE AND CONNECTIVITY: NEW CAPACITIES, NEW OPPORTUNITIES

- Alex Twinomugisha<sup>2</sup>

## ABSTRACT

This paper reviews the most recent developments in Information and Communication Technologies (ICTs) in the Southern African Development Community (SADC) region. It discusses and documents advances in international, regional and national telecommunications infrastructure (primarily fibre optic cable), available network bandwidth and other ICT capacities. In summary, this paper establishes that there is now adequate fibre infrastructure available in almost every country in SADC for universities to take advantage of. The report also looks at the opportunities provided by the emergence of Third Generation (3G) and broadband mobile cellular services. The paper concludes by making suggestions on how universities in the region could exploit these emerging ICT capacities and opportunities.

## INTRODUCTION

In 2007, the Southern African Regional Universities Association (SARUA) commissioned and published a study<sup>3</sup> on the status of Information and Communication Technologies (ICTs) in public universities in the Southern African Development Community (SADC) region.<sup>4</sup> The study reviewed the availability and usage of ICTs in the universities to support teaching, learning, research and administration. The study also looked at the availability of high-speed ICT infrastructure (focusing on fibre optic networks) in each country and in the SADC region as a whole. The study found that universities in the region were making commendable efforts to integrate and use ICTs across all functions of the university, but there remained challenges. One of the biggest challenges was cited as the cost of access and the amount of bandwidth. Bandwidth in this case refers to the capacity of a data network, often expressed in bits per second, units which most non-technical people would call the 'speed of the Internet connection'.

<sup>2</sup> Alex Twinomugisha is the Africa Regional Director and Country Programme Manager for the Global e-Schools and Communities Initiatives in Nairobi. E-mail: [atwino@yahoo.com](mailto:atwino@yahoo.com) or [alex.twinomugisha@gesci.org](mailto:alex.twinomugisha@gesci.org).

<sup>3</sup> Twinomugisha, A. 2008, ICT: A Status Review of ICT in Universities in the SADC Region, SARUA [online] available at [http://www.sarua.org/files/publications/ICT%20Strategy\\_Full.pdf](http://www.sarua.org/files/publications/ICT%20Strategy_Full.pdf) accessed 7 September 2010.

<sup>4</sup> The SADC region comprises the following countries (member states): Angola, Botswana, the Democratic Republic of Congo (DRC), Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, Swaziland, South Africa, Tanzania, Zambia and Zimbabwe.



The quantity, quality and cost of bandwidth to the universities is mainly determined by the reach and capacity of their country's telecommunications network, its links to the region and the rest of the world and the overall regulatory environment in place. As such, universities are more likely to have much more and cheaper bandwidth if they are in countries with well-developed national telecommunications networks based on optical fibre cables, with direct access to international submarine fibre networks and a competitive and deregulated telecommunications sector. Further, the need for specialised educational and research applications and global research collaboration in addition to 'regular' Internet connections often requires universities to develop dedicated high-speed Research and Education Networks (RENs).

Because of the importance of national and regional connectivity infrastructure to the universities' own connectivity requirements, this paper attempts to review progress made by SADC countries and the region as a whole in improving their ICT infrastructure since the 2007 SARUA ICT report. This paper also looks at the progress universities have made in establishing and operating RENs at the national and regional level. Lastly, the paper makes suggestions and recommendations for universities to take advantage of developments in the ICT sector in their own countries and in the SADC region as a whole.

## REVIEW OF CONNECTIVITY INFRASTRUCTURE DEVELOPMENTS IN SADC

The review of connectivity infrastructure is based on an 'Open Access' network model concept which assumes that a typical telecommunications network's reach can be divided into four distinct parts: institutional or campus network, an access network or last mile, a national high speed network or backbone and an international segment that links to the outside world.<sup>5</sup> For purposes of this review, only developments in the national and international network segments are addressed. Nonetheless, it must be stressed that the campus and access portions of the network are also vital for good, reliable, high-speed connectivity.

### International connectivity - Connecting SADC to the rest of the World

In the latter part of 2007, the SARUA report noted that 'Of the 14 SADC countries, only three (Angola, South Africa and Mauritius) had access to one international fibre (SAT3/SAFE)' and that 'most countries' international bandwidth was still below 100Mbps.<sup>6</sup>

The situation has changed, quite dramatically, for the better, since then. In the last year or so, three new submarine fibre cables have become operational on the east coast of Africa. In mid 2009 Seacom, with a total capacity of 1.28 terabits per second, became the first cable to become operational.<sup>7</sup> This was followed in 2009 by the launch of the Lower Indian Ocean Network or LION cable connecting Mauritius, Reunion and Madagascar to each other and to the rest of the world through the SAT3/SAFE cable system.<sup>8</sup> And in mid July 2010, the East African Submarine Cable System dubbed EASSy became operational.<sup>9</sup> These three cables together have added a whopping 4 terabits per second of new bandwidth capacity in the last year alone.

5 InfoDev 2005 Open Access Models, Options for Improving Backbone Access in Developing Countries (with a Focus on Sub-Saharan Africa), Final Draft An infoDev Technical Report prepared by SPINTRACK A B

6 Twinomugisha, A. 2008, ICT: A Status Review of ICT in Universities in the SADC Region, SARUA [online] available at <[http://www.sarua.org/files/publications/ICT%20Strategy\\_Full.pdf](http://www.sarua.org/files/publications/ICT%20Strategy_Full.pdf)> (accessed 7 September 2010).

7 Seacom. 2009, 2009 highlights newsletter, [online] available at <[http://www.seacom.mu/newsletters/SEACOM%20Newsletter\\_dec%2009.pdf](http://www.seacom.mu/newsletters/SEACOM%20Newsletter_dec%2009.pdf)> (accessed 7 September 2010).

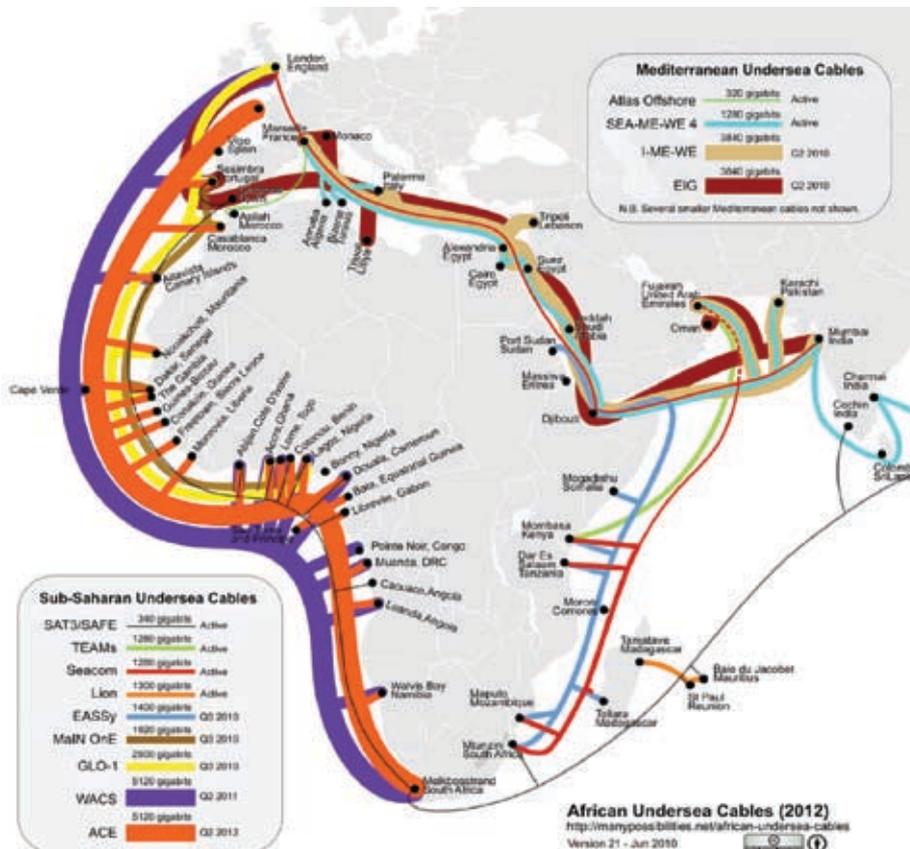
8 Orange Telecom, press release, [online] available at <[http://www.orange.com/en\\_EN/press/press\\_releases/att00014090/CP\\_cableLION\\_VA\\_.pdf](http://www.orange.com/en_EN/press/press_releases/att00014090/CP_cableLION_VA_.pdf)> (accessed 7 September 2010).

9 Daily Nation, 2010. Eassy to go live on Friday, [online] available at <<http://www.nation.co.ke/business/news/Eassy%20to%20go%20live%20on%20Friday/-/1006/957368/-/itnfhvz/-/index.html>> (accessed 7 September 2010).

As of July 2010, every SADC country with a coastline, save for Namibia and the Democratic Republic of Congo (DRC), has had access to at least one international submarine cable. To date, South Africa now has direct access to SAT3/SAFE, Seacom and EASSy; Tanzania and Mozambique have EASSy and Seacom, Madagascar has EASSy and LION (connecting to SAT3), and Mauritius has access to SAT3/SAFE and LION. These cables have led to dramatic increases in international bandwidth capacities for almost all countries. For example, Seacom estimates that bandwidth supply in Mozambique and Tanzania had grown by 850% and 1000% respectively by the end of 2009, just a few months after becoming operational.<sup>10</sup>

By the end of 2012, there will be more international submarine fibre cables available with the DRC and Namibia also having direct cable access. Two fibre cable networks are under deployment at the moment on the Atlantic ocean side of Africa: cables of the Africa Coast to Europe (ACE) and the West African Cable System (WACS) are expected to connect South Africa, Namibia, Angola and DRC to other countries on the West African coast and then on to Europe. There are even recent announcements<sup>11</sup> that Seacom will tie up with Nigeria's Main One thus providing additional capacity to the West African coast and an alternate and backup route for East African states to Europe. The map below captures all the existing and planned submarine fibre cables through to the end of 2012.

Figure 1: Map showing existing and planned submarine fibre cables for Africa until 2010.



Source: <http://manypossibilities.net/african-undersea-cables/>

10 Seacom. 2009, 2009) highlights newsletter, [online] available at <[http://www.seacom.mu/newsletters/SEACOM%20Newsletter\\_dec%202009.pdf](http://www.seacom.mu/newsletters/SEACOM%20Newsletter_dec%202009.pdf)> (accessed 7 September 2010).

11 Techcentral, 2010. Seacom, Main One team up for new cable, [online] available at <<http://www.techcentral.co.za/seacom-main-one-team-up-for-new-cable/14155/>> (accessed 7 September 2010).



## Regional connectivity

At the regional level, there have been significant developments in intra- and inter-country connectivity. In 2007, the landlocked countries of Malawi, Zambia, Zimbabwe and the island nation of Madagascar did not have optical fibre connections to their neighbours. These countries relied extensively on telecommunications satellites (using Very Small Aperture Terminals or VSATs) and low-capacity radio links to their neighbours for their international voice and data connectivity. Today, all of these countries have optical fibre links to their neighbours and on to the international submarine fibre cables: Malawi through Mozambique, Zambia through Namibia, and Zimbabwe through Botswana and Madagascar via LION. Moreover, more cross-border fibre connections are on the way as national backbones are rolled out and extended. Another important development in the region is the increased competition in South Africa, which is a main telecommunications transit point for all the landlocked neighbours and Namibia. The entry of the second national operator with increasingly extensive network coverage is likely to reduce telecommunications transit costs to the advantage of both South Africa and its neighbours.

## National fibre backbone networks

At the national level, there have also been significant developments with new national fibre backbones deployed in several countries. In 2007, DRC, Malawi and Tanzania had no backbone to speak of. Zimbabwe, Zambia and Mozambique had some significant fibre networks but no comprehensive backbone. By the end of July 2010, government-backed (either directly or through state-owned teleco) optic fibre backbones with increasingly extensive reach that are now active in Tanzania, Zambia, Mozambique, Madagascar and Malawi.

## Summary of major developments in selected countries:

### *Tanzania*

Of all the countries in the SADC region, Tanzania has recorded the most dramatic improvement in both national and international connectivity in the space of just about a year. EASSy and Seacom both have landing points in Tanzania. Even more important, Tanzania is well on its way to deploying an extensive national fibre backbone. Already, phase one covering most of the northern, eastern and western parts of the country is active, with connections to Rwanda, Burundi, Kenya and Uganda, and Phase 2 is expected to be operational later in 2010 or early 2011, covering the central and southern parts of the country with connections to Malawi and Zambia.<sup>12</sup>

### *Zambia*

Zambia has had some fibre in-country for a while now. The electricity company ZESCO Limited, the state-owned telco Zambia Telecommunications Company Limited (ZAMTEL) and the Copperbelt Electricity Company (CEC) all have some fibre assets. However, there have been interesting developments in the last year with ZESCO, which is thought to have the largest installed fibre base, forced to cede its fibre assets to ZAMTEL in order to plump up ZAMTEL for privatisation<sup>13</sup>. This move has not gone down well among stakeholders, according to recent news reports, as it would ensure ZAMTEL's near monopoly status.<sup>14</sup>

12 Balancing Act Africa, 2010. First Phase of Government-funded Backbone is Activated in Tanzania, Issue no 507 4th June 2010 [online], available at <<http://www.balancingact-africa.com/news/en/issue-no-507/internet/first-phase-of-government-funded-fibre-backbone-is-activated-in-tanzan>> (accessed 7 September 2010).

13 Balancing Act Africa, 2010. Zambian Government reinforces Zamtel monopoly as country heads for competition, Issue no 490 5th February 2010, [online], available at <<http://www.balancingact-africa.com/news/en/issue-no-490/top-story/zambian-government-reinforces-zamtel-monopoly-as-country-heads-for-co>> (accessed 7 September 2010).

14 The Postonline, 2010. Zesco cedes Optic Fibre Cable to Zamtel, [online], available at <[http://www.postzambia.com/post-read\\_article.php?articleId=6535](http://www.postzambia.com/post-read_article.php?articleId=6535)> (accessed 7 September 2010).

ZAMTEL was sold to Libyan LAP Green Network at the end of July 2010 with LAP Green acquiring a 75% stake of the company.<sup>15</sup> ZAMTEL is also reported to have finalised the 10 Gigabits per second Lusaka Metropolitan Area Network covering most of the capital<sup>16</sup> and has reportedly contracted the Chinese firm: Huawei Technologies to build a national fibre backbone with connections to the Democratic Republic of Congo, Tanzania, Botswana and Malawi. There is also fibre connection between ZESCO's network to SAT3 by local Internet Service Providers through Namibia and South Africa.<sup>17</sup>

### **Malawi**

Malawi is in an interesting position with two entities rolling out extensive fibre networks in the country. The Malawi Telecommunications Limited (MTL) is developing an extensive fibre backbone covering all major parts of the country and connecting to Mozambique, Zambia, Tanzania and South Africa<sup>18</sup> and there are reports that the network was launched in late 2009.<sup>19</sup> The other significant player in Malawi is the Electricity Supply Corporation of Malawi (ESCOM). ESCOM Malawi already has fibre between Blantyre and Lilongwe and also plans to build fibre metropolitan networks in the main cities.<sup>20</sup>

### **Zimbabwe**

Zimbabwe's telecommunications sector has noted some significant developments in the last year or so. Zimbabwe finally has a fibre optic connection to the outside world through Powertel's connection to Botswana Telecommunications Company (BTC) network in Botswana.<sup>21</sup> Powertel is also reported to have improved its internal fibre network. Not to be outdone, Econet Wireless is reported to have contracted the Chinese contractor Huawei Technologies to build a fibre backbone with national coverage, metropolitan networks in main urban centres and connections to all of Zimbabwe's neighbours.<sup>22</sup>

## **DEVELOPMENTS IN RESEARCH AND EDUCATION NETWORKING**

At the end of 2007, there were only two operational National Research and Education Networks (NREN) in the SADC region: South Africa's Tertiary Education Network (TENET) and Malawi's Research and Education Network (MAREN). Operational here means providing connectivity services to universities and other educational and research institutions. It was also reported that there were NRENs under development in Namibia, Mozambique, Tanzania, Zimbabwe and Zambia.

Almost three years later, there appears to be little development in the way of more operational NRENs. Nevertheless there are some promising developments in the region as regards NRENs. MAREN is reported to have acquired some fibre assets from ESCOM.<sup>23</sup> South Africa went a step better and created a new network, the South African Research and Education Network (SANREN). Funded by the government,

15 Lusaka Times, 2010, Zambia: Sale of ZAMTEL will rake in more cash for govt than the sale of all mines combined-RB, [online] available at <<http://www.lusakatimes.com/?p=26851>> (accessed 7 September 2010).

16 <[http://www.zamtel.zm/forms/WEBSITE\\_SITE\\_INFOR\\_LMOFN.pdf](http://www.zamtel.zm/forms/WEBSITE_SITE_INFOR_LMOFN.pdf)> (accessed 7 September 2010).

17 Balancing Act Africa, 2010. Zambian Government reinforces Zamtel monopoly as country heads for competition, Issue no 490 5th February 2010, [online], available at <<http://www.balancingact-africa.com/news/en/issue-no-490/top-story/zambian-government-reinforces-zamtel-monopoly-as-country-heads-for-co>> (accessed 7 September 2010).

18 Malawi Telecommunications Limited, Current project, Optic Fibre Cable Project, [online], available at <[http://www.mtl.mw/about\\_project\\_fiber.html](http://www.mtl.mw/about_project_fiber.html)> (accessed 7 September 2010).

19 Malawi Telecommunications Limited, MTL Fibre Optic Launch, [online], available at <[http://www.mtl.mw/newz\\_foclauch.html](http://www.mtl.mw/newz_foclauch.html)> (accessed 7 September 2010).

20 ESCOM Malawi <[http://www.escommw.com/transmission\\_strategies.php](http://www.escommw.com/transmission_strategies.php)>

21 Powertel Communications, International Internet Bandwidth, [online], available at <[http://www.powertel.co.zw/home/index.php?option=com\\_content&view=article&id=86](http://www.powertel.co.zw/home/index.php?option=com_content&view=article&id=86)> (accessed 7 September 2010).

22 Balancing Act Africa, 2010. Liquid Telecom to launch Southern African fibre network at 'good prices the like of which have not been seen', Issue no 492 19th February 2010 [online], available at <<http://www.balancingact-africa.com/news/en/issue-no-492/top-story/liquid-telecom-to-launch-southern-african-fibre-network-at-good-price>> (accessed 7 September 2010).

23 Malawi Research and Education Network, work in progress, [online], available at <<http://www.maren.ac.mw/work.htm>> (accessed 7 September 2010).



implementation planning was led by the Meraka Institute and the network is operated by TENET.<sup>24</sup> SANReN with its 10Gbps backbone and connection to the outside world represents sub-Saharan Africa's first Gigabit NREN and perhaps it's only 'real' NREN in so far as providing dedicated connectivity to global research networks as well as commercial or commodity Internet.

The development of SANReN is also politically significant in the region: as the project was home-grown and government-funded, it is more likely to inspire other governments in the region to consider funding their own NRENs.

On the regional front, the Ubuntunet Alliance continues to be a viable vehicle for the creation of a regional REN. Further momentum, interest and funding are growing for a regional REN in Southern and Eastern Africa. During 2009, the European Commission funded a study; 'The Feasibility Study for African-European Research and Education Network Interconnection', also known as FEAST, which concluded that it was indeed feasible and timely to develop a regional REN to connect national RENs to each other and to the rest of the world starting with Eastern and Southern Africa.<sup>25</sup> Ubuntunet Alliance is recognised by the FEAST study as a natural partner in such an endeavour for Eastern and Southern Africa. Recent reports indicate that the European Commission has approved funding for the first phase as proposed by the FEAST study.<sup>26</sup> This means that a regional REN for Eastern and Southern Africa is closer to reality.

Nevertheless, as noted by the FEAST report and as documented in the 2007 SARUA report, the main challenges remain the quality of the campus network and the understanding and willingness of universities to collaborate to create viable and operational NRENs which a regional REN will interconnect.

## OPPORTUNITIES

The recent developments in the ICT sector in the SADC region and in Africa as a whole offer great opportunities for universities. Further, shifts in socio-economic developmental thinking, and policy centred on the knowledge society and the role of ICTs, are also a boon to universities only, if they can identify and take advantage of these emerging opportunities.

### Research and Education networking now a real possibility

For a long time now, universities have decried the limited availability of high-speed connectivity infrastructure, and the high costs of access and bandwidth. The situation is changing dramatically. Every country in the SADC region is developing or improving its national ICT infrastructure. Further, every country in the SADC region except for DRC has fibre connectivity to its neighbours and indirectly or directly to the submarine fibre networks. Even DRC is likely to have international fibre connectivity by the end of 2012 - through ACE and WACS. This dramatic improvement in available national and international fibre networks, and the tumbling prices occasioned by competition in the international connectivity arena are making affordable high-speed connections to the global research community a real possibility.

24 SANRen, [online], available at <<http://www.sanren.ac.za/>> (accessed 7 September 2010).

25 FEAST project, 2010, Feasibility Study for the AfricaConnect Initiative, Final Report, [online] available at <<http://www.feast-project.org/documents/FEAST-Final-Report-2010-03-22.pdf>> (accessed 7 September 2010).

26 SciDevnet, 2010. New Broadband Network for Africa Approved, [online], available at <<http://www.scidev.net/en/news/new-broadband-network-for-africa-approved.html>> (accessed 7 September 2010).

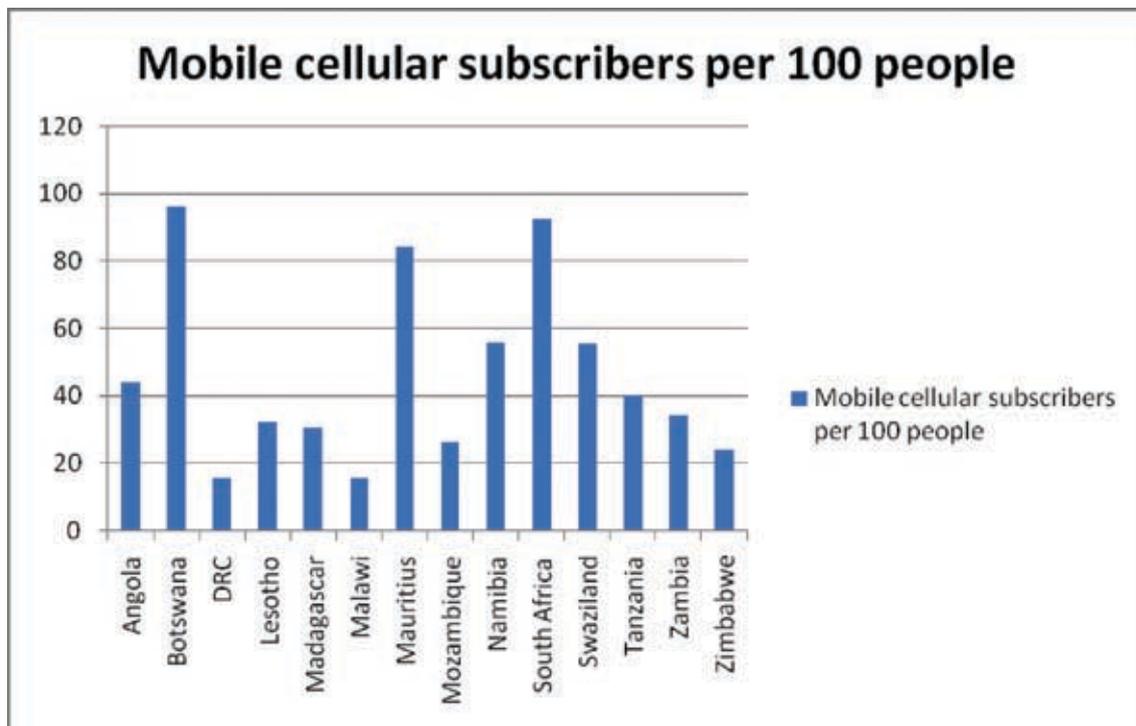
The increasing reach and coverage of national backbones and cross-border links is also making it possible to interconnect, share resources, communicate and collaborate in-country and regionally.

The onus is now on universities and research institutions in the SADC countries to collaborate, to develop and to operate NRENs and, together, to lobby for political support and government support as well as donor support for these NRENs. University leaders in SADC countries may wish to draw the attention of their governments and policy makers to the case of South Africa, where SANReN attracted political support and government funding and where TENET has successfully operated an educational and research network for about 10 years now. The possibility of funding from the European Commission and the presence in Southern Africa of Ubuntunet Alliance (of which a number of NRENs in SADC are members) should be exploited to develop the regional REN.

### Growth of mobile cellular Internet services

The real ICT revolution in Africa is probably not fibre but rather the mobile phone. From humble beginnings in the early 1990s, mobile phone networks and services have grown at a dizzying rate. According to the International Telecommunications Union (ITU), on average about 40% of SADC inhabitants have subscribed to mobile cellular services.<sup>27</sup> The individual country data (shown in the chart below) reveals that some countries in the SADC region, notably Botswana, Mauritius and South Africa are nearing 90-100% subscription levels.

Figure 2- Mobile phone subscribers per 100 people for SADC member countries.



Source: International Telecommunications Union

27 International Telecommunications Union, ICT Statistics, [online], available at <<http://www.itu.int/ITU-D/ict/ey/Indicators/Indicators.aspx>>#



As fascinating as these figures are, the real opportunity for universities lies in the fact that increasingly, broadband Internet access is available via mobile cellular networks either directly to the mobile phone handset or through a dongle-type access device that plugs into a computer. Smart phones, representing convergence between computers and traditional voice-and-SMS-only handsets, coupled with high-speed third and fourth generation (3G and 4G) networks being rolled out across the continent, means that students and working professionals will soon have as much bandwidth on their handsets as entire universities had in the early 2000s. This revolution provides unprecedented opportunities for universities in the region, and indeed in the rest of the world: to expand teaching and learning beyond the traditional walls of the universities (eLearning), to promote lifelong learning, to connect researchers wherever they may be and to easily and instantly disseminate new knowledge for society's benefit.

### **Government focus on ICT skills development and Knowledge Society development**

Governments across Africa and the rest of the world now acknowledge the importance of investing in ICTs. Evidence for this in Africa can be deduced from the number of government-backed ICT projects from national fibre backbones to even international fibre projects. Policy environments and regulatory regimes across the continent are becoming more investor friendly. The focus, over the last few years, has been on deregulation, encouraging foreign investment and developing infrastructure. This focus is broadening to encompass human resources development and specifically ICT skills development. Governments and donors are becoming increasingly more aware of the need to develop appropriate skilled human resources, if the ICT revolution is going to be sustained and maximum advantage taken of it. For example, the World Bank has developed new programmes aimed at building ICT skills and related capacities.<sup>28</sup> In part, the increased awareness in the need for skills development also comes from the increased challenges of having a large number of unemployed youth, especially in Africa.<sup>29</sup> This increased focus on youth and skills development is leading to a revival of the technical and vocational training sub-sector.

Sustainable development, including the creation of new employment opportunities, increasingly relies on a country's ability to innovate, create and apply new knowledge. This is the central thinking behind such concepts as the 'knowledge society'. Universities are well placed, to play a vital role in the development of knowledge societies, as they are the centres of innovation and knowledge creation. Universities, it can be argued, are also responsible for developing new skills required for the knowledge society through research and development. The contribution of NRENs in the development of the ICT sector in the more developed countries is a clear example.

As such, universities in the SADC region, together with their peers in the rest of Africa, should start to clearly articulate their role in sustainable skills and innovation development for the knowledge society. If universities can convince policy makers of their vital role in development, particularly within the conceptual framework of the knowledge society, they stand to tap into political support and government funding for their programmes, especially their ICT programmes.

28 World Bank Group, 2010. Contribution by the World Bank Group to the 'Assessment of the Progress Made in the Implementation of and Follow-up to the Outcomes of the World Summit on the Information Society,' [online], available at [http://www.unctad.org/sections/wcmu/docs/ecn232010\\_WB.pdf](http://www.unctad.org/sections/wcmu/docs/ecn232010_WB.pdf)

29 World Bank, Youth and Employment in Africa: The Potential, the Problem, the Promise, available at [http://siteresources.worldbank.org/INTAFRICA/Resources/ADL\\_Youth\\_Employment\\_summary.pdf](http://siteresources.worldbank.org/INTAFRICA/Resources/ADL_Youth_Employment_summary.pdf) and [http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/AFRICAEXT/0,contentMDK:22157069~menuPK:2246551~pagePK:2865106~piPK:2865128~theSitePK:258644,00.html?cid=ISG\\_E\\_WBWeeklyUpdate\\_NL](http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/AFRICAEXT/0,contentMDK:22157069~menuPK:2246551~pagePK:2865106~piPK:2865128~theSitePK:258644,00.html?cid=ISG_E_WBWeeklyUpdate_NL)



## CONCLUSION

Two years ago, a country in the SADC region having 100Mbps of total Internet connectivity could be considered lucky, this at a time when the same level of connectivity was becoming standard for a typical home in the more developed parts of the world. Improvement in telecommunications infrastructure in the SADC region since then can only be considered as phenomenal. The days when universities lamented the near impossibility of getting access to high-speed networks should be over. But access to this connectivity will not happen automatically. Collaboration to create functional, national and a regional REN(s) are critical: to negotiate with one voice for lower costs and faster access, and to raise a single loud and consistent voice to the politicians, policy makers and regulators to allow cross-border linkages among other challenges that must be overcome. While this paper does not review the state of campus networks, they remain critical and wholly within the purview of the universities. Investing in campus networks, within a constrained resource environment, takes courage and visionary leadership but it must be done. Universities too must recognise the changing development policy environment and seek to identify and play the role that is rightful theirs. The opportunities offered by ICTs are not about access to fancy technology, but rather about access to tools and infrastructure to support innovation and knowledge creation. In all this they have a home advantage: innovation and knowledge creation (the university's forte) which have been at the forefront of human development.



# INNOVATIVE MODELS FOR FINANCING ACCESS TO BANDWIDTH

- *Duncan Martin*<sup>30</sup>

## ABSTRACT

NRENs are important for several reasons. Some reasons are structurally inherent to research and education institutions, such as the common need for high-speed connections to other research and education institutions nationally and internationally. But, especially in developing countries and regions, the economic role of the NREN as a non-profit-seeking aggregator of the institutions' buying power is of major importance. The main topic of the paper is how TENET financed the USD20 million purchase of long-term capacity on the SEACOM submarine cable. But the underlying message is the centrality of the NREN as the organisational vehicle through which a nation's research and education institutions can aggregate their bandwidth buying power and, where economic and regulatory considerations so auger, can acquire and share long-term network infrastructure. NRENs are absolutely central to realising the benefits of the wave of telecommunications liberalisation that is sweeping through Africa. NRENs have ever-widening opportunities to deliver more bandwidth at lower and lower cost through becoming operators themselves and even through developing their own infrastructure where this makes economic sense. Every nation should ensure that its NREN is structured and managed appropriately to be able to grasp such opportunities. Participating institutions must be able to trust and work with the NREN in these developments.

## SEACOM BURSTS UPON THE SCENE

In August 2007, out of the blue, came the announcement of a new, privately-owned submarine cable, called SEACOM, which would be commissioned in June 2009 and would connect the Eastern and Southern African seaboard countries to Europe. The project was initiated by an American company called Heracles Telecom, and backed by American private equity interests. Happily, by attracting South African and other African investors, SEACOM overcame efforts by incumbent operators and governments to block the project. African entities hold 75% of the equity. Unlike most submarine cables, none of the investors is a telecommunications operator. SEACOM Ltd is incorporated in Mauritius.

In each country, SEACOM had contracted with a local operator to establish and to operate the landing station, and to provide backhaul to a suitable open-access facility where customers could connect to their SEACOM capacity.

In South Africa, SEACOM contracted Neotel, and recently launched as the long-awaited 'second network operator', to construct and operate a landing station at Mtunzini, 130km north of Durban, and to provide backhaul to an open-access virtual landing station in Johannesburg.

30 Duncan Martin is the Chief Executive Officer of the Tertiary Education Network (TENET). Email: ceo@tenet.ac.za.

Internet Service Providers and other network operators were invited to purchase 'indefeasible rights of use' of specified capacities for the life of the cable, for once-off capital prices and a low annual Operations and maintenance charge. Even at low average utilisations, the effective price was orders of magnitude lower than the then SAT-3 rental charges.

### **SEACOM'S OFFER TO TENET**

From the outset, SEACOM offered TENET a very special deal. Initially this comprised a 10Gpbs (STM-64) circuit to Europe at a price that was a fraction of the price it was asking commercial operators to pay. However, the deal was not the customary monthly rental for a specified bandwidth and period, but entailed a once-off capital sum to purchase an 'Indefeasible Right of Use' of the specified capacity for the life of the cable. Initially, the proposed circuit would have run from the virtual landing at Johannesburg to an exchange point in Sicily, for a price of USD23m. The negotiation ultimately settled on an STM-64 circuit, with 1+1 SDH protection, which would run from the SEACOM Landing Station at Mtunzini to Telehouse, London, for a once-off price of USD20m. An operations and maintenance charge of 3% (USD 600,000) per annum, payable quarterly, would also apply. This agreement was conditional upon TENET's ability to finance the purchase.

In terms of the effective price of bandwidth, justifying the SEACOM purchase was a no-brainer. In aggregate, the institutions were paying some R4 million per month for some 200Mbps of international bandwidth. With due allowance for interest charges and SEACOM's operations and maintenance charges, a loan of USD20 m could be repaid over six years from such a revenue stream. During those six years, and for another 14 years thereafter, the institutions would have some fifty times the bandwidth available to them.

### **BACKHAUL TO THE CAMPUSES – SANREN**

There would be little point in purchasing 10Gb/s of capacity on a submarine cable if the institutions could afford only a few hundred megabits per second of backhaul capacity between the landing station and the campuses throughout South Africa. Fortunately the Department of Science and Technology (DST) had already announced its intention of deploying the very high-speed South African National Research Network (SANReN) and contracted the Meraka Institute of the CSIR to deploy SANReN. This was seen as a monopoly-circumventing way to secure a high-speed research network to support the DST's existing and future big-science projects.

At the time the CSIR fully anticipated substantial components of SANReN would be deployed before SEACOM cable was commissioned, and would inter-connect many campuses and many institutions.

Dr Johan Eksteen, then Deputy Director of the Meraka Institute, who had overall responsibility for deploying SANReN, endorsed TENET's SEACOM project and confirmed formally that the SANReN network would provide the backhaul between the SEACOM Landing Station at Mtunzini and the campuses of the institutions.



## FINANCING THE PURCHASE

Initial discussions with investment banks showed that TENET's balance sheet was just too tiny to support an application for a USD20m loan. Collateral commitments to the bank by the universities and research institutions would be essential. Discussions with finance directors of large universities showed that such collateral commitments were very unlikely, as was loan financing from reserves held by universities.

No further attempts were made to arrange a secure loan as an essential precursor to contracting with SEACOM. Instead, the basis for both TENET's and SEACOM's confidence in the ability to pay the purchase price would have to rest upon firm commitments from the institutions to continue paying at least the same monthly amounts in respect of international bandwidth, for six years after the cable had been commissioned. TENET should seek payment commitments from the IT directors under whose control these bandwidth budgets lay and who desperately wanted more bandwidth. Importantly, since these budgets would be required to continue buying SAT-3 capacity until the SEACOM capacity became available, no SEACOM-related payments should be required until the SEACOM capacity was available.

The first step was to explain the proposed financing scheme to SEACOM. TENET and the institutions were and are enormously grateful to SEACOM for its ready agreement to allow TENET to repay the purchase price over six years, with the first of six annual payments being due only when the cable was brought into service. TENET accepted that SEACOM would apply a cost-of-capital of 14% p.a. on outstanding balances. TENET would be entitled to make additional lump sum payments and/or to settle the full outstanding amount at any time.

TENET then issued a formal invitation to the IT Directors for their institutions to bid for SEACOM capacity. Each 'Bid Unit' entitled the institution to 10Mbps of SEACOM capacity, but committed the institution to making six annual 'Bid Payments' of just under USD7000, the first being due when the cable was commissioned. The invitations were customised so that each IT Director was apprised of his institution's current spend on international bandwidth and advised as to how many Bid Units the institutions could afford.

Importantly, TENET accepted that not all institutions would be in a position or would agree to make such Bids, notwithstanding which, if the SEACOM capacity were indeed purchased, then it would be used to provide international connectivity to all campuses of all institutions – not just to those institutions that had made bids. The terms and conditions regarding Bid Units had to provide for this, and were as follows:

- All Bid Payments would be treated as loans to TENET that TENET would be obliged to repay, rather than being treated as direct payments for bandwidth.
- All institutions would be charged the same base price (in Rand per Mbps per month) for SEACOM bandwidth, but institutions that made Bids would receive a 25% discount.
- TENET would repay the Bid Payment loans in the first instance from revenues generated by charges for SEACOM bandwidth.
- Institutions that made Bids would have preferential ordering rights (of 10Mbps per Bid Unit). Such institutions would not have to order their full bid bandwidths.
- The 'breakeven' Bid Unit count was 750 – if fewer Bid Unit commitments than this were received TENET would simply abandon the project.

In the event 27 institutions, including all but two of the universities, submitted duly authorised and signed bids totalling 950 Bid Units with concomitant commitments to pay the six annual tranches to SEACOM and provide for equipment and other costs. These formal institutional commitments served to satisfy both TENET and SEACOM that the negotiated capacity purchase agreement was financially sound and could proceed.

## CONSULTATION AND DECISION

The proposed purchase was workshopped at length with, and was strongly supported by, a reference group of institutional representatives. TENET also consulted the Department of Education, the National Treasury and the Development Bank of Southern Africa (DBSA), all of which expressed understanding and support for the proposed purchase.

It was recognised that being dependent on a single submarine cable would expose the institutions to the risk of lengthy outages, because repairing a fault can take several weeks. TENET should consider a further capacity purchase as soon as capacity on a second cable became available.

The Department of Communications indicated that it hoped TENET would wait for the submarine cable then being planned by NEPAD's e-Africa Commission for deployment, like the SEACOM cable, to serve Eastern and Southern African countries. However, it was clear from a briefing by the responsible official of the e-Africa Commission that the NEPAD project was still beset by major uncertainties as to its governance and financing and pricing structures. Consequently TENET took the view that it should proceed with the SEACOM deal, but should consider acquiring capacity on the NEPAD cable at a later stage.

TENET's Board, at its meeting on 19 September 2007, approved the SEACOM deal in principle and delegated to the CEO authority to finalise and execute a capacity purchase agreement with SEACOM. The agreement was signed on 4 November 2007, some 19 months ahead of the scheduled Ready for Service Date.

## LOAN FROM THE DBSA

A drawback of the financing arrangements described above was that it left the 27 bidder institutions with significant payment obligations over a six year period that were denominated in USD rather than in Rand (ZAR).

Realising that this imposed an uncomfortable risk upon the institutions' bandwidth budgets, TENET applied in January 2008 to the Development Bank of Southern Africa (DBSA) for a loan equal to the Rand equivalent of USD20 million at the date of drawing down the loan; the loan to be repaid over six years. Such a loan would enable TENET to settle its debt to SEACOM directly upon commissioning; to convert the Bid Payment obligations of the bidder institutions to Rand obligations; and to use the Bid Payments themselves to repay the DBSA loan over six years. In addition, the DBSA's interest rate might well be less than SEACOM's 14%.

The DBSA consultants that handled the applications were very keen on the project and assisted TENET to prepare the documentation required at various stages of the Bank's approval processes. Importantly,



the formal Bid Payment commitments from the 27 bidder institutions convinced the Bank of TENET's ability to repay the loan. The DBSA finally approved the loan in May 2009, and released it for drawdown by TENET in August 2009.

## **IS IT WORKING?**

Yes, it's working! The SEACOM cable was commissioned on 23 July 2009. In August 2009 TENET withdrew loan funds from the DBSA and SEACOM accepted the USD20m in full settlement of the purchase price. The applicable exchange rate was USD1 = R7.70 and this was used to convert all Bid Payment obligations to Rand amounts.

The SEACOM IRU appears as a long-term, intangible asset on TENET's balance sheet. It was valued initially at the purchase price plus aggregated financing charges, and is being depreciated over six years. The outstanding balances of the DBSA loan and Bid Payment loans owed to the bidder institutions appear as liabilities.

In 2009 the bidder institutions all made their first Bid Payments, and most have already made their second one as well.

The 10Gbps SANReN National Backbone did not route through the SEACOM Landing Station at Mtunzini, which obliged TENET to secure a backhaul circuit between the Landing Station and the SANReN Backbone Node in Durban. This was ready in time for the SEACOM's commissioning.

The SANReN National Backbone was commissioned on 1 December 2009, and from 1 January 2010, TENET has provided international bandwidth only via its SEACOM capacity. The basic unit price charged to institutions is R1100 per Mbps per month. Bidder institutions are charged only R825 per Mbps per month, and the charge is offset against the Bid Payment loan amount that TENET owes the institution. In June 2009, when SAT-3 capacity was still being used, the price was R12 705 per Mbps per month.

At the time of writing, only some 15 campuses have high-speed (several hundreds of Mbps) connections to the SANReN Backbone. This number will increase rapidly over the coming year as further SANReN access networks are deployed. Inbound international traffic on the SEACOM circuit currently peaks daily at over 1.6Gbps. This will increase rapidly over the coming year.

## **THE NEED FOR REDUNDANCY**

The SEACOM cable has suffered serious two outages, the most recent of which was due to a faulty repeater at a depth of 4.7km north of Mombasa and lasted three weeks. In association with SEACOM and other South African ISPs, TENET managed to restore a reduced level of service using other routes.

No alternative east coast submarine cable materialised in the form envisaged by NEPAD, but rather in the form of the so-called EASSy cable, which is owned by a consortium of licensed operators and was commissioned in July 2010. In addition, the West African Cable System, which is also an operator-consortium cable, is scheduled for commissioning in late 2011. TENET is actively negotiating with a view to acquiring bandwidth that will provide much needed redundancy. The intention is to finance any further capital purchases in the same way.



## **CONCLUSION: THE NREN IS KEY TO SHARING RESOURCES**

As the telecommunications regime in a country liberalises, new kinds of opportunities open up for the country's NREN to enable, initiate, undertake and manage the sharing of networking and other resources and capacities.

Initially TENET was no more than a Telkom-facing agent that aggregated the institutions' collective bandwidth buying power. The SEACOM capacity purchase had TENET in the role of a service provider in its own right to each institution, and also as the owner of major network assets to support its service provision.

As described above, the institutions themselves financed the acquisition of these assets. Because TENET is a membership-based organisation over which the institutions themselves exercise ultimate sovereignty, network assets owned by TENET are seen and accepted as assets that are shared by, and exist for the benefit of, all the institutions.

For an NREN to fulfil this role it must be a bottom-up, membership-based organisation that is manifestly not controlled by any single institution or small subset of institutions, or by government officials. The senior management of the institutions, including the ICT Directors, must be willing and able to trust their NREN! If you don't trust your NREN, find out why and fix the problem! The NREN cannot negotiate deals and conclude contracts if its participating institutions do not believe in the NREN and do not work with it to realise the shared infrastructure and services upon which real economic advantage rests.



# AFRICACONNECT: CONCRETE POSSIBILITIES

- *John Kondoro*<sup>31</sup>

## ABSTRACT

The paper presents the rationale of the AfricaConnect initiative tracing from the problem of poor connectivity in Africa to the various plans and strategies taken by the African Union (AU). The key strategies include the formulation of the Africa Science and Technology Consolidated Plan of Action (CPA), the formation of the African Ministerial Council on Science and Technology (AMCOST) and the establishment of the African Regional Action Plan on Knowledge Economy (ARAPKE). The paper notes that Africa in collaboration with the European Union (EU) has started financing various key ICT initiatives through partnerships such as; the ACP-EU Partnership agreement signed in 2000, and revised in 2005; the AU-EU Joint strategy and Action Plan signed in 2007 in Lisbon; and the EU-AU Partnership on infrastructure signed in 2007 in Addis Ababa. AfricaConnect is one of the initiatives financed by the AU in partnership with the EU to facilitate the establishment of a regional research and education network and its connectivity to GEANT. The initiative will have a big impact on Internet connectivity, Telemedicine applications, and accessing high-performance computing and laboratory facilities. The paper discusses some of the foreseen challenges due to the migration from satellite-based to broadband infrastructure and suggests modalities of making progress with the emerging paradigm shift.

## INTRODUCTION

The African continent occupies about 20% of the total land mass of the earth with about 17% of the total world population. However, this huge continent has very few Internet users, and a very low Internet penetration rate compared to other parts of the world.<sup>32</sup> Those countries with a high Internet usage or Internet penetration rate, or big IP traffic per Internet user, are the leading countries in economic growth too because communication is power. Africa needs to communicate and collaborate much more with the rest of the world in finding solutions for real problems that are affecting its population. This isolation is largely due to the excessively high cost of Internet connectivity, with many institutions typically paying USD7000 per full duplex Mbps per month, a capacity that would cost less than USD20 per month in North America and Europe. This reality was the backdrop for the formation of the UbuntuNet Alliance, with the intent of acquiring fibre capacity so that African research and education institutions would achieve not just equity, but equality to the rest of the world in terms of volume and cost of bandwidth.

Africa has a high growth rate of 2357.3%, in the use of mobile phones in the period 2000 – 2010 followed by the Middle East with 1825.3%, and Latin America/Caribbean with 1032.8%. Such a widespread use of mobile phones in rural agricultural settings<sup>33</sup> is likely to grow and pave the way for even more innovative use of the Internet, and will stimulate research in the universities in these areas. This will in turn enhance economic development and the lives of the population. In general, prosperity levels track the growth of Internet use. Today, most aspects of education in the developed world rely on Internet technologies. Africans can benefit from sharing knowledge and experience in a range of research areas

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32 Internet World Stats (2010) Usage and population statistics <[www.internetworldstats.com/stats.htm](http://www.internetworldstats.com/stats.htm)> accessed August 2010.

33 As at 33.

that are studied worldwide, including research areas with particular relevance to Africa, such as malaria and other diseases, and the effects of climate change. An increase in academic networking activities will also stimulate commercial Internet providers to enhance their services, allowing Africans to participate more fully in the global Internet economies.

## **EFFORTS TAKEN TO ADDRESS THE PROBLEM OF DIGITAL DIVIDE**

Africa has recognised that Science and Technology (S&T) and Information and Communication Technology (ICT) are key vectors for bridging the scientific and digital divides, for reducing poverty and ensuring socio-economic development and eventually for supporting the sustainable evolution of Africa. Some of the efforts taken by Africa include the formation of the African Ministerial Council on Science and Technology (AMCOST), which is a high-level policy and political forum for ministers, responsible for science and technology from all member states of the African Union. It sets continental priorities and policies pertaining to the development, harnessing and application of science and technology for Africa's socio-economic transformation (AMCOST, 2003).

Other efforts include the formulation of the Africa's Science and & Technology Consolidated Plan of Action (CPA) that was developed and adopted by AMCOST. The Plan focuses on the development and use of S&T for the socio-economic transformation of the continent and its integration into the world economy. The African Regional Action Plan on the Knowledge Economy (ARAPKE) is another key step that aims at building a region fully benefiting from ICT services by 2015. It is based on the vision defined by the African Information Society Initiative (AISI) and the NEPAD, under the AU leadership. This is a Regional Action Plan for rolling out the information society in the continent. Its momentum is supported by the African UbuntuNet Alliance that is to secure affordable high-speed international connectivity and efficient ICT access/usage for African National Research and Education Networks.<sup>34</sup>

In order to achieve the plans and strategies set out in CPA, ARAPKE and other organisations under AMCOST, Europe has been a key partner. Some of the notable partnerships between Europe and Africa in S & T and ICT are:

- a) The Africa-EU Joint Strategy & Action Plan (JSAP) is the EU-AU agreement signed in 2007 (Lisbon EU-AU Summit) focussing beyond the donor-recipient arrangements and paving the way for a partnership of equals based on mutual interests.
- b) The sub-Saharan Africa-ACP-EC Partnership Agreement (Cotonou Agreement) between the members of the ACP Group of States and the European Community signed in 2000 (ex Yaounde / ex Lomé Conventions), was brought into force in 2003 and revised in 2005. The agreement focuses on reducing and eventually eradicating poverty (in coherence with the objectives of sustainable development and the gradual integration of the ACP countries into the world economy).

It is also quite logical that one of the eight thematic partnerships identified in Lisbon in 2007, on the occasion of the EU-AU Summit, is a 'Partnership for Science, Information Society and Space' (also known as the '8<sup>th</sup> partnership'). This thematic partnership focuses on 19 'lighthouse projects' (6 of them being considered as early deliverables). Under implementation since October 2008, it should contribute widely to strengthening S&T co-operation between the two continents in the ICT domain.

34 NRENs (2009) The case for NRENs, <[www.terena.org/activities/earnnet/docs/20080429-final-report.pdf](http://www.terena.org/activities/earnnet/docs/20080429-final-report.pdf)> accessed August 2010.



The 8<sup>th</sup> project under the 8<sup>th</sup> thematic partnerships is 'Science, Information Society, and Space', which bridges scientific and digital divides and strengthens Africa's base in the S&T field. It enhances the use of ICT and space applications as enablers for growth and socio-economic development. There are 19 lighthouse projects, among them 2 projects that are ICT related and are ready for early implementation:

- (i) AfricaConnect – This is one of the six 'early deliverables' of the 8<sup>th</sup> Partnership projects supporting the establishment of sustainable and extensible regional backbone networks dedicated to the interconnection of African NRENs to each other and to the world via the pan-European GÉANT Network
  - (ii) The African Internet Exchange System (AXIS) – This project supports the establishment of a continental African Internet infrastructure through the national regional Internet exchange points. It aims at keeping local traffic local as well as offering better quality of service and new application opportunities.
- c) EU-Africa Partnership on Infrastructures – Interconnecting Africa is a project that was signed in 2007 (Addis Ababa, Ethiopia) with the objective of creating and sustaining regional infrastructure networks and services. It aims at securing the interconnectivity of the African continent (transport, water, energy and ICT) and different regions, as well as substantially increasing investment in infrastructure and delivery of related services. Besides, it supports the creation of the EU-Africa Infrastructure Trust Fund.<sup>35</sup>

## EDUCATION NETWORKS AND CONNECTIVITY IN AFRICA

The National Research and Education Networks (NRENs) was originally a product of academic research to find efficient and cost-effective ways of sharing scarce expensive computer resources; and of communicating and collaborating with researchers and academics in the early 1970s.

The United States was at the forefront of this research. These early research networking efforts can be said to have changed the world; they gave birth to the Internet. In some cases, these early NREN networks also developed their nations' first national Internet backbone infrastructure. For example, in Canada, CA\*net was for many years the only Internet backbone in the country, and in Australia, the early national backbone infrastructure was established and run by the Australian Academic and Research Network (AARNet). In Africa, as elsewhere in the world, the rise, if not the birth, of the Internet can be attributed to the universities and the general academic and research community.<sup>36</sup>

UbuntuNet Alliance, which covers most of the countries of sub-Saharan African countries, was formed in 2005 out of the necessity for connectivity. A similar organisation, called WACREN, has been formed in 2010 to serve the countries of Western and Central African countries. UbuntuNet Alliance is a Research and Education Network backbone of Africa to secure affordable high-speed, international connectivity and efficient ICT access and usage for African NRENs. It is capitalising on the emergence of optical fibre and other terrestrial infrastructure opportunities.

35 Karine Valin, (2010) eI-Africa Project: Strengthening Cooperation on e-Infrastructures between Europe & Africa, IST-Africa Conference / Durban, eI-Africa.eu - EU/FP7 #246650 South Africa / May 2010.

36 Tinomugisha, 2007. National Research and Education Networks in Africa: <http://www.ubuntu.net/documents/sarua-fibre-final-report-draft-2006-03-04.pdf> accessed August 2010.

The recent developments have provided high-capacity submarine fibre optic cable systems on the eastern coast of Africa. One of the submarine fibre optic cables is SEACOM, which has a capacity of 1.28TB/s, linking Africa to Europe and Asia through the Middle East. It connects all the countries on the east coast between Mtunzini (South Africa) with Marseille (France) and London (the United Kingdom). It started its operations in July 2009. EASSy submarine cable system runs from Mtunzini to Port Sudan linking the cities on the eastern coast of Africa with Europe. It has a capacity of 3.84TB/sec. It started its operations in August 2010. TEAMS submarine cable system links the Mombasa port with the Middle East, with a total length of 4500km and a capacity of 40Gb/sec but upgradeable to 640Gb/sec.

Access to dedicated high-performance research and education networks is necessary if the nation wants their research and higher-education institutions to be able to fulfil their missions. It has been shown in other parts of the world that growth in the deployment of the Internet is mirrored by an increase in economic development of the nation. Failing to provide such network resources will make the institutions fall behind, incapable of participating in most international research areas, and cause frustration leading to brain drain.<sup>37</sup>

## GENESIS OF AFRICACONNECT AND ITS ROLE

The EU-Africa Partnership in Science, Information Society and Space supports the African Regional Action Plan for the Knowledge Economy (ARAPKE) adopted by the African Union in the context of the World Summit on the Information Society. ARAPKE identifies both capacities in terms of infrastructures and research and development as priorities. In this context, the African Union Commission expects AfricaConnect to contribute to the development of Africa by enabling African researchers to have the facilities to work with their international peers and also widen Africa's research base. In addition, the new high-speed link with the global research and education network via GEANT2 would provide bandwidth that National Research and Education Networks in Africa need.

AfricaConnect is a deliverable of AU-EU Partnership with the overall objective to contribute to poverty reduction by harnessing the potential of Information and Communication Technologies for sustainable development of the region. The specific objective is facilitating the establishment of a regional research and education network and its connectivity to GEANT, in view of having a more inclusive information society at African national and regional levels. While the regional network will initially be created in the UbuntuNet Alliance membership region, it will enable the establishment of NRENs in Western Africa as members of West and Central African Research and Education Network. The overall cost is €15m for the period 2010-2013.<sup>38</sup> The EU will contribute €12m and countries of the sub-Saharan countries will contribute €3m, which is 20% of the total cost of the project. €11m will be used for connectivity linking the NRENs through one or several regional backbone networks. €2m is planned to support advanced user communities utilising AfricaConnect infrastructure and €2m will target training and support measures.

Expected results from AfricaConnect are:

- a) Provision of ICT connectivity to the education and research organisations in the quality and capacity meeting the needs of the end users (students, researchers).

<sup>37</sup> FEAST final report, 2010 <<http://www.feast-project.org/documents/FEAST-Final-Report-2010-03-22.pdf>> accessed 6 October 2010.

<sup>38</sup> Abela, C. M. (2009) European Commission, AfricaConnect as enabler for Research Collaboration and EU's Framework Programme for Research, UbuntuNetConnect 2009, Uganda Kampala, 12-13 November 2009 <<http://www.ubuntunet.net/connect2009>>. Carmen Mena Abela's statement, 2009. <<http://ei-africa.eu/2009/11/27/carmen-mena-abelas-statement/>> accessed 6 Oct 2010.



- b) Consolidation of the emerging NRENs into organisations with sufficient organisational and financial capacity to provide Internet connectivity to the research and education community in their country.
- c) Development of regional network(s) between the NRENs of sub-Saharan countries providing international Internet connectivity with sufficient capacity and on a stable basis.
- d) Connection of the regional sub-Saharan network(s) to the European GEANT network.
- e) Development and promotion of the use of ICT application in education, research, medicine and other sectors (e-learning, teleconferencing and telemedicine).

AfricaConnect is one of the early deliverables of the Africa-EU Partnership in Science, Information Society and Space. It is an outcome of the FEAST (Feasibility Study for African- European Research and Education Network Interconnection) study on the feasibility of interconnecting existing and emerging African research and education networking infrastructures and connecting them to the European backbone network, GÉANT.

The objective of AfricaConnect is to integrate the African research and education communities both regionally and internationally, using the most cost-effective high-bandwidth network capacity. The target is to ensure that emerging National Research and Education Networks (NRENs) in sub-Saharan countries have digital connection for their students and researchers in sufficient capacity and on affordable terms. Deployment of the network will provide increasing opportunities for collaboration with commercial companies that provide network equipment, and for companies, institutions and organisations that are involved in education and training to deploy, manage and operate the network. On the application side, there are many opportunities for organisations and companies to participate in FEAST and AfricaConnect.<sup>39</sup>

There has been significant development of underlying infrastructure in the region recently, which has brought with it real opportunities for the connection of African researchers to their global peers. Most of the current connectivity for Research and Higher Education in Africa is provided by low-bandwidth, high-cost VSAT links without direct peering to the global community. High-bandwidth undersea cables are both deployed and being constructed on the east coast of Africa, bringing the potential of high-bandwidth/low-costs closer to the African market. There are mutual benefits for both African and non-African research and education in setting up collaborative relationships that can form the basis for the development of future collaborations. Academic and vocational courses are needed to provide a sustained stream of skilled and qualified people to develop and maintain their own advanced communications infrastructures to support research and education. The approach is to extend existing BSc and MSc curricula with a problem-oriented, project-driven course on communication networks in a joint development framework involving industry.<sup>40</sup>

## **OPPORTUNITIES UNDER THE AFRICACONNECT INITIATIVE**

The FEAST study has identified a few lighthouse demonstrators, providing examples of end-user applications that are just waiting for better connectivity and could start operating as soon as the institution at which the researchers are located get connected to their NREN, connected to a regional network and connected to the world.

39 FEAST Study (2010) Supporting the connection of African research and education to global Internet via GEANT. <[www.feast-project.org](http://www.feast-project.org)> accessed August 2010.

40 AfricaConnect initiative (2010) FEAST project: results and outlook, <[www.feast-project.org](http://www.feast-project.org)> accessed August 2010.

### **Good Internet connectivity**

Internet connectivity is one of the key activities which will be facilitated under the AfricaConnect initiative. Good and sufficient connectivity is vital for a country to fully participate in the global knowledge economy. Research and education institutions in sub-Saharan Africa need to change from the current networking model, based on individual satellite connections direct to a commercial Internet service provider, to a co-operative model based on terrestrial networks and the facilitation of joint procurement of bandwidth to the commercial Internet, as well as the facilitation of academic peering between universities, nationally, regionally and globally.

Good Internet connectivity is important for institutions because staff and students find the Internet a necessary tool. Besides the use of ICT for e-learning and Telemedicine, the Internet is frequently used by education and research institutions to access information and distant libraries. With a modest number of about 500 computers, at least 2 Gigabits/sec is a necessity. Budgets of institutions in Africa are not high; therefore connectivity has to be sufficiently affordable.

### **Telemedicine applications**

There is an interest from university hospitals to establish global human networks of medical experts interested in participating in consensus decisions about treatment programmes for patients with severe diseases, such as cancers in pancreas, liver, kidney etc, in order to advance the knowledge about how to treat such diseases. There already is such an emerging network that African medical specialists are interested in joining. This activity is now possible due to the emerging optical fibre broadband systems.

The ICT support needed is multi-party high-definition video conferencing with shared workspaces facilitating sharing of patient records including; x-rays, audiograms and endoscopic video recordings. Such sessions may need Gbps bandwidth, very low latency and packet loss rates, etc.

### **Sharing High-performance computing facilities**

On a regional scale, there are high-performance computing facilities in South Africa and Tanzania which could be shared by other researchers within the region, but are constrained by connectivity. Broadband connectivity is necessary for data access/retrieval on the computing facilities, not only within the region but even within the same country. The Malawi Malaria Genome Project is a good example of an ongoing project that will benefit a lot from better connectivity and direct access to computing resources. The project has the objective of exploring if susceptibility to malaria is in any way correlated to the human genome. Tests producing data are made in Malawi while more complex computations are made by partners in the UK. Large data volumes are transported physically via disks. Better resources would speed up the project considerably.

### **Sharing expensive scientific facilities**

With the availability of sufficient bandwidth, institutions can share various expensive facilities such as laboratory equipment and libraries thereby removing the idea of each institution buying its own facilities. Furthermore, sharing contributes to efficient utilisation of such facilities.

High Performance Liquid Chromatography (HPLC) can be used to detect faked drugs and to monitor the usage of drugs by determining the drug concentration in the blood stream. Connecting the equipment to powerful networks would facilitate capacity-building co-operation between HPLC laboratories.



## **e-Services**

The availability of broadband connectivity would create the availability of various e-services which would otherwise not be available. Such services would include:<sup>41</sup>

### **a) e-Health**

Resources could be utilised in drug tracking (including counterfeit drug monitoring), fleet management and monitoring, health statistics analysis, telemedicine, community and health practitioners' training through video conferencing, patient management records, and continual professional development for health workers.

### **b) e-Government**

Resources would serve in the management and monitoring of government financial systems (revenue, expenditure, taxation, e-procurement and monitoring and evaluation; land and property management; e-commerce; civil related applications (citizen database, passports, ID and e-voting).

### **c) e-Learning**

e-Learning would benefit in content development, digital depositories, and distance education.

## **CHALLENGES IN THE IMPLEMENTATION OF AFRICACONNECT**

The migration from a satellite-based infrastructure to a terrestrial optical fibre communication system has many challenges. Policy and regulations are required to open up and recognise the information and communication infrastructure as a utility; the market also has to transform from low-volume and high-price to high-volume and low-price business model, to the benefit of all stakeholders. This paradigm shift needs support from policy makers and regulators. The development of the knowledge society is driven by research and education and access to ICT is a must for the responsible institutions.

The research and higher-education institutions of Africa need to be connected, not only to the Internet but more importantly to the dedicated global research and education infrastructure, just as their peers on other continents are. Research and higher education institutions have dedicated networks for performance reasons, just like banks have dedicated networks for security reasons, healthcare institutions for privacy reasons, etc. Policy makers and regulators need to facilitate access to links for such networks. The fact that the networks are non-commercial and are for the public-good makes them useful to support the general market transformation.

### **Capacity building**

When discussing capacity building, it is important to understand that the establishment of dedicated research and education networks will have an impact in all sectors of society. The students that get access to these networks will be accustomed to it and able to exploit it, and will require access to similar resources when they go into working life. Both the public and the private sector will need their competences. The private sector especially, will be able to pay better salaries and offer different challenges. The plans for capacity building need to take this into account. The experience from other markets is that system and network administrators, project managers and directors will be in high demand. The individuals will frequently move on into private-sector positions and will need to be

41 Taylor, S. J. E., Ngwira, M., Pehrson, B., Matranga, I. and Lombardo, T. (2010) ERINA4AFRICA Overview: Exploiting Research Infrastructure potential for boosting Research and Innovation in Africa. <[www.erina4africa.eu](http://www.erina4africa.eu)>.

replaced when moving on. This development can be expected to hit Africa as a Tsunami; once you see it, it is too late to prepare. There is a need both to reinforce the education of network engineers in general and for specific training related to the actual networks to be deployed.

### **Education**

Few African institutions have curricula on the BSc and MSc level specialising in communication networks, and they need stimulation to meet the rapidly growing demand for this competence, from all sectors of society, as the new infrastructure becomes available. It should be considered in what form this stimulation can be provided. Ultimately capacity building will help reduce brain drain and the digital divide. Specific training, necessary to make the AfricaConnect Initiative a success, should be organised as part of the project itself. One of the forms of training is the NREN twinning program co-ordinated by TERENA.

## **THE WAY FORWARD**

As already discussed elsewhere, the ingredients for success are as follows:<sup>42</sup>

### **Awareness, will and capacity**

The governments and relevant government organs have to be aware not only of the concept of dedicated Research and Education Networks but also the need for them and the importance of them in relationship to other needs. There also has to be the will to act on all levels on policies and on the enforcement of regulations. Awareness, Will and Capacity to Act are the key ingredients in the entire value chain.

### **The creation of NRENs**

Research and higher education institutions are key actors in the creation of the knowledge society. Therefore, they should have a common dedicated network infrastructure, just like banks, the airline industry and the weather institutions have. The creation of NREN is very important because institutions that are not connected cannot fulfil their missions. They have to connect not only between themselves but also to their peers in other parts of the world.

Member institutions must create and be responsible for Campus networks and be aware of facilities available for sharing such as; the HPLC facilities, high-performance computing facilities, as well as sharing libraries.

NREN organisations must be ready in terms of creating content and providing the required services by clients who are the staff and the students. There have to be competent human resources to deliver the required services. The NRENs must have acceptable Use and Connection policies and must have been assigned their numbers from the African Network Information Centre (Afrinic)

### **Appropriate policy and regulatory environment**

There has to be political awareness and support by governments, especially Ministries responsible for Higher Education, Research and Communication, that NRENs are the best means to connect institutions to their global peers. The governments also have to stimulate the general telecom transition from low volume/high price to high volume/low price.

<sup>42</sup> Pehrson, B. (2010) 'Building a Research and Education Infrastructure in Africa: Policy Perspectives and AfricaConnect', FEAST Identification of Remaining Gaps. IST-Africa, Durban, 20 May 2010.



Commercial conditions for e-infrastructures in African countries should be flexible so that they can deliver the expected benefits. If development is a priority, policy should give priority to users rather than to vested interests in industry. Competition must go from 'hardly allowed' to 'stimulated'. Open access to key infrastructure resources should be enforced by the regulator to allow anyone to buy/ lease resources on one level and provide services on any higher level. Right-of-Way obstacles should be resolved. Permitting formal regulations is one thing; enforcement and leadership to change behaviour is another.

In order to get maximum benefit of the unfolding opportunities of the e-infrastructures, capacity building is very important for growth and sustainability. The training should be in Communication Systems and Networks presented both as vocational courses that satisfy the immediate NREN needs, and as academic programmes at Bachelor and Masters' levels. Education is necessary in order to meet the being Tsunami created, by needs in all sectors of society, not only NRENs, to retain staff.

## REFERENCES

Abela, C. M. (2009) European Commission, AfricaConnect as enabler for Research Collaboration and EU's Framework Programme for Research, UbuntuNetConnect 2009, Uganda Kampala, 12-13 November 2009 <<http://www.ubuntunet.net/connect2009>>.

Carmen Mena Abela's statement, (2009)  
<<http://ei-africa.eu/2009/11/27/carmen-mena-abelas-statement/>> accessed 6 Oct 2010.

AfricaConnect initiative, (2010) FEAST project: results and outlook, <[www.feast-project.org](http://www.feast-project.org)> accessed August 2010.

FEAST Final report (2010) Final report of the feasibility study for AfricaConnect initiative, <[www.feast-project.org](http://www.feast-project.org)> accessed August 2010.

FEAST Study (2010) Supporting the connection of African research and education to global Internet via GEANT. <[www.feast-project.org](http://www.feast-project.org)> accessed August 2010.

Internet World Statistics (2010) Usage and population studies  
<[www.internetworldstats.com/stats.htm](http://www.internetworldstats.com/stats.htm)> accessed August 2010.

NRENs (2009) The case for NRENs, <[www.terena.org/activities/earnet/docs/20080429-final-report.pdf](http://www.terena.org/activities/earnet/docs/20080429-final-report.pdf)> accessed August 2010.

Pehrson, B. (2010) 'Building a Research and Education Infrastructure in Africa: Policy Perspectives and AfricaConnect', FEAST Identification of Remaining Gaps. IST-Africa, Durban, 20 May 2010.

Taylor, S. J. E., Ngwira, M., Pehrson, B., Matranga, I. and Lombardo, T. (2010) ERINA4AFRICA Overview: Exploiting Research Infrastructure potential for boosting Research and Innovation in Africa.  
<[www.erina4africa.eu](http://www.erina4africa.eu)>.

Twinomugisha, A. (2007). National Research and Education Networks in Africa:  
<http://www.ubuntunet.net/documents/sarua-fibre-final-report-draft-2006-03-04.pdf>>  
accessed August 2010.

Valin, K. (2010) The e-I-Africa Project: Strengthening Co-operation on e-Infrastructures between Europe & Africa, IST-Africa Conference / Durban, ei-Africa.eu - EU/FP7 #246650 South Africa / May 2010.



