

New models for NREN's and Universities in era of Broadband and Web 2.0 Applications and Innovations:

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Abstract

National Research and Education Networks (NREN's) are relatively new institutions that have evolved in Sub-Saharan Africa Higher education landscape. The changing role of universities in context of globalisation, participating in global scientific and research communities and the recent role internet and web's transformation in education delivery have seen sea-changes. The advent of undersea cables and open access principles in many SSA's presents an opportunity for upgrade in value chain- purchasing wholesale capacity and passing benefits to members (i.e. UbuntuNet Alliance).

With advent of a new 'broadband abundance' environment, there is logical evolution of both NRENS and their role in education networking. As Higher Education Institutions (HEI's) evolve into 21st century, they will require new generation NREN's with capacity, networking, advocacy and managerial capability for the 21st century. Through NREN collaboration, new research and development capacity, increased post-graduate student, universities are developing corporate models management functions – *strategic management, managing IPR and patents, commercialization of technology, etc.* Hence a new business model for Universities and NRENS are emerging.

Broadband abundance in SSA's Higher Education landscape will enable and drive many new generation innovation areas such as *apps development, incubation service, cloud computing, etc.* New trends in open education resources (OER) and the creating enabling environment for new content as well as new application development will require that many universities to provide new generation services like incubation services, shared services and support and tech entrepreneurship services. This require HEI's and NREN's to develop new services to be in line with rapid and multi-layered demands of the 21st century university.

1. Background and Context

On the eve of the 10th year of the UN review of the UN Millennium Development Goals (MDG's) in New York in September 2010, the ITU/UNESCO's new Digital Commission for Broadband Development (DCBC) formally launched its 2010 Declaration of Broadband for

Inclusion for All at the UN General Assembly with a clarion call for an inclusive broadband agenda:

'We believe that the Internet should be used for the benefit of mankind. Beyond any physical and virtual infrastructure that has preceded it in the industrial revolution or information age, and as a catalyst of and critical enabler for recovery in the wake of the global financial meltdown, broadband will be the digital invention and innovation and foundation for digital and other investments that lie at the very heart of our shared knowledge economy and society...' ITU UN Broadband Commission Sep 2010(www.broadbandcommission.org)

It is significant (and not surprising) that one of the key recommendation of the ITU/UNESCO Broadband Commission (recommendation 3.1) calls for investments in 'future proofing' technology.' *Optical fibre is desirable at the core of the internet, and for the majority of backhaul traffic, to achieve a high-capacity backbone....'* And it is international undersea optic cables & national fibre-networks that will deliver the high speed broadband networks for both developed for developing regions.

2. Plugging SSA' Info-Infrastructure Gap - Undersea Cable boom in SSA

However, Sub-Saharan Africa's (SSA) exhibits many 'telecoms paradox' deficits & outcomes' preventing it from accessing and using broadband services.

While developed and developing regions (Europe, Asia, Latin America, Oceania) of the world have made good progress at providing internet and broadband to citizens at affordable rates. Sub-Saharan Africa (SSA) *internet access, usage, affordability* and hence social appropriate is the lowest in the world. Several structural, policy, regulatory, investment and other variables has led to what I term Sub Saharan Africa's (SSA) 'high cost, low access & usage telecoms/internet paradox'. This paradox expresses itself in multiple areas and spheres.

- Monopoly bottlenecks of undersea cables leading to high an Internet high cost, low access/usage situation;
- Policy regulatory and institutional disconnect – imperfect markets/outcomes;
- High investment in Undersea cable systems but low sub-regional and backhaul backhaul national roll-outs – 'Demand model stimulation gaps;

LAYER	ACTIVITY	EXAMPLE COMPANIES
VI	<i>Customers/Consuming</i>	-
V	<i>Applications Layer, including contents packaging</i> (e.g. Web design, on-line information services, broadcasting services, e-commerce etc)	Bloombergs, Reuters, AOL-Time Warner, MSN, Newscorp, etc
IV	<i>Navigation & Middleware Layer</i> (e.g. browsers, portals, search engines, directory assistance, security, electronic payment, etc)	Yahoo, Netscape, Vizzavi, Genie, etc
III	<i>Connectivity Layer</i> (e.g. Internet access, Web hosting)	IAPs and ISPs
TCP/IP INTERFACE		
II	<i>Network Layer</i> (e.g. optical fiber network, mobile network, DSL local network, radio access network, Ethernet, frame relay, ISDN, ATM, etc)	AT&T, BT, NTT, WorldCom, Qwest, Colt, Energis, Vodafone, NTT DoCoMo etc
I	<i>Equipment & Software Layer</i> (e.g. switches, transmission equipment, base stations, routers, servers, CPE, billing software etc)	Nortel, Lucent, Cisco, Ericsson, Nokia, etc

Source: M. Fransman, <http://www.TelecomVisions.com>

Fig. 2. A layer model of the infocommunications industry.

Figure unpacks the various layers in new generation networks and services and applications in the telecoms value chain. Broadband 2.0 will catalyse many African players to compete in the players 4 and above.

Jensen (2006) unpacks this open access model /concept as a distinct model whereby any entity would be free to invest, either as an operator (tied to guaranteed amounts of bandwidth), or a non-user shareholder who may invest funds to provide right of way. Ownership of a cable can also be defined on a national level, with shares held by a Special Purpose Vehicle (SPV) that will own and operate landing cable and points. The main objective of an SPV is not profit, but to facilitate profits made elsewhere by participating companies. It is not to exclude incumbent telecom operators, but allow others to participate and bring additional funding and advantages to the table. This approach, Jensen notes would ensure that the wholesaler (SPV), is separated from retailers, licensed in each country, thus ending international gateway monopolies.

3. Sub-Saharan Africa's National and Regional Backhaul Fibre

The rise of open access models in undersea cable model and the EASSy cable (through WIOCC) as enabled smaller players like NREN's to own and operate cable access. Together with competition at landing stations, open access has 'first tier' access to the development of backhaul access and national fibre infrastructure and development. The recent formation of UbuntuNet Alliance as a dedicated regional consortia and its foray into AfriConnect consortia to purchase capacity and access to undersea-cable access is significant development. It signals the potential

of broadband for a development and increasing education access, but also African scholars and students to participate in global science and education networks (GEANT, ERINA, JANET etc).

3.1. Backhaul access and national fibre consortia development

According to Southwood, the broadband provision model is changing lower prices of international bandwidth mean (tenth cost of satellite costs) move from wholesale to services and applications. International and competitively priced bandwidth is driving new investment plans for national roll outs. Which will be the best and most appropriate? Competition will drive redundancy and lower prices; operators to hope to build cheaper networks. Competition at wholesale level (between operators) needs to be accompanied by competition at retail level end-user customers) co-dependency

3.1.1. Commercial infrastructure sharing. Many factors such as the recession and lower ARPU's as well as high sunk cost to roll out national networks, are encouraging commercial operators to build and own common fibre infrastructure.

With experience in the diverse undersea-cable consortia co-investment has set good precedence for nation commercial sharing. For example, in SA Neotel, MTN and Vodacom have built a new 5 000km fibre network. Operators agreed to share cost and trenching, project management- but provide own transmission - they are sharing the ducts. Neotel estimates to save R 400 million – could pass on savings to consumer and users.

3.1.2. Third party providers: third party providers have emerged in context of **maturing** markets. These are 1) 'carrier carriers (wholesale capacity to market, neutral & trusted) and are providing links between countries and within countries; 2) alternative infrastructure operators - only marginal cost to upgrade fibre only existing network (like Infracore was) and 3) dark fibre operators – new model selling dark fibre to both operators and maintains the physical infrastructure for those its leasing capacity to users on the needs basis.

UbuntuNet Fibre Chart

We already beginning to see regional fibre systems such as COMESA's East Africa Broadband Network, Burundi Broadband System (BBS), SADC's SPII develop backbone networks offering open access services to users. With education being a priority, many NREN's are having the benefit of first tier wholesale access to broadband. This is changing negotiating power in the sector and offering broadband to key constituencies, especially universities.

4. Higher Education Transformations in 21st century knowledge economy

As the global economy becomes increasingly reliant on Information Communication Technologies (ICT), the competitiveness of local economies and self reliance of associated societies become ever more dependent on access to 'e-Skilled' workers who have achieved a measureable level of competence (ideally certified, quality assured & benchmarked against an international standard) & engaged citizens. The WSIS Process (2005) stated that

“e-Skills are essential in empowering individuals so that they can participate fully as citizens of the Information Society, and take advantage of all the opportunities before them: opportunities for employment and wealth creation, for taking advantage of innovative education and learning strategies, and for using new life-enhancing services, such as interaction with public authorities”¹.

A starting point for discussion on NREN models would be a discussion on the evolving role of restructuring of Higher Education institutions globally and regionally.

Broadly driven by information and knowledge economy, mobility of workforce and new forms of work and skill requirements for the 21st century economy. (UNESCO, 2008). Higher education institutions are undergoing a series of systemic transformations and transition that impacting organisation and model.

These key variables include:

- New Governance models at HEIs’;
- Private public partnerships in knowledge production;
- Commercialisation of higher education;
- Competition from private education providers;
- New accreditation and quality assurance systems;
- University cluster co-operation and peer-production;
- Increased student ratios and mobility of students that require multi-modal education delivery systems;
- Importance of distributed & distance learning education models that require quality ICT and management-operations infrastructure;

Rapid technology a regulatory environment is having major impacts on the roles of NREN’s. Extensive research on NREN’s role and transformations has showed a strategic, qualitative, organizational and business model shift. Many refer to the capability maturity model (CMMI) and the various layers of evolution) Martin, 2008).

This transition model can further be allocated as follows.

NREN- Current Model	NREN 2.0- New Generation Model
<ul style="list-style-type: none"> • ISP service function • Bulk broadband purchases, negotiations, contracting; • Aggregator role and traffic management; • Training 	<ul style="list-style-type: none"> • Multi-stakeholder negotiations with cable operators, backhaul providers, ISP’s etc; • Investor in broadband consortia role; • Knowledge Management services and functions; • Policy and Advocay role in national and regional policy; • Participating in layers, 4 &5 (Fransman 2001) • Potential Incubator services.

Business Models and information models

According to Osterwalder (2004), a business model seeks to describe a process of the how organization offer within a value chain, processes and operations. In the context of information economy and web 2.0 business world, the boundaries of business model (ie. What you do and how you do it) is in constant flux and evolution. He describes the concept as:

‘....A business model is a conceptual tool that contains a set of elements and their relationships and allows expressing the business logic of a specific firm. It is a description of the value a company offers to one or several segments of customers and of the

architecture of the firm and its network of partners for creating, marketing, and delivering this value and relationship capital, to generate profitable and sustainable revenue streams...'

Hence, NRENS will be called upon to develop new generation services and expand its capacity model roles, responsibilities.

5. Next generation opportunities in the Broad Band value chain

5.1. Innovation, Applications as next generation drivers for broadband

In the previous section, it was highlighted that the plugging the Info-structure gaps and evolution of broadband abundance environment through international internet connectivity in Sub-Saharan Africa (SSA) is one track. With extensive investments in undersea cable systems from a diverse funding sources (operators, World Bank, IFC, private capital etc), broadband diffusion would be rapidly increased. The broader regulatory and investment infrastructure is in place for extensive national and fibre-backbone infrastructure investment. So what's next? I argue that the 'emerging broadband abundance' in Sub-Saharan Africa creates new opportunities for Higher Education Institutions (HEI's)

5.1.1. New drivers regarding in broadband ecology and Web 2.0 era

Broadband enables a new ecology of Web 2.0 services and allows various countries (even in developing regions) to move up along the value chain in new Information, Technology and Electronic Services (ITES) to take route for Web 2.0 applications.(InfoDev 2010). In context of NREN ecology and the primary objective to provide quality internet for higher education, NREN's and Universities and UOT's are in the perfect position to leverage quality broadband these development.

a) Web 2.0, Virtualisation and Green computing: is set to be the next wave in the PC and software industry. The growth of Web 2.0 web applications and Google massive demand for data- warehousing. As Sub-Saharan African (SSA) universities and community colleges tap into broadband abundance, entrepreneurs are in and with new generation and access to broadband, African cyber-entrepreneurs are place in global application developments; develop business process off-shoring (BPO) capability.

b) Open Innovation & Content: the internet core architecture is one of openness and interoperability. The rise and success of free and open source movement has generated thousands of new innovations; the creative commons copyright as pushed the boundaries of copyright and opened up new innovation spaces. These models have provided expansion of education access through open education resources (OER).

c) Social Media Apps - The phenomenal rise of social media enabled devices (i-phone, blackberry, Nokia, Google phone) opened up peer-to-peer software development. Apps are associated with Apple's i-phone generation of devices and are is the fastest growing sector in the software, industry employing thousands in the USA and Europe and generating (hundreds of USD millions) for thousands of small scale apps developers globally. With the incubation services, tech capacitated universities and new generation mobile devices African apps developers can be equal players in the global apps space.

Both are required to bolster African education and can contribute to job creation, generate new content, develop new applications, education content for internal African market as well as contribute to global application and software development programmes.

It is clear that the boundaries of higher education and market place interaction are complex, multi-layered and dynamic and interactive. Universities producing graduates in line with skills development in 21st century market place. Furthermore, New generation science and technology policy such as South African's IPR and Publically Financed Research & Development Act (PFDAAct) (2008) new frameworks on Public R&D and the requirements to commercialise IP knowledge and research within clear timeframes.

This is catalyzing many Universities to adjust strategic policy and develop new management systems. These policy frameworks will enable Higher Education Institutions (HEI's) to generate new income by commercializing IP and developing technology transfer policies. My assertion is that this will require Sub-Saharan Higher Education Institutions (HEI) are increasingly asked to provide incubators *or innovation hubs* infrastructure & services. These incubators would provide new generation services;

- ICT Incubators;
- Technology entrepreneurship services;
- Business planning and commercial marketing etc;
- Shared services – HR, Operations,
- IPR legal and contracting services;
- Call centre services;
- Mentorship and Coaching;
- Tech Transfer Offices (TTO's) to manage IPR and commercialization potential of HEI's;

Already many South African universities have identified the rapid growth of tech enterprises and are setting up dedicating innovation hubs and incubators at university level. Examples include Tshwane University of Technology's (TUT). Donors funded programs such as the InfoDev/Finland partnership seeks to develop and grow mobile application capacity at universities, setting up of incubation hbs, science park development, IPR and virtual incubation services** (Infodev 2010)

Pillar	Business Model Building Block	Description
Product	Value Proposition	Gives an overall view of a company's bundle of products and services.
Customer Interface	Target Customer	Describes the segments of customers a company wants to offer value to.
	Distribution Channel	Describes the various means of the company to get in touch with its customers.
	Relationship	Explains the kind of links a company establishes between itself and its different customer segments.
Infrastructure Management	Value Configuration	Describes the arrangement of activities and resources.
	Core Competency	Outlines the competencies necessary to execute the company's business model.
	Partner Network	Portrays the network of cooperative agreements with other companies necessary to efficiently offer and commercialize value.
Financial Aspects	Cost Structure	Sums up the monetary consequences of the means employed in the business model.
	Revenue Model	Describes the way a company makes money through a variety of revenue flows.

Figure 2: Business Model ontology describes the changing nature of Web 2.0 businesses in broadband rich era.

5.2. Towards Open Education Resources (OER) and Distance Learning

As developing regions like Africa begin to participate in the 'knowledge economy' world, and if so, two processes seem worth noting. First, societies of the global south are struggling with everyday challenges of education and literacy, while their institutions and governments perform the inevitable balancing act between scarce resources and burgeoning human resource needs. Second, producers of knowledge goods, heretofore located in the north, are increasingly global in scope; exporting, with their expansion, an intellectual property rights (IPR) regime that poses current and potential deterrents to learning. (Tralac, 2006)

5.2.1. Rise of Access to Knowledge (A2K) movement

It is against this backdrop that the global Access to knowledge ('a2k') campaign emerged. In the context of economic development in the south, and education world in particular, curricular resources in primary, secondary and tertiary education bear examination. While much of the changes wrought recently in IPR (in the domain of multilateral and bilateral trade negotiations) concern changes to the digital environment, their effects are as yet minimal in the southern African context. But while this is currently true on account of the relative lack of affordable and available telecommunications and computing infrastructures cannot be overlooked in that they pose a potential threat to the learning environment and curtail opportunities available – now and in the future – to institutions with adequate capacity.

The a2k movement¹ grapples with exactly such categorical difficulties while calling for action on two broad fronts: first, to limit the barriers imposed on access to knowledge by current and forthcoming intellectual property policy (in the most part, copyright law) second, to widen the horizons of access by positively licensing knowledge goods (to protect and populate the public domain).

Today's technology makes possible the widespread low-cost distribution of high quality intellectual property. The first notable expression of this openness, known as the open source movement, took place in computer software. The concept of openness, applied to intellectual property related to teaching and learning, has been expressed through open education (or educational) resources (OER), open courseware (OCW), and open knowledge. These terms are more than just words; they are concepts actively being advanced by serious people. And these concepts are beginning to converge.

Another trend is an emphasis by foundations and governments on **teacher training**. Improving teaching in all countries is seen as a necessary accompaniment to any form of OER, and one with a high impact that provides a high return on patron investment.

This same search for leverage is the reason that **existing, effective networks** need to be identified and supported. No funding source, private or governmental, can achieve its goals alone or without the effective "institutionalization" of the effort: a sustainable infrastructure dedicated to carrying forward initiatives beyond the funding term.

5.2.2. OER requires new institutional design and delivery systems

For Sub-Saharan African universities and education providers, OER offers new frontier of expanding knowledge by developing mixed models of course delivery (internet and web-learning as a platform). These present exciting challenges for the universities and potentially new roles:

- Design new instructional learning and e-learning organizational units;
- Engage with Community Technology Centres (CTC's) to deliver foundational course and programmes;
- Peer learning and community of with other African HEI;
- New broadband requirements (i.e.
- Streaming educational content to devices (mobile, phones smart phones)
- Wireless community networks for villages

Examples of recent successful and innovative open education initiatives include the Free Science Textbook Initiative (FSTI) of the UCT that seeks to offer free science textbooks, these removing cost barriers. The MobileMath project is a math education /curricula is offered online by live tutors via South Africa's MxiT portal. The Eifl e-journal project offers many universities and library consortia in Africa the ability to access build purchasing of e-journals at discounts, thus reducing barriers to knowledge and expanding education in the 21st century economy.

6. Conclusions and Recommendations

The paper argues that It is clear Higher education institutions in Sub-Saharan Africa are first tier beneficiaries of the broadband boom. Key drivers of new generation innovation, applications and new open content and education resources (OER) model will require significant changes in University strategy and innovation proactive need to be embedded in strategic management, operations management and in the new multimedia education delivery and design. Much more work lies ahead in the near future. The following is recommended

- Commission new research on broadband and innovation readiness
- Explore new generation Science and Tech Policy and its implications for IPR, patent, commercialization and tech transfer.
- Develop niche Training and development programme for national NRENS
High level training for Universities in Innovation management;
- Promotion of incubators at Higher Education

- Quality engagement with sector technology providers and industry

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