

The Potential for unified backbone optical transmission in Zambia: The analysis

Chanda MULENGA¹ and Mbuyu SUMBWANYAMBE²

*University of Zambia, School of Engineering, Electrical Engineering Department,
P. O Box 32379, Lusaka, Zambia. Tel: + 260 950 004153, Email: mulechanda@yahoo.com*

*University of Zambia, School of Engineering, Electrical Engineering Department,
P. O Box 32379, Lusaka, Zambia. Tel: + 260 953 547310, Email: sumbwam@gmail.com*

Abstract

Information and Communications Technology (ICTs) and telecommunication service provision in developing countries is undergoing speedy progress and inspiring numerous deployments. It has been looked upon as a substitute to accelerating social and economic growth and shows the potential to provide the goal of “communication access for all” in both rural and urban areas. One of the areas which Zambia as a country is facing is lack of a unified backbone optical transmission to carry services to majority of the areas both rural and pre-urban areas. This paper analyses the unified backbone optical transmission.

Keywords: infrastructure, ICTs,

1. Introduction

Information and Communications Technology (ICTs) and telecommunication service provision in developing countries is undergoing speedy progress and inspiring numerous deployments. It has been looked upon as a substitute to accelerating social and economic growth and shows the potential to provide the goal of “communication access for all” in both rural and urban areas (Ozioma .A.O, 2011).

Mobile GSM operators, Internet Service Providers (ISP’s) in Zambia are rapidly covering most populated areas with communication services, video and data services. Regardless of the multiple benefits of what these services can provide, in developing countries such as Zambia, major problems are currently being faced in the area of coordinated infrastructure development and access to information by the general populace (Zambia National Broadband Strategy, 2014).

It is therefore necessary for the regulators and policy makers to identify such problems and design solutions or network models that are capable of promoting socio-economic development. Generally, it is widely believed that a unified infrastructure access by different service providers may induce investments in ICT and lower down tariffs for the consumers due to increased competition. The lowering down of tariffs may, in many cases, translate into more social and economic benefits (Msimang. M, 2011).

The expected benefits of unified service provision and proper policy facilitation have been identified as, inter-alia, enhancing telecommunication play field, promotion of Foreign Direct Investment (FDIs), reduced infrastructure damage, and enhanced access to important information. One of the areas which Zambia as a country is facing is lack of a unified optical backbone transmission to carry services to majority of the areas both rural and peri-urban areas. This can only be achieved by having a unified transmission optical system of which the

government, as a monopolistic shareholder, can form a company to take full responsibility in installation, operations and maintenance of a unified infrastructure. Such a company will be responsible of leasing the capacity to mobile operators and other ICT service providers. This, in some eventuality, can lead to a lot of economic benefits and improve on the ICT knowledge gap that is common in Zambia; as the majority of the population will have access to ICT services.

An analytical research method will be used in this study. An analysis of the current regulatory framework regarding unified backbone structure will be done. Additionally, this paper will look into the economic implications of having a unified backbone structure in Zambia and its benefits to other infrastructures such as municipal infrastructure, low CAPEX for service provider seeking entry. Promotion of telecommunication Small, medium and Micro Enterprise Businesses (SMMEs) who cannot afford the capital to lay new telecommunication infrastructure.

2. Literature Review

Unified optical backbone transmission is generally defined as a high speed, high capacity transmission medium that can carry multiple independent network carriers. Globally, the recognized benefits of ICT's and a unified communication system cannot be over-emphasised since they have contributed to most countries Gross Domestic Products (GDP) in the 21st century (Zambia National Broadband Strategy, 2014). This paper looks at Zambia, and on lighter comparison to South Africa and Kenya in the analysis of optical infrastructure unification.

3. Comparative Analysis

3.1 Zambia Broadband Infrastructure overview

Zambia Electricity Supply Company (Zesco) an electricity utility company has laid and built the optical broadband infrastructure. Zamtel who are the incumbent telecommunications, are the carrier of carrier, CEC Liquid Telecoms and two privately owned Mobile operators, MTN Zambia and Airtel have also installed their backbone infrastructure networks. This infrastructure predominantly runs from the Southern to northern parts of Zambia. Fiber optical being the main national broadband backbone with a current geographical spread covering 10,000km connecting about 46 districts and is complimented by mobile wireless broadband communication networks with 78% mobile geographical coverage. Apart from this predominant route, state and private owned fiber has been laid mainly following the line of rail in the metropolitan areas (Zambia National Broadband Strategy, 2014)

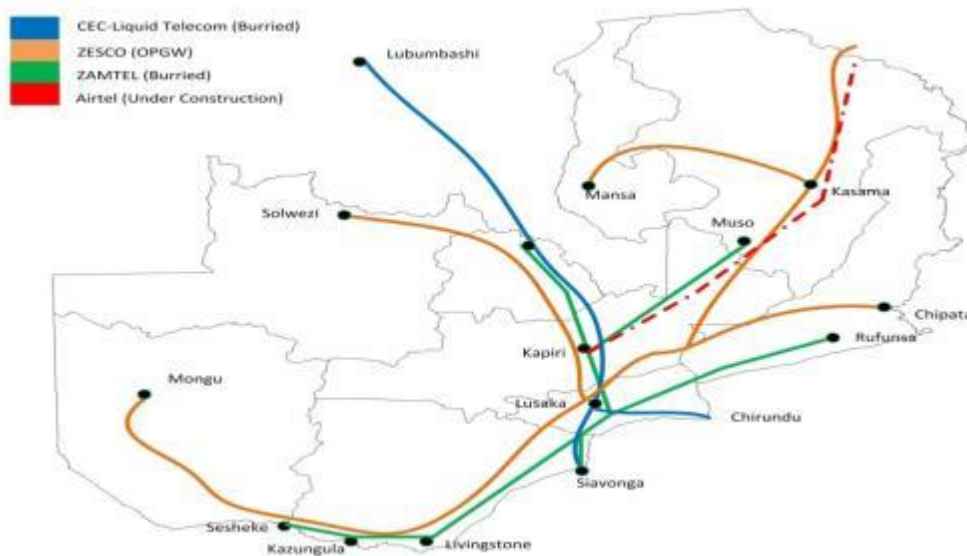


Figure 1: Optical Fiber of Zambia

3.2 South Africa Broadband Infrastructure overview

The biggest gap in the national broadband infrastructure in South Africa is currently in the access network. This is illustrated by the fact that 86% of the population is within 10 Km from a fibre access point. Until 2009, South Africa was connected to the rest of the world by a single international submarine cable (SAT3). By the year 2013, four submarine cables were in place with a combined capacity connectivity of 11.5 Tbps to the international community.

This capacity was available to at least five (5) service providers at a wholesale price. With construction works underway of additional cables, the anticipated capacity will be 29.5 Tbps which will connect to Europe, Asia and Africa. This development has resulted in prices of ICT services to drop drastically going by demand and resulting in better use of available capacity. This optical fiber connectivity is provided by a number of sector companies such as Telkom, Broadband infraco, Dark fiber Africa, Fibreco and Liquid Africa (South Africa Broadband Policy, 2013).

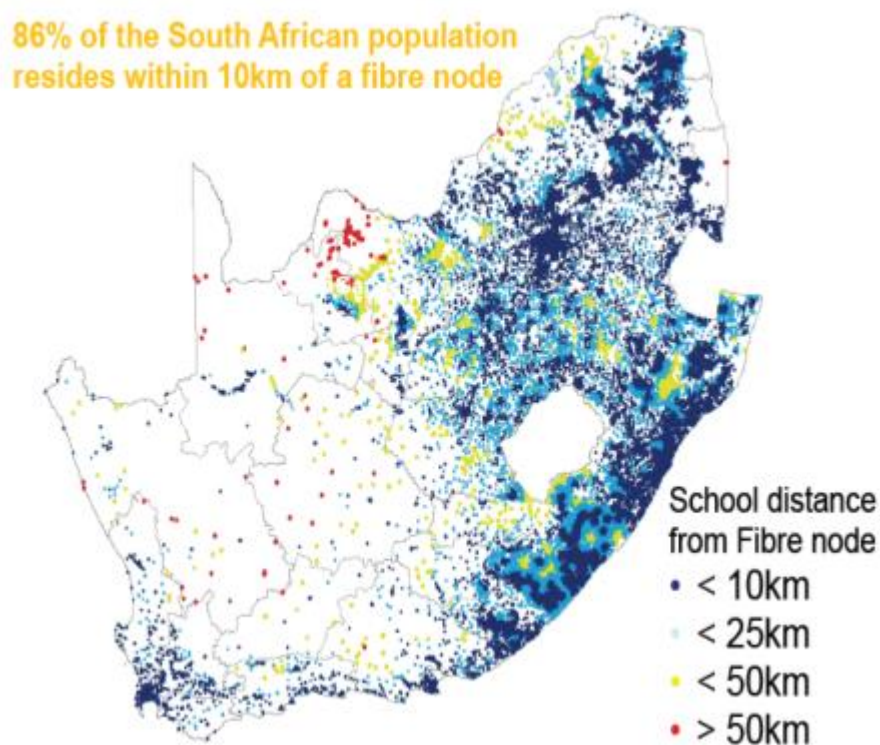


Figure 2: Fiber Distribution (South Africa Broadband Policy, 2013).

3.3 Kenya Broadband Infrastructure overview

Located in the east coast of Africa, Kenya has a natural advantage compared to other landlocked African countries. Its government motto on broadband “build it and they will come” has leveraged its advantage by playing a major role in increasing its fiber optic backbone capacity (Msimang. M, 2011). In the last five years, three undersea optic fibre cables have been installed giving an access capacity of 4Tbps international connectivity. And this has made Kenya not to depend on satellite connection which it used to rely on previously. This has contributed to 80% decrease in whole sale bandwidth costs.

4. Regulatory framework for unified backbone in Zambia.

Different types of ICT Acts have been developed to propel the Zambian infrastructure development to great heights. In recent months great focus on infrastructure development, particularly the broadband strategy, has taken much of the center stage in Zambia. Different types of Acts were enacted by the Zambian government to promote infrastructure development. For example, the Zambia national broadband strategy (2014), working draft, outlines the following Acts which have, partially, necessitated infrastructure development in Zambia.

4.1 Information and Communication Technology Act No. 15 of 2009.

The Act provides for the economic and technical regulation of information and communication technology; facilitates access to ICTs; "protects the rights and interests of

service providers and consumers”; and regulates and manages radio spectrum. The ICT Act also renamed the CAZ to the Zambia ICT Authority (ZICTA).

4.2 Electronic Communications and Transaction Act No. 21 of 2009.

The ECT Act, 2009 provides for the development of a safe, secure and effective environment for the consumer, business sector and the government to conduct and use electronic communications. Additionally, the ECT Act of 2009 aims to promote legal certainty and confidence, and to encourage investment and innovation in the electronic communication industry. Also, it facilitates the creation of secure communication systems and networks; and allows the legal interception of electronic communications and admissibility of intercepted communications.

Zamtel, Airtel, MTN Zambia, Zesco and CEC Liquid have installed and keep on expanding their own backbone transmission links so that they can reach new areas which has resulted in the duplication of telecommunication backbone networks. Generally, Zambia’s infrastructure network has less than 47% countrywide coverage and still have major gaps in transmission links reports the Zambia Information and Communications Technology Authority (ZICTA, 2011). The mobile operators, the utility company now own and control the bulk of transmission backbone capacity. Despite this, regulation and competition between operators have largely prevented shared use of infrastructure in terms of such emerging transmission backbones (microwave, satellite and optical fibre) which has resulted in under utilization of this vast sea of infrastructure. Regardless of having such an amount of fibre infrastructure, sadly, only less than 8% of the total population has an average access to the internet and telecommunication facilities. The reason being that most of network infrastructure companies tend to concentrate in areas where the perceived rate of return exceeds their initial investment capital in infrastructure.

By and large, one of the areas of concern to the Zambian government is lack of a unified optical backbone transmission to carry services to majority of the areas in both rural and peri-urban areas. This can be solved by having a workable broadband governance framework to outline various strategies. Notwithstanding these provisions and efforts of the strategic government paper, the country is still faced with a number of challenges in its quest to build broadband infrastructure in Zambia and they have thus come up with a lot of recommendation within the broadband working paper. For example the Zambian working draft on broadband clearly states that “The Government shall take a broader perspective and focus on infrastructure as well as creation and nurturing of various elements in the broadband ecosystem. An autonomous ICT Infrastructure and broadband Government Agency shall be created for broadband deployment to ensure the quality and time of delivery”.

In order to improve on the broadband connectivity, availability and obtain maximum value on broadband infrastructure, the Zambia national broadband strategy 2014 (working draft) recommends the following:

- a) Develop a robust and reliable national backbone for the broadband network
- b) Provide a harmonised and enabling environment for infrastructure deployment
- c) Promote affordable access to high speed internet
- d) Promote the use of alternative and affordable energy sources for ICT equipment to supplement the nation’s conventional energy sources;
- e) Enhance infrastructure for the National and International Internet Exchange Points;
- f) Encourage the use and sharing of common infrastructure amongst different operators
- g) Establish redundancy to ensure broadband service continuity and availability;
- h) Undertake a Spectrum re-farming exercise and re-assign it to needy areas

- i) Utilise the Universal Service Fund to extend broadband network penetration;
- j) Promote research on T.V. White Spaces

Currently most of these frameworks are not in place which needs to be addressed and has led to the economic implications.

5. Problems associated with non-unified backbone infrastructure.

There are several disadvantages with regard to non unification of the backbone infrastructure by the Zambian government. Some of the notable problems associated with non unification are:

5.1 Network destruction

The most common cause of fibre cuts come from construction companies who do not follow procedures and laid down municipality by-laws. This usually results in a lot of interrupted service and loss of revenue caused by downtimes. Additionally, this significant network down time may result in stoppage in the network in terms of fiber cuts and copper cable infrastructures across the country hence there is need to investigate the municipality regulations so that appropriate measures are recommended (Savory, 2012).

5.2 Heavy CAPEX on infrastructure laying

Network companies or the government itself will have to lay out the infrastructure which is very costly. For example the Zambian country report states that infrastructure objectives for Zambia would cost \$1.6 billion per year over the next decade. Capital expenditure (CAPEX) would account for 70 % of this requirement. Figure 3, for example, depicts the annual market- driven investment infrastructure of some African countries including Zambia.

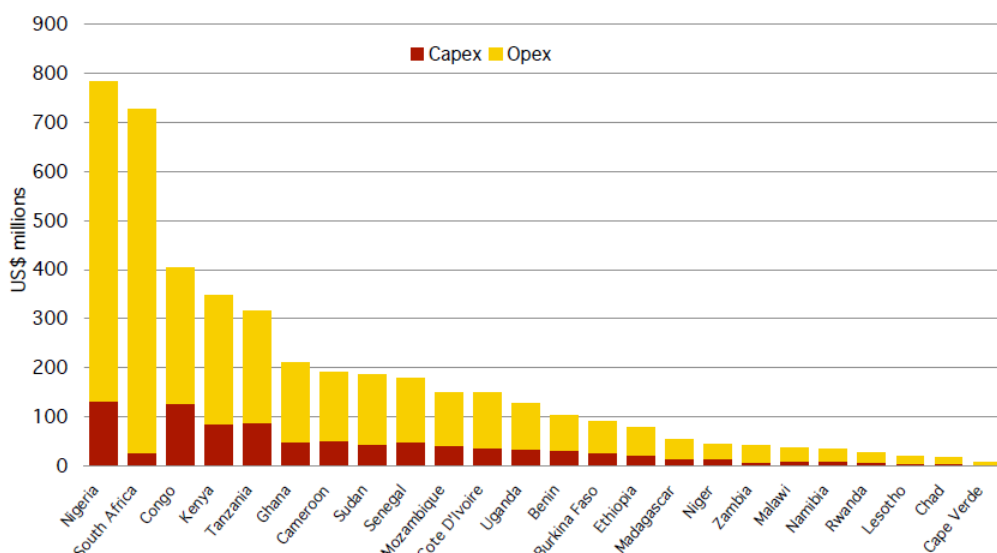


Figure 3: Average annual market-driven investment in voice infrastructure by country, 2007–15 (Winrock International / Pyramid Research).



Figure 4: Construction works on Direct Optical Fiber in Ndola.

5.3 Uncoordinated Regulation

A liberalization of the telecommunications market is rapidly taking place in most of African countries and Zambia in particular. Therefore, it is important to come up with flexible clauses in the regulatory structure so that the laws are in line with the current market demands to attract foreign direct investment in the telecommunications and ICT industry. From an economical and practical point of view, network sharing is a huge and intricate process that requires a number of coordinated actions. Regulatory and policy supporting network sharing is a useful tool for regulators and policy makers to boost network deployment and coverage improvement in un-served or underserved areas (Djamel E.D, Tinku.R and Gourhant.Y, 2011). If operators are allowed more freedom to share their infrastructure in the unified optical transmission and concentrate on competing as far as their services are concerned, the large consolidation upsurge in the telecommunications market across the globe could be open.

5.4 Under usage of bandwidth.

Most network operators have dedicated much of their bandwidth resources to Voice centric services at the expense of data. Their transmission system are not fully riding on an IP transport layer platform but relies on the synchronous digital hierarchy (SDH) or wavelength division multiplexing(WDM), which does not give proper and required bandwidth to a customer. Most of the fibre bandwidth in Zambia is lowly used.

5.5 Constrained investment opportunities

Open access means that optical backbone facilities and bandwidth should be provided to all interested parties on equal and transparent terms. This implies that access charges should be cost effective and affordable based. Habeenzu. S (2010) notes that there are a multiplicity of high-speed broadband Internet access packages on the Zambian market with different pricing

strategies stretching from usage-based to fixed Internet access charges. The market place is highly unregulated and lacks uniform pricing, which makes comparative price analysis difficult. Generally, CEC is the only company that provides leased dark fibre in the country. Additionally, only CEC and Zamtel provide bandwidth below 2Mbps such as 512kbps, 256kbps even as low as 64kbps. ZESCO's service is limited to providing backhaul services for ISPs and mobile operators. Though, CEC and ZESCO infrastructure has reached some areas in different regions, there is no competition between them. On the other hand, ZESCO charges according to distance on a wholesale basis and its fiber is very reliable. The cable is an Optical Ground Wire (OPGW) which is an overhead line installed on high voltage power lines. Optical fibre cables are often assumed to be the best transmission media, and the general opinion is that the costs of fibre would be very low. In business terms, open access essentially means that all operators agree to compete only on the service layer and not on the infrastructure layer.

6. Critique on the unified Zambian infrastructure

Though there is a lot to do with Zambia's unified backbone transmission, a number of issues and benefits have been raised and outlined. Zamtel, MTN, Airtel, Zesco and CEC Liquid are the only companies in Zambia providing the backbone transmission of telecommunication services as well as ICT services. By having a unified transmission optical system, as a primary transmission for all operators, of which the government can spearhead and form a company (Zambian working draft on broadband) to take full responsibility in installation, operations and maintenance of a unified infrastructure, network operators can have secondary transmission of their own has a resiliency. This organization will be responsible of leasing the capacity to mobile operators and other ICT service providers. This, in some eventuality, can lead to a lot of economic benefits and improve on the ICT knowledge gap that is common in Zambia. The end result will lead to the majority of the population having access to the internet and telecommunication services.

6.1 Economic magnitudes of network sharing

Infrastructure sharing between operators and service providers undoubtedly leads to a reduction of the investment made by each operator involved in the network sharing process. However, network sharing may further help operators in realizing better coverage, as operators may choose to use only those links that provide deeper and better coverage and decommissioning sites with poor coverage possibilities. Operators may reinvest the capital realized from such savings in upgrading their networks and providing better roll out and coverage to end-users. Network sharing, under heavy regulation, may also bring substantial environmental and social benefits, by reducing the number of individual links thereby improving the general landscape (Djamel E.D, Tinku.R and Gourhant.Y 2011).

6.2 Promotion of social and economic benefits

The social benefits, some of which outlined above, of unified optical transmission and ICT is completely invaluable and a good number of such benefits can be attained. These benefits, to mention but a few, will include social interactions, business to business (B2B), business to government (B2G) and business to citizens (B2C). Such social and commercial interaction may bring revenue to telecommunication companies and internet service providers (ISP's) and in some instances have some trickle down effects on the economics of the country. These

benefits can also reduce inequalities in opportunities between rural areas, the urban and peri-urban areas. Internet services of social value to the people may spin off with the introduction of Internet Services, and may deliver educational, health programmes to remote locations. Unified communication coupled with proper ICT policies and implementation can also help to reduce costs and improve efficiency in health care delivery. Unified optical transmission may increase network availability in rural areas increasing the chances on adopting telemedicine in rural areas. Telemedicine applications such as connecting remote computers to a-ray machines may provide precision focusing and transmission of digitized X-ray photographs which is lacking in almost all the healthy institutions in Zambia. Having a unified communication can assist to achieve all these despite the infrastructure cost and maintenance.

7. Conclusion

From the context of this study, a sound conclusion can be drawn with emphasis that telecommunication and ICT policies in its economic and social development role, are just facilitators meant to help national development. Having a unified optical backbone transmission will yield, the benefits of ICT policies to a national economy. This can be measured as an input to other economic activities such as social, healthy and economy. And more importantly they should also be considered as complementary to other sectors. Telecommunication and ICT development is linked with and complements the development of industry, trade, farming, education, housing, health and financial institutions.

References

- Doc 'ICT Sector Legal and Regulatory Framework vis-à-vis Opportunities for Growth: ZICTA's vision for the sector' pp.5-12.
- Djamel, L, Gourhant, Y. & Tinku, R (2011). 'On the role of infrastructure sharing for mobile network operators in emerging markets'. *Computer Networks. The journal*.www.elsevier.com/locate/comnet [accessed 14 August 2014], pp.9-16.
- Habeenzu, S. (2010). 'Zambia ICT Sector Performance Review 2009/2010'. *Towards Evidence-based ICT Policy and Regulation Volume Two, Policy Paper 17*. pp. 24-26.
- Mayer. R, Figueredo. K, Jensen. M, Kelly. T, Green. R & Federico. A.B. 'Costing the needs for Investment in ICT infrastructure in Africa'.www.eu-africa-infrastructure-tf.net/attachments/library/aicd-background-paper-3-ict_ [accessed 31st October, 2014].pp.7-9
- Msimang, M. (2011). 'Broadband in Kenya: Build it and They Will Come.' <http://www.infodev.org/publications> [accessed 10th October, 2014] pp.3-5.
- Ozioma, A.O. (2011). 'The Economic and Social Benefit of ICT'. www.webpages.uidaho.edu/~mbolin/anie.htm [accessed April 18, 2014]
- Savory, B. (2012). 'Fiber Optic Network Reliability & Security for NRENs: The Threat and Potential Solutions'.http://www.ubuntunet.net/ubuntunet-connect_proceedings [accessed 20th, October, 2014].p2
- South Africa's Broadband Policy. 'South Africa connect: Creating Opportunities, Ensuring Inclusion' [accessed 19th, October, 2014].
- Zambia. Ministry of Transport, Works, Supply and Communications. 'Zambia National Broadband Strategy' [accessed 19th, October, 2014].

Biographies

Chanda Mulenga is the First Line Maintenance Manager at Zambia Telecommunications Company under Mobile Network Operations and currently pursuing a Master's Degree at the University of Zambia in Telecommunications Systems. He holds a bachelor's degree in Electrical/ Electronic Engineering and he is responsible for day to day network availability of the transmission networks, Power systems, Core networks and Radio Access across the country in Zamtel. He has worked in the transmission planning department involved in the roll out of optic fiber, microwave, satellite communication and Radio Access (2G and 3G) before moving to operations in 2012.

Dr. Mbuyu Sumbwanyambe is a lecturer at the University of Zambia and is a member of international association of engineers (IAENG). He is the recipient of UJ-commonwealth scholarship. Dr Mbuyu Sumbwanyambe has a MEng in Electrical and Electronic Engineering from the University of Johannesburg in South Africa and a PhD in Engineering Management from the same University. Dr. Sumbwanyambe has a multi-disciplinary background and has varied research interests, which include Risk management, Application of Game theory in telecommunication, digital communication, resource management regulation and policy issues, telecommunication and ICT engineering, economic and social ICT delivery, Energy management and green ICTs, and information systems evaluation. He has reviewed several papers for IEEE and Francis and Taylor Journals, as well as acted as chair and invited panelist at numerous international conferences.