The Submarine Cable Connection: What should it means for Rural Africa?

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The Submarine Cable Connection: What should it means for Rural Africa?

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Abstract

This paper focuses on the implication of the Indian Ocean Submarine Cable Connection at East African coast to Africa's economies. It looks at the current Wide Area Networks (WAN) technologies. With the connection of the Indian ocean submarine there is an expected switch to the relatively cheaper fiber optic technology. It briefly reviews the technologies currently being used. The paper then proposes a network design that will optimally utilize fiber's high per user bandwidth. It also suggests introduction of applications that will take advantage of the technology's potential. The paper suggests a design that will in the long run extend the Information and Communications Technology (ICT) to academic institutions and the community.

Key words: Fiber, Local loop, Technologies

1.0 Introduction

In the past, network backbone capacity has been dominated by voice traffic, but of recent, due to the increasing number of internet supported applications such as online banking, electronic money transfer and Short Messaging Service (SMS), there has been a growing need for high bandwidth, and fast connectivity to extend these services not only to the urban population, but also to the rural community. With the rapid expansion in optical transmission and the setting up of Indian ocean submarine fiber line that through Kenya is expected to connect East Africa and to the rest of the world, there has been an opportunity open to East Africa and Uganda [5].
The two communications technologies currently taking center stage are: wireless, that can virtually go anywhere and optical fiber [2] Wireless networks despite their advantages have limited capacity. On the other hand optical fiber despite being confined to fixed limited paths, has almost an unlimited bandwidth capabilities to at least support the increasing bandwidth demands.

The implication is, high bandwidth will mean a possibility of not just supporting the different internet traffic types, but provide nationwide access to affordable broadband data services and thus facilitating the use of the now so called bandwidth intensive internet applications. On the other hand there will be a relatively lower cost of extending internet based services to academic institutions and the community by service providers.

The result will be a general improvement of research in academic institutions because of access to relevant online resources, easier course management through the use of online learning environment.
To the community, there is a guaranteed improvement in the standards of living as communication is eased, and services can easily be extended to the community.

Service providers have mainly deployed fiber at the "local loop" or "last mile" and the backbone of their networks. This has limited the realization of the full potential of the services that could be realized by the subscribers these advantages where extended either to homes or to premises[2].

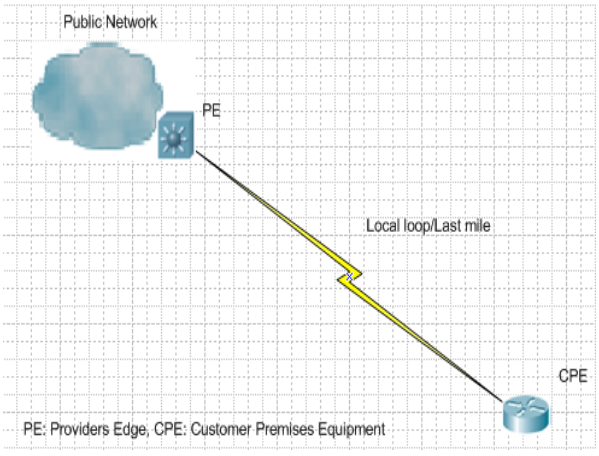

Figure 1: The local loop/Last mile

2.0 Current technologies

A computer is more than a gigabit per second into the information world where as looking at the worlds metro and long haul communications capacity its of Kilobits per second and few megabits per second, it is clear that there is an underutilization of the computers' potential[2].

There exists quite a varied number of network technologies currently being deployed, however they are limited by a number of factors which are discussed in the following sections.

2.1 *Public Switched Telephone Network (PSTN)*

PSTN is the world's public circuit switched network originally a fixed line analog system but has gradually moved to digital including the use of mobile phones.

According to [7], PSTN could be faced with a period of economic turmoil because of the legacy billing and design methodologies hindering its ability to cope with the increasing subscriber demands. For example PSTN was also originally designed for voice or human speech which uses frequency below 4000Hz. The design was therefore built around this fact. This will not appropriately support higher frequencies over long distances.

2.2 *The Digital Subscriber Lines (DSL)*

DSL also known as XDSL is a group of technologies that provide for transmission of digital data over telephone network that was initially meant for analog data. This can be done at the same time on the same telephone line with regular telephone.

Despite its interesting features though, DSL is characterized by upstream noise, it has a capacity asymmetry.

2.3 *Cable Network*

Cable channel is a television channel available via cable television. It is common in the United State. However this is a technology that is rare in Africa. It also has bandwidth limitations.

Cable TV is a broadcast medium and therefore not the best for a setting of high security. Its also hampered by the modem speed

2.4 *Optical Fiber Technology*

Optical fiber has been a successor to copper twisted pair or coax over the "local loop". Fiber has been proved to have reduced maintenance costs, fairly high immunity to electrolysis and electromagnetic interference [1][2].

By comparison, fiber has a usable bandwidth today of about 75,000Ghz. Extra ordinary bandwidth is realized in single mode [2]. This is appropriate given the fact that peer to peer communication represents a sizeable fraction of the total communication connections[2].

The inherent digital mode also gives fiber an advantage over its analog counterparts [4]

According to [1], fiber also has much longer service life that is about 30years compared to the copper counterpart which is only around on third of fiber. Figure 2 next, illustrates the different modes used by fiber.

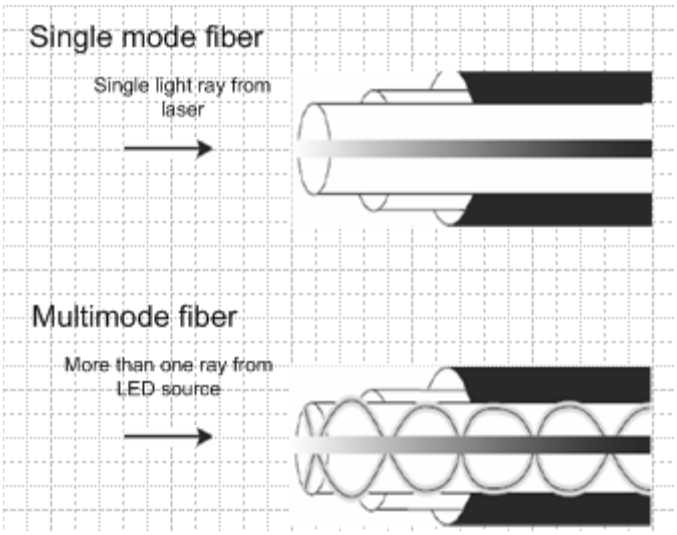

Figure 2. Dual and Single mode fiber

The table below compares the different technologies with reference to the bit rate. Its clear that fiber offers a higher bit rate.

Service	Medium	Intrinsic bandwidth	Per-user offered peak bit rate, down//up	Standard	Issued by
DSL	24-gauge twisted pair	10 KHz 10 KHz	ADSL: 1//0.1 Mb/s* < 6Km [3] VDSL: 10/10 Mb/s @1Km [3]	G.992 Emerging	ITU ITU/ETSI
Cable modems	Coax (HFC)	1 GHz	2 //0.4 Mb/s*	DOCSIS 1.1	CableLabs
BPON	Fiber	75,000 GH	622 or 155 Mb/s//155 Mb [2, 4]	G.983 (FSAN)	ITU
GPON	Fiber	75,000 GHz	2.4 or 1.2 Gb/s//622 or 155 [4]	G.984 draft	ITU
EPON+	Fiber	75,000 GHz	10–1000 Mb/s//10–1000 Mb/s [1, 4]	802.3ah and ae	IEEE

Figure 4. Comparing current technology bandwidth (*NY Times, Oct. 17,2002*)

3.0 Method

The architecture suggested below will allow service providers extend services to Colleges and Universities and in the long run to the rural community hence expanding their market and benefiting scholars at the same time.

3.1 Schematic design for the fiber network

3.1.1 *Connection from the Internet Service Provider (ISP)*

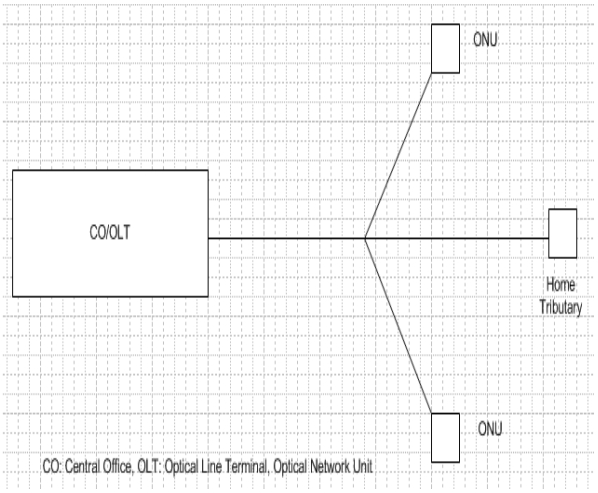

Figure 3. Local loop technology

With the expected move to fiber technology, preparation should be made for an increased number of subscribers. The above design adopts the Passive Optical Network (PON) by [2]. PON provides an all optical solution from the CO/OLT to the CPE or home tributaries. It makes use of passive splitters to direct traffic to the different subscribers or ONUs. Different wavelengths are used for incoming and outgoing traffic.

PON provides data rates of at least 0.6 Gb/s (OC-12 rates)

3.1.2 *Solution at the Customer Premises Equipments (CPE)*

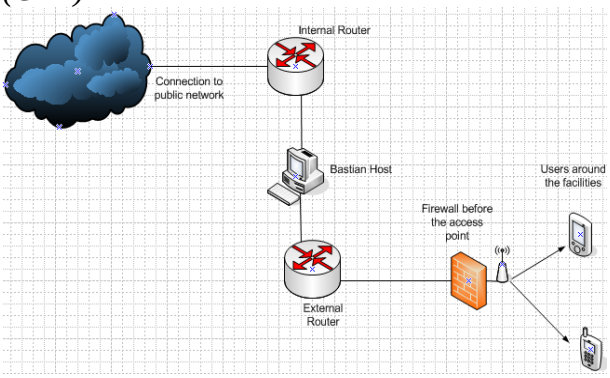

Figure 5. Connection at the Customer Premises

The users get access by direct connection through available ports or they can have wireless access through Personal Digital Assistants (PDA), laptops and mobile phones.

These however may pose a security threat to the network. For example a user can knowingly or unknowingly upload a malicious code such as a macro virus. That code may not be of any harm to the PDA itself, but when sent as attachments to computers on the network it can disastrous effects.

The external router filters out unwanted traffic from the external network. While the internal routers accept connections by internal devices with defined addresses.

The bastian host is meant to provide internal services such as receiving and forwarding email, answering DNS queries.

The internal router then connects to the public network, with all the necessary security configurations such as Virtual Private Network (VPN) and application support in place.

4.0 Discussion

Many argue that the most pressing online applications have led to a lot of consumer dissatisfaction because of the slow download speeds, quite a number of applications demand for relatively high bandwidth. Examples are: Remote disk back ups at the central servers. In addition to the need to speed up human productivity, one has to clearly see that the missing link has been communication bandwidth.

Due to its high bandwidth, fiber will be able to support a number of applications that could have otherwise been considered too high for other technologies. Among others are: videoconferencing, online movie rental on demand, exchange of home videos, electronic mails.

Fiber uses light to transmit, its therefore less prone to interference, and much faster.

Kadirire in [3] showed that SMS can be successfully used in group discussions. And this appropriately fits to the demands of academic institutions and the community.

The ability to support these applications and observing from the current trends of ICT makes fiber optics technology the way to go.

This paper presented the technologies currently being used over the WAN. It went on to suggests a design that adopted work done to extend services to academic institutions and the community.

One of the main benefits of the proposed design, is to fully utilize the untapped potential of fiber optics in extending services to the community.

Despite its strengths however, optical fiber has a number of limitations. In assessing the deep water hazards, [6] mentioned the following as some of the fiber cable under sea hazards:

Geo-hazards like near surface hydrates. There is an abundance of gas hydrates on continental shelves, Mass gravity flows, strong abyssal flows resulting from atmospheric events and subsurface-intensified currents to mention but a few.
Over all though, fiber optics provides the necessary connection speed and bandwidth necessary for today's connectivity demands.

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