

# **KENYA EDUCATION NETWORK (KENET) INFRASTRUCTURE** *(Current & Future Infrastructure; Potential & Emerging Possibilities)*

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**Abstract - This paper focuses on Kenya Education Network(KENET), its current network infrastructure, future infrastructure as well as emerging infrastructure options. Available options for both service and content provision are also looked into. Other infrastructure options for KENET are also delved into with special focus on fiber optics, under sea fiber cables as well as a mention of dark fiber as an emerging alternative last mile connectivity for educational networks.**

## 1.0 INTRODUCTION

There has been inherent problems with connectivity in Kenya with regard to availability of infrastructure, its cost and overall uptime. This led to either use of local leased line infrastructure with no Service Level Agreements (SLA's) and/or satellite connectivity which was highly costly in terms of bandwidth. There have also been problems resulting in market monopoly of infrastructure making it impossible for customers to have a wide range of choices hence resolving to use terms dictated by the provider(s). Though Kenya is a fully liberalized economy, providers are always geared towards maximizing profits; thus in essence setting exorbitant rates for access to their infrastructure.

## 2.0 KENYAN EDUCATIONAL INFRASTRUCTURE

Kenya's Higher & Tertiary education sector like in any other country needs telecommunication infrastructure that is both affordable and sustainable. This resulted in

the Institutions of Higher learning coming together to negotiate infrastructure lease as a group due to the relative afford-ability when negotiating as a team as opposed to as individuals. This was mainly for international bandwidth and was a stepping stone towards achieving world class connectivity.

Institutions of higher learning and research institutions not only need high speed international bandwidth but also high speed links between themselves for both telecommunication purposes as well as research work. Most institutions have all along used satellite bandwidth for international traffic while using leased lines for both local traffic as well as connectivity between them.

## 2.1 KENYA EDUCATION NETWORK TRUST

Kenya Education Network (KENET) being the Kenyan National Research & Education Network (NREN) has been interconnecting Kenyan institutions for about eight years now and has developed a considerable number of member institutions. Previously, KENET had about 10 members directly served with both international bandwidth and local connectivity; and an extra 12 institutions connecting to each other locally via KENET. The total international bandwidth purchased by member institutions through KENET totaled slightly below 32,000Kbps as at 31/10/2008!

Currently, KENET is in the process of upgrading all its active member institutions, totaling 65 with an

estimated potential of 75 institutions expected to be connected on completion of the upgrade. All member institutions are to be connected to at least 10Mbps last mile connectivity which is set to boost service implementation by member institutions as well as boost research services in the member institutions. This infrastructure and bandwidth upgrade to member institutions has expanded international bandwidth consumption for 48 connected institutions to 200Mbps currently!

Figure 1 is a network diagram showing KENET's Points Of Presence (POP's) on completion of the current infrastructure upgrade as well as future connectivity through under-sea fiber cable:

## KENET POP LOGICAL NETWORK

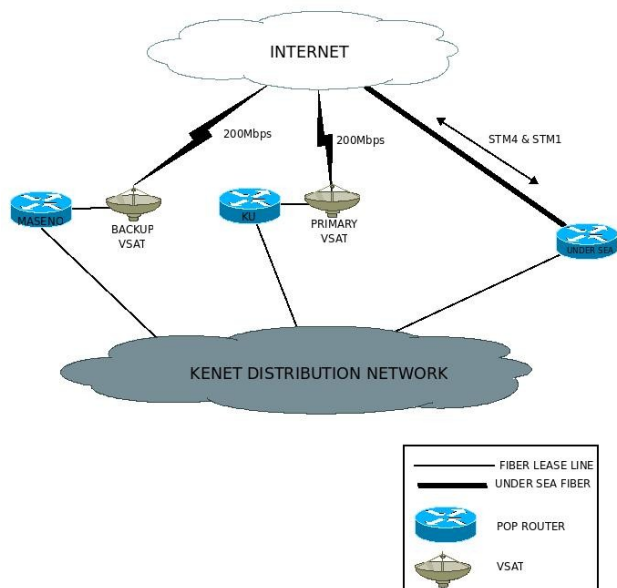


Figure 1: KENET Future Network Infrastructure

It is worthy to note that KENET has been receiving licensing waivers from the Communications Commission of Kenya (CCK) [3]. This, coupled with the hope for future considerations and plans by the government to implement a national fiber optics infrastructure; KENET is posed to gain from several

national infrastructure implementations.

Thus, the goodwill from the government and developments in the industry will boost the connectivity of member institutions greatly as there will be alternative choices for connectivity.

## 2.2 KENET SERVICES & CONTENT CREATION

Apart from bandwidth services, KENET also offers the following to member institutions:

- Network Support & Design
- Technical Training Of Member Institutions' Technical Staff
- Server Co-location
- Hosting Services: Mail hosting, Web hosting
- Backup & Custom Server Setup
- DNS Services & Domain Registration
- E-Learning Platform
- Mirroring Services (Ubuntu, OpenOffice.org, Mozilla Firefox, FreeBSD among others)
- E-learning & multimedia content creation

KENET is also encouraging institutions and other associations engaging in journal publishing to broaden their reach by deploying their literature on-line.

Currently, KENET has commissioned an on-line version of the Kenya Engineer Journal [7] which is hosted at KENET for free! This is with an aim of providing more content to both member institutions and the general public. Finally, KENET is in the process of researching and testing newer technologies and services including:

- Internet Protocol version 6 (IPv6)
- Rich Multimedia Content for Education
- Affordable & Sustainable Network Security Platforms, Virtual Private Networks and MPLS
- E-learning & Multimedia content creation, just to name but a few.

### 3.0 EMERGING OPPORTUNITIES

As an acknowledgement of current developments, technologies and inherent problems facing the country in terms of telecommunication infrastructure; The Government of Kenya (GoK) has encouraged the construction of telecommunication infrastructure to cover all districts in the country. This initiative dubbed The National Fiber Optics Infrastructure is meant to give the government leverage in its implementation of the e-government strategy as well as offer citizens an affordable connectivity that is not commercially oriented. Another goal of the project is to minimize exploitation by commercial players in telecommunication infrastructure and avail more opportunities to the citizens.

There have also been initiatives by Kenya Power & Lighting Company (KPLC) to also offer operational fiber optics network all over the country. This is aimed at providing the company with its own telecommunication infrastructure apart from power provision. Their strategy has been aimed at offering open access infrastructure as they will not be in a position to use the entire infrastructure that they will set up.

Finally, several other commercial players have engaged in roll-out of fiber optics infrastructure in the country and offering lease lines. These include Kenya Data Networks, Access Kenya, Jamii Telecommunications Limited amongst others.

#### 3.1 UNDER SEA FIBER CABLE

Apart from the nationwide fiber infrastructure, there are also several initiatives for the provision of under-sea fiber cable connecting the country to the rest of the world via the coastal city of Mombasa. These initiatives have included TEAMS, EASSy [9] and SEACOM [4] one having an operational fiber network,

one in the final testing phases while the other expected to be operational in mid 2010.

With these in mind, the overall cost of telecommunication is set to drastically reduce as institutions will have more options to choose from in terms of the carrier to their traffic while also insisting on stringent SLA's. This will imply that the overall cost of either ownership of the infrastructure or lease of the infrastructure will reduce while the uptime of the infrastructure increase due to competition and stringent SLA's.

#### 3.2 TERRESTRIAL FIBER NETWORK

Having used existing terrestrial fiber networks to connect member institutions, KENET has first hand experience with reliability of the networks as well as the costs involved in paying for the lease lines.

Reliability as well as fault resolution of existing terrestrial fiber providers is wanting and this may be attributed to the vastness of their networks as well as the number of clients that they serve.

Finally, the costs involved with leasing point-to-point links are very high. These costs, say for a 10Mbps terrestrial leased fiber line when calculated over a 1 year period is approximately equivalent to acquiring an undersea 25 year STM1 IRU from Kenya to Europe!

Therefore, where possible it will be more cost effective to look into obtaining IRU's for terrestrial fiber lines that span expansive distances or alternatively build a private fiber network if terrestrial lease line costs do not reduce.

#### 3.3 COST-BENEFIT OF EMERGING INFRASTRUCTURE

With infrastructure availability comes the option of which type of infrastructure and the types of

agreements that will be beneficial to the institutions in the long run. Considering that Kenya's national infrastructure initiative is based on fiber optics, there will be two options to be considered when selecting the type of agreement for infrastructure use: Customer Owned/ Dark Fiber, or Managed Carrier Service.

KENET will consider available options for IRU's in both undersea as well as national fiber network connecting its POPs and where possible own the last mile fiber.

Some of the benefits of dark fiber to educational institutions include:

- Reduced local loop costs as well as telecommunication costs to satellite campuses
- No additional costs to increase bandwidth save for upgrade of transceivers at each end of the fiber connection
- Development and deployment of new applications and services without much worry on bandwidth
- Allows testing and deployment of new optical technologies that would not be possible with a managed carrier service

KENET is still looking into both available and future options for connectivity for its member institutions especially on emerging infrastructure and open access options. From estimates in other countries that have already implemented the emerging infrastructure, the cost benefits are enormous not forgetting a potential increase in services and content that will be offered by the research and educational institutions.

### 3.4 EMERGING SERVICES

There are also several possibilities of services that KENET will be exploring in order to provide value addition to members on its network. These include:

- Video conferencing

- VOIP Telephony
- Security Key Infrastructures
- Secure VPNs

### 4.0 CONCLUSIONS

KENET is likely to benefit from the TEAMS project and/or the National Fiber Optics project due to the growing willingness by the Government of Kenya to support KENET as well as research & educational institutions. But KENET is keeping its options open!

There is an immediate need to empower educational institutions both in terms of affordable infrastructure availability as well as content creation so as to ensure that research and educational institutions are well equipped to offer competitive learning platforms.

With more focus being given to both accessible and affordable infrastructure; there is need for institutions to adopt affordable infrastructure alternatives so as to enhance the services that are offered for both connectivity and research.

It is also important that educational institutions come together to enable them not only have a better negotiating power but also to develop better technical capacity. This should also be coupled by both government and private sector support in order to have effective research and educational institutions.

### 5.0 ACKNOWLEDGEMENT

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