GRAND DUCHY OF LUXEMBOURG
Ministry of Foreign Affairs

Directorate for Development Cooperation

IXP Case Studies

The Internet Exchange point of Nigeria (IXPN) and The Kenya Internet Exchange Point (KIXP)

1. INTERNET EXCHANGE POINT OF NIGERIA (IXPN)

Background

- In Nigeria, most Internet users connect using dial-up modems installed in cyber cafés and other public places.
- While large corporations in Lagos are served by fiber access, overall the broadband sector remains underdeveloped.
- According to Telegeography, there is an estimated 150,000 (fixed and mobile) broadband subscribers by the end of March 2011 marking a significant 54% growth .
- Subscriber growth is hampered by the poor state of the fixed infrastructure of the incumbent Nigerian Telecommunications (NITEL), the unreliable power supply, and the low PC penetration.
- Several operators offer DSL service e.g NITEL and 21st Century
- Mobile broadband on GSM and CDMA are gaining strong momentum in the past few years.

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- Service prices are still very high and are not affordable for the vast majority of the population.
- There is significant geographical variation in retail prices.
- Despite these access challenges, usage is growing based on public Internet access.
- There is an estimated 4.8 million Facebook users in Nigeria at the beginning of 2012. Source : http://www.socialbakers.com/facebook-statistics/

Domestic Connectivity

- Several ISPs have developed relatively large fiber-optic backbones
  - Phase 3 with its 1500km network
  - Multi-Links Telecommunications (MLTC) 8200km network
- Microwave backhauls are used to complement the fiber
- At the same time, the government has initiated a nationwide network infrastructure initiative, Nigeria's National Broadband Carrier Network Project, which will ultimately consist of a 14,000 km open-access fiber-optic backbone network

International Connectivity

- Historically, Nigeria's main source of international bandwidth has been the SAT-3 cable for which the incumbent NITEL holds a monopoly.
- The arrival of competing cables, namely Main One and Glo 1 in 2010, has been a real catalyst for Internet access.
- The WACS cable goes live in 2012, further increasing competition.
- Following the arrival of the cables, prices of international bandwidth have decreased around ten-fold in just three years.
- According to Telegeography there was san estimated 30Gbit/s of international Internet bandwidth for Nigeria at the end of 2011.

Domestic Infrastructure Challenges

- Highly fragmented market with several large ISPs such as Starcomms and Multilinks and a large number of small ISPs with limited geographical coverage
- Investment of Fiber optic infrastructure is hampered by administrative challenges such as “rights of way”
- The result is that national connectivity costs are higher than international. It is more expensive between Lagos and Abuja than between Lagos and London
- There is also a fair amount of duplication in rollouts, as operators are generally unwilling to share networks, often for competitive reasons

IXPN

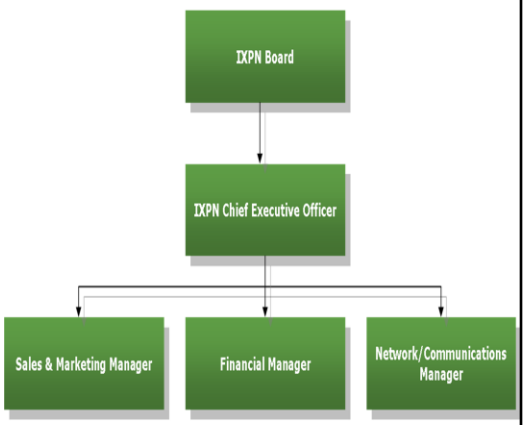
- The IXPN was established in 2006 in Lagos as a neutral exchange
- Stated objective of reducing reliance on international transit for exchanging local traffic between members
- To improve efficiency of operations and communications.
- The IXPN operates an Multi-lateral Peering Agreement
- As of December 2011, the IXPN served over 30 members, including Google, Gateway, Linkserve, Main One Cable, Internet Solution Nigeria, Swift Networks, KKON, Simbanet, Netcom, NIRA, Skannet, and Tara Systems.

Objectives

- IXPN is among the fastest growing IXPs in Africa with over 300Mbit/s being exchange in 2012
- IXPN aims to become a leading IXP in Africa by the year 2015
- In particular, the IXP aims at becoming a regional hub for West African countries, and a one-stop-shop company for content and service providers

Governance Structure

- IXPN is a company limited by guarantee (not-for-profit entity)
- IXPN is overseen by the IXPN Board comprising the CEO and six directors.
- The board is responsible for control of proper management of the IXPN
- The Technical Committee assist the IXPN staff and advises the Board on technical matters relating to IXPN operations.
- The technical committee is presently made up of seven members including the IXPN CEO.



IXPN Business Model

IXP Revenue

- IXPN charges a one-off Joining fee of $ 1,515
- Quarterly Membership Fee of $393
- Port Fees
  - 10Mbit/s port for $121/pm
  - 100Mbit/s port for $303/pm
  - 1Gbit/s port for $909/pm
  - 10Gbit/s port for $3,030/pm
- Private Interconnects Intra-site
- Private Interconnects Inter-site

Other Revenue

- Government grants from the regulator NCC provided the setup seed money
- Another Govt agency NITDA has provided funding to establish 4 other sites in the country
- Salaries were initially paid through NCC grant but now IXP revenue caters for most of the expenses.

Challenges

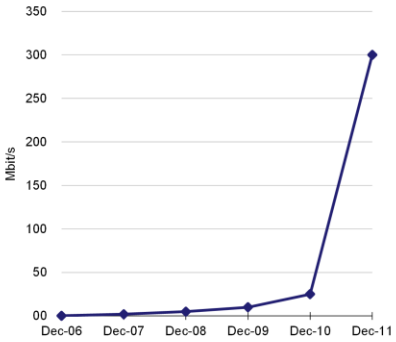
- Fixed-line incumbent NITEL is not a member of the IXP, nor are some major ISPs (like Multilinks and Rosecom) and mobile operators (like MTN and Globacom).
- It appears that large ISPs that own private fiber backbone and mobile operators that own capacity on submarine cables may see the IXP as a competitor in the transit market, which limits their interest in joining the IXP.
- Large ISPs also already exchange local traffic together directly, thus making a connection to the IXP less relevant for some of their local traffic.

Benefits of IXPN

- The presence of the IXP has reduced latencies experienced from between 200 – 400 to sub 10ms depending on the connection
- There has been significant cost savings experienced by operators. Using an average cost of $300 per Mbit/s for International connectivity, the wholesale savings of exchanging 300Mbit/s = $1,080,000 per year
- The benefits will keep increasing as more operators join the IXPN

Building Critical Mass

- In March 2011, Google extended their European network to Lagos.
- Google traffic represents more than 50% of traffic exchanged at IXPN
- The dominant platform for e-transactions and e-payment in Nigeria (with over 10,000 ATMs and 11,000 POS Terminals) Interswitch, is connected to the IXP via an ISP
- The West African Examination Council (WAEC) that conduct two major exams in Nigeria and requires online registration is at the IXP.
- ngREN and Eko-Konnect are also linked to the IXPN



A few examples illustrate tangible benefits that the IXP has been able to provide thus far in Nigeria. For instance, the dominant platform for e-transactions and e-payment in Nigeria, Interswitch, is connected to the IXP via an ISP. Interswitch was established by seven Nigerian banks to facilitate transactions using infrastructure that links debit, credit and prepaid cards to a wide range of payment channels including point of sale terminals, automated teller machines and web merchants. Interswitch today runs a network of 10,000 ATMs and 11,000 point-of-sale terminals. With the take-up of Interswitch, financial platforms that were formerly hosted abroad have begun to migrate back to Nigeria, and all transactions on these platforms are now exchanged locally by ISPs connected together via the IXP. This platform is expected to grow in the coming years, to support the large and still unsatisfied demand for such services.
Another example of improvement of access to local content can be found in the membership of the West African Examination Council (WAEC) at the IXP. The WAEC is a body that conducts two major exams in Nigeria: the General Certificate of Education Examination – GCE – and the Senior Secondary Certificate Examination (SSCE) for secondary school leavers. Nigerian students are required to register online in order to get access to their exam results via the WAEC online portal. Before the IXP, congestion to access the WAEC servers created considerable delays. With the participation of the WAEC in the IXP, congestion issues have been solved overnight.

The IXPN also has an active impact in other areas of education. For instance, the Eko-Konnect project (Lagos Higher Education Connectivity Project) launched at the end of 2009 saw, as a first development phase, the linking of the University of Lagos, the Federal College of Education (Technical), the Yaba College of Technology and the Lagos University Teaching hospital. This ring is connected to the IXPN by a 100Mbit/s fiber link. Eko-Konnect also peers via the IXPN with the Google University Access Program and its partner institutions (Lagos State University, University of Nigeria Nsukka, University of Benin, Benson Idahosa University and Convenant University). The IXPN also hosts a dedicated hub link for the establishment of ngREN, the national research and education network, which will allow in the future the connection of additional specialized networks across Nigeria.

The success of Interswitch is also based on positive regulations. For instance, a daily cash-withdrawal limit of 150,000 naira for individuals and 1 million naira for companies will take effect in June 2012 in Lagos, encouraging more online financial transactions. This initiative from the Central Bank aims at reducing the amount of cash circulating in the country and encouraging online banking.

Future Developments

- The IXPN aims at implementing Points of Presence (PoPs) in the main six geopolitical zones of Nigeria.
- Plans are under way to connect the main government data center to the IXP.
- The IXPN can play a key role in promoting cloud services in Nigeria due to low latencies hence improving their chances of commercial success.
- Online streaming content is a growth opportunity for the IXP is related to the extremely dynamic local movie industry "Nollywood" the 2nd largest by annual movie production.
- Regional Interconnection will also play a big factor in the near future as it aims to explore regional Interconnection to become a regional hub by 2015.

The IXPN aims at implementing Points of Presence (PoPs) in the main six geopolitical zones of Nigeria. Once this development is achieved, the IXPN will be in position to play a useful role as regards national connectivity, allowing members across the country to connect at different points within the country and exchange traffic at lower costs than the one currently applied for national backhaul. For instance, the new IXPN PoP in Abuja might effectively provide a decrease in the tariff of national backhaul between Lagos and Abuja overall, which is still today almost ten times more expensive than between Lagos and London for some ISPs. Currently, the connectivity provided by the IXPN between its PoPs in Lagos and Abuja provides ISPs with savings on their exchange of local traffic between those cities. While IXPN currently does not allow the exchange of international traffic, an increased level of collaboration between ISPs in aggregating their demand for national capacity may enable them to aggregate their demand for international capacity as well.
Further, according to IXPN all arrangements have been finalized to connect the main government data center to the IXP. Once the connections have been implemented (which will be facilitated by the presence of a PoP of the IXPN in Abuja, the administrative capital), the IXP will contribute greatly to the localization of most of the government services currently hosted abroad. This could in turn potentially lead the way to the development of more affordable and advanced data-centers in Nigeria.

The IXPN could also replicate its role in localizing online financial services for other types of applications and services. For instance, the IXPN can play a key role in providing cloud services in Nigeria. As such cloud-based applications are typically quite latency sensitive, it will improve their chances for commercial success if they are hosted close-by and available to all end users over local connections through the IXPN.

Another growth opportunity for the IXP is related to the extremely dynamic local movie industry. This industry – so-called Nollywood – is the second largest film industry in the world (in terms of number of annual film production), behind the Indian film industry and ahead of the United States. This constitutes a tremendous potential for local movies to be digitized and then served via online platforms (e.g. streaming websites) to local or foreign users. Also, with the proper incentives, the industry could turn to directly creating online content, be they videos or games, and offer them to the local audience.

Finally, as mentioned above, the IXPN currently only allows local traffic to be exchanged at the IXP, and therefore the IXPN does not have any impact on regional connectivity at the moment. However, it can be safely assumed that this situation will evolve in the short to medium term, as the IXPN aims at becoming a regional hub for West African countries by 2015. Source:
http://www.economist.com/node/17723124?story_id=17723124&CFID=153287426&CFTOKEN=59754693

KENYA INTERNET EXCHANGE POINT (KIXP)

Internet Access

- There were 5.4 million Internet subscriptions at end of 2011 and 14.3 million users in Kenya.
- 99% of Internet connectivity is through mobile data, followed by DSL, Terrestrial Wireless, Cable and then Fiber
- Low household PC penetration limits the demand for broadband in Kenya.
- An additional source of Internet access is through cyber cafés and other shared access.

Domestic Connectivity

- The government set up a 4469km National Optical Fibre Backbone Infrastructure (NOFBI)
- The Kenya Power & Lighting Company (KPLC), the power utility company in Kenya has leased its extra capacity to 3 licensed operators.
- There are also two private national fiber networks in Kenya which covers 70% of the Kenyan population
- In November 2011, Safaricom announced plans to build its own terrestrial fiber-optic network of 4000km
- In addition to this national connectivity, there are a number of city network. Specifically, four providers (Wananchi Group, Jamii Telkom, Frontier Optical Networks (FON) and Access Kenya Group) have substantial fiber in the main urban cities of Nairobi and Mombasa.
- As a result, domestic capacity between Nairobi and Mombasa is cheaper than international capacity to main international destinations like London

International Connectivity

- International connectivity in Kenya has dramatically improved in the past couple of years, with the landing of several high-capacity submarine cables as follows;
  - *SEACOM*: the SEACOM submarine fiber-optic network launched in July 2009 as the first submarine cable to serve East Africa. It was installed, and is managed, by SEACOM, a privately owned company. Capacity 1.28TerabitsPerSecond (Tbps)
  - *TEAMS*: the TEAMS cable was completed in September 2009. It is 85%-owned by TEAMS Limited, a consortium that includes Telkom Kenya, Safaricom, Kenya Data Networks and other local operators, with UAE-based Etisalat owning the remaining 15%. Capacity 1.2TerabitsPerSecond (Tbps)
  - *EASSy*: East Africa Submarine Cable System was operationalized in July 2010. The project is owned and operated by a large consortium that includes Etisalat, Bharti Airtel, TTCL and Zantel, as well as other African operators, international carriers and development funding institutions. Capacity 4.7Tbps
  - Lion1: Lower Indian Ocean Network currently connects Madagascar, Réunion and Mauritius to Kenya. Cable is owned by Orange. Capacity 1.2Tbps (Not yet active)

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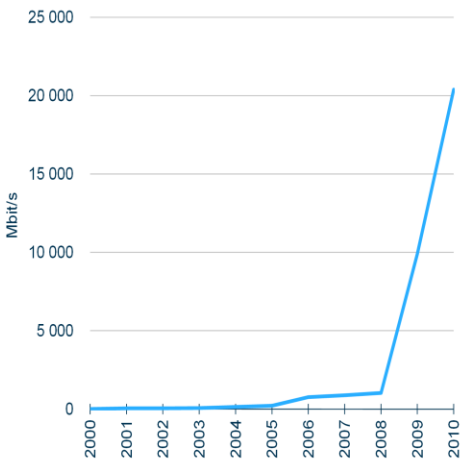
- By mid-2010, Kenya had 20Gbit/s of international Internet bandwidth
- Kenya can also draw on an available undersea capacity of 200Gbit/s if needed
- Satellite now accounts for just 1% of capacity used



KIXP

- There are two IXPs in Kenya: one located in Nairobi and one in Mombasa.
- Both IXPs are operated by the Telecommunications Service Providers Association of Kenya (TESPOK)
- The first IXP, known as the Kenya IXP (KIXP), was launched in Nairobi in 2000
- Following a dispute raised by the incumbent, KIXP was shutdown 2 weeks later.
- KIXP was re-launched in 2001 with an operating license granted by the regulator.
- This made KIXP the first licensed IXP in the world

KIXP

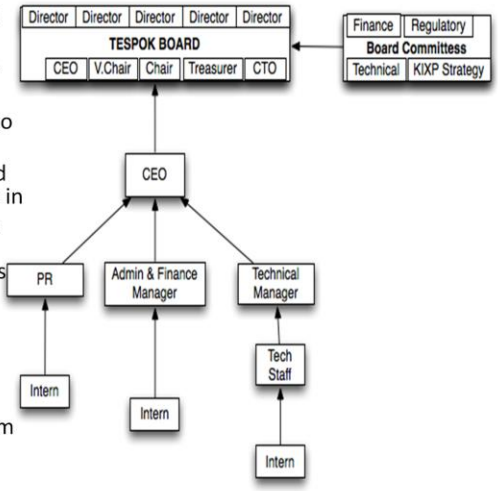
There are two IXPs in Kenya: one located in Nairobi and one in Mombasa. Both IXPs are operated by the Telecommunications Service Providers Association of Kenya (TESPOK), a non-profit organization that represents ISPs and the interests of other telecommunications operators. The first IXP, known as the Kenya IXP (KIXP), was launched in Nairobi in 2000, but, following a dispute raised by the incumbent Telkom Kenya, which complained that the IXP was not licensed and violated its exclusive rights to carry international traffic; the IXP was forced to shut down. Following a year of debate, KIXP Limited was allowed to re-open, albeit with an operating license granted by CCK in November 2001, making Kenya the first country in the world to require an IXP to be licensed.

Objectives

- Keeping Kenyan Internet traffic local
- Enhance the Internet experience of users
- Reduce overall costs related to providing Internet services
- Promote and encourage the creation of local content
- Create Internet opportunities
- Build technical skills and capacity

Governance and Admin Structure

- There TESPOK board is made up of 9 members and the CEO
- The board nominates a Chair, V.chair and treasurer as executive positions
- There are 4 committees that report to the board.
- The committees are chaired by board members with background expertise in the area (i.e finance, technical, legal, etc)
- The CEO sits on all the committees as secretary
- Board meetings are held once every quota
- General Assembly meeting is held annually
- Each board member has a 2 year term and a maximum of 2 terms
- The CEO is appointed by the board



Business Model

IXP Revenue Model

- Port Fees
  - 10Mbit/s for $300/pm
  - 100Mbit/s for $415/pm
  - 1Gbit/s for $530/pm
- Additional Rack Space for Carriers
- Computer Security Information Response Team (CSIRT) Services
- The IXP revenue is used to meet operating expenses

Other Sources

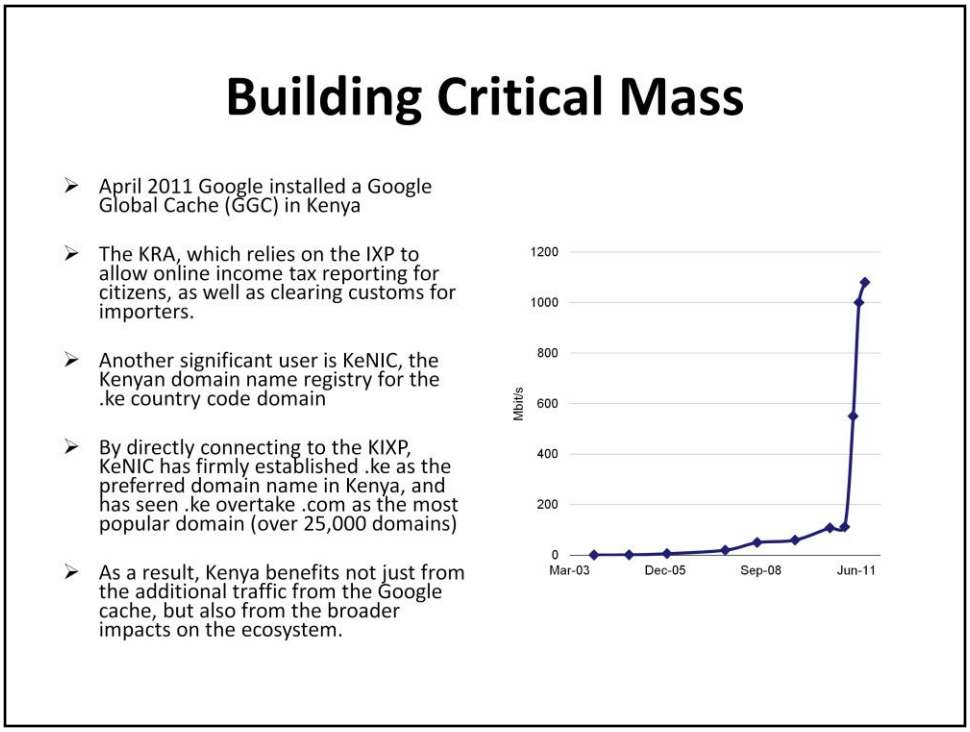
- Most of the equipment at KIXP has been received through equipment donation and grants.
- DFID donated equipment for the setup of the IXP
- ISP Members also donated racks, Air Con, Power backup at the setup stage.
- CISCO through PCH and ISOC have donated additional equipment. NSRC via KENET donated equipment for the KIXP backup site in Nairobi
- AMSIX recently donated 2 switches worth $10,000

Challenges

- Under-developed local hosting services that cannot compete with foreign hosting solutions.
- Lack of adequate hosting infrastructure like carrier neutral data centers and facilities
- As a result, most prime websites like Government, online newspapers, airlines, etc are hosted abroad.
- As an English speaking region, most of the content accessed is abroad.

Benefits of KIXP

- **Latency Impact**: KIXP members experience between 10ms – 2ms latencies between their networks compared to between 200ms – 600ms without the IXP. This enable latency sensitive services such as VoIP to thrive.
- **Cost savings**: KIXP exchanges 1Gbit/s and using a conservative value of $120/Mbit for Transit. Wholesale saving are at $1,440,000 per year.
- **Increased business opportunities:** several ISPs reported that access to the KIXP is often included as a necessary requirement for winning tenders issued by businesses and government agencies for Internet access services
- **Increased revenues:** mobile operators in Kenya charge by the MB for Internet access, and thus increased usage resulting from the KIXP translates into increased revenues. Estimates for a member with 100Mbit/s charging an avg. of $0.01/MB realises increased revenues of about $6,000,000 per year.
- **Foreign Investments:** Investments by global organizations such as Google opening offices regional offices in Nairobi.



Kenya Revenue Authority (KRA)

Another key user of the KIXP is the KRA, which relies on the IXP to allow online income tax reporting for citizens, as well as clearing customs for importers. The KRA reported 160,524 citizens filed their income taxes online in the first half of fiscal year 2011, and 5,000 users are registered for the customs system, representing 95% of the industry. Firms are also able to take advantage of online applications and filing, saving the private sector $4.5 million according to the World Bank. The KRA reports that the KIXP has facilitated this online system by significantly lowering latency, and that it is now reliant on the KIXP to help to deliver services to taxpayers while also ensuring that valuable revenues are captured through KRA's online system.

Kenya Network Information Center (KENIC)

Another significant user is KeNIC, the Kenyan domain name registry for the .ke country code domain. By directly connecting to the KIXP, KeNIC has firmly established .ke as the preferred domain name in Kenya, and has seen .ke overtake .com as the most popular domain. Users experience more personal service in registering in Kenya for their domain name, which in turn resolves more quickly than generic top level domain names that are not based in Kenya. The figure below details the steady increase of growth experienced by .ke over a select period.

Revenue Performance Report, Kenya Revenue Authority, 24 January 2012. http://www.kra.go.ke/notices/pdf2011/Revenue-Performance-Report-jan2012.pdf

"Comprehensive Reform in Kenya Yields Broad Business Impact," *Investment Climate*, January 2012, World Bank Group. http://www.kra.go.ke/notices/pdf2011/Revenue-Performance-Report-jan2012.pdf

See http://www.kenic.or.ke/.

KIXP Regional Impact

- The benefits of the KIXP are beginning to extend beyond Kenya's borders
- Some KIXP members are beginning to win customers in neighboring countries and are exchanging the resulting traffic at the KIXP
- As of January 2012, 56% of the Autonomous System numbers routed through the KIXP in the previous six months were from 16 foreign countries.
- The second IXP location in Mombasa is also likely to attract traffic from neighboring countries, as well as content caches and servers from abroad.

Future Developments

- KIXP is working on a local cache from a large international content delivery network (CDN) which is going to be made available to all members of the KIXP, in a similar fashion to the access to the GGC.
- The KIXP would play a key role in serving members cloud services in Kenya.
- Other likely benefits will arise from foreign investment, which is just starting.

SUMMARY

IXPN Summary

Benefit	*Without IXPN*	*With IXPN*	*Summary*
Latency	200-400 ms	2-10 ms	Significant increase in performance
Local traffic exchange	Negligible	300Mbit/s peak	Estimated total saving of $1,080,000 per year on international transit
Content	All content was accessed through international links, almost all content hosted abroad	Google network present locally. Expansion and rehoming of content hosted abroad	Increased revenues of new mobile data traffic
E-government	Congestion of education & research networks	Eko-Konnect, WAEC connected to IXPN for local traffic exchange	Improved access for students and researchers
E-commerce	No service platforms hosted locally	Financial platforms hosted locally and traffic routed locally	IXPN allowed financial transactions to remains local

KIXP Summary

Benefit	*Without KIXP*	*With KIXP*	*Summary*
Latency	200-600 ms	2-10 ms	Significant increase in performance
Local traffic exchange	Negligible	1Gbit/s peak	Estimated total saving of $1,440,000 per year on international transit
Content	All content was accessed through international links, almost all content hosted abroad	Google network present locally. Expansion and rehoming of content hosted abroad	Increased revenues up to $6 million per 100 Mbit/s of new mobile data traffic
E-government	KRA collected taxes manually	Revenues collected online	Significant reliance on KIXP to clear customs and raise revenues
Domain names	.com was the predominant domain, registered overseas	.ke is the predominant domain, registered and based locally	KENIC uses KIXP to help increase service delivery for .ke
Regional routes	All regional traffic tromboned internationally	An increasing amount of regional traffic exchanged at KIXP	KIXP more attractive to content providers and backbones able to access regional users

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