Universal Journal of Communications and Network 2(7): 118-123, 2014 http://www.hrpub.org
DOI: 10.13189/ujcn.2014.020702

A Model to Determine Quantitative Savings that Can be Achieved through an IXP Via Peering-A Case Study of ISPs in Kenya

Esther Makori[1,2,*], Cyrus Wekesa Wabuge[3]

[1]Sci. & Tech., Jaramogi Oginga Odinga University , Kenya
[2]Department of Information Communication and Technology, Kisii University, Kenya
[3]Department of Electrical & Information Engineering,University of Nairobi, Kenya

Abstract Internet Service Providers (ISPs) in developing countries are incurring high operating costs. Developing countries local Internet traffic is billed at the same rate with internationally accessible content hence high operating cost for the ISPs. If ISPs use the right interconnection models they can be able to reduce the high Internet cost, reduce latency and increase access speed. In this paper the author has developed a model to determine quantitative savings that can be achieved through an Internet Exchange Point (IXP) via peering. Peering model is preferred when there is high ratio of local traffic to international traffic while the Transit model is preferred when there is high ratio of international traffic to local traffic. Savings increase when the ratio of local traffic increases and savings decline when the ratio of international traffic increases.

Keywords Internet Service Providers (ISPs), Peering Model, Transit Model Local Internet Traffic, International Traffic

1. Introduction

An Internet Service Provider (ISP) is a company that provides Internet connectivity to its customers (corporate or individual). A major constraint to Internet access in Africa is high costs. ISPs in Africa pay proportionally more for telecommunications than ISPs in other regions. One reason for this high cost is that most developing countries use international bandwidth to exchange data at a local level. Jensen [4] states that the use of international bandwidth to exchange local traffic is costly and slows down access speeds in that the round trip time, is much higher. Additionally the latencies experienced in these countries are much higher compared to developed countries. Flickenger & Belcher, [3] and makes the use of bandwidth-heavy applications practically impossible Thaba, [8]. The cost of Internet bandwidth in developing countries is generally very high compared to the developed countries. Bell [2] argues that developing countries connecting to the global internet backbone must pay for the full cost of the international leased line to the country providing the hub. Jensen [4] states that cost per megabit of bandwidth in developing countries is a hundred times more than the cost of bandwidth in developed countries. If developing countries had the ability of exchanging traffic locally, they would not be paying expensively for international bandwidth Yoshi [10].

When an end user in Kenya sends an e-mail to a correspondent in the USA, it is the Kenyan ISP who is bearing the cost of the International connectivity from Kenya to the USA. Conversely when an American end user sends an e-Mail to Kenya, it is still the Kenyan ISP who is bearing the cost of the international connectivity, and ultimately the Kenyan end user who bears the brunt by paying higher subscriptions. 50% of Kenyan web sites are hosted overseas Bell [2].

Fiber optic cables have been launched in Kenya but the cost of Internet bandwidth is still high. This is because local traffic is billed at the same rate with internationally accessible content Russell [7]. National and regional IXPs would dramatically lower the amount of national and inter-continental traffic that needs to leave the continent rather than exchanging local Internet traffic overseas AfrISPA [1].

ISPs connect their networks to each other in order to exchange traffic between their customers and the customers of other ISPs. ISP Interconnection allows traffic originating at a source connected to one ISP's network to reach a destination connected to another ISP's network, around the block or around the world Flickenger & Belcher [3]. In order for an ISP to provide access to the global Internet, it must be attached to the global Internet by either the Transit or Peering model, or a combination of both within an Internet Region Norton [7].

Internet traffic in developing countries must travel across multiple satellite hops to get routed and exchanged via a backbone in another country before it reaches its destination. Internet traffic moving from one ISP to another ISP in the same developing country has to be routed overseas Marcus [5]. As a result local Internet traffic in developing countries is billed at the same rate with internationally accessible content. The cost per megabit of Internet traffic in Kenya ranges from USD 2,000 - 5,000 Michuki [6]. There are few IXPs which connect local ISPs so that local traffic is exchanged locally, developing countries like Kenya suffer from high Internet bandwidth cost, slow access speed and higher latency compared to developed countries.

ISPs in Kenya are incurring high costs, slow access speeds and high latency because of using international bandwidth to exchange local traffic Yoshi [10]. If ISPs use the right interconnection models they can be able to reduce the high cost, reduce latency and increase access speed. This study is exploring ISP interconnection model with a view to determine conditions under which the Peering and Transit models should be used.

2. Materials and Methods

This study adopted an exploratory research approach. It explored the Transit and Peering ISP Interconnection models in Kenya. The sample population used in this study has been selected using judgment sampling method. This sampling method relies on logic and good judgment of the researcher, based on suitable knowledge.

The population size was 20 ISPs and the researcher's sample size was 15 ISPs. (31) Respondents were included in this study and this included Network technicians and Network engineers who design, implement and troubleshoot computer networks. Two employees were selected from each of the 15 ISPs and 1 employee from the IXP.

To ensure validity the researcher pre-tested the research instruments, in order to reveal questions that could have been misunderstood. Pre-testing of the research instruments was done at UUNet Kenya before data collection. After pre-testing the necessary alteration were made on the research instruments. To achieve the objective of this research study the following research instruments were used.

Questionnaires

Quantitative structured questionnaires were administered to the employees of Internet Service Provider (ISPs) companies and Kenya Internet exchange point (KIXP). To ensure validity of the above mentioned instruments, the researcher pre-tested the research instruments so as to reveal questions that were misunderstood.

Interviews

An interview was carried out with the KIXP employees, to collect data and understand how the KIXP functions and operates.

Other Sources of Data

Publicly available Data from the CCK: The statutory Communications regulator, the CCK has published various articles, magazines and other literature covering its operations and the state of telecommunications in Kenya. Relevant portions of the publicly available information were used for this research, (Communications Commission of Kenya, 2008).

Publicly available Data from the ISOC

The Internet society has published various articles, magazines and other literature for the public covering ISP interconnection models.

Internet Sources

Being a technical research paper, the researcher has made use of information published on the internet. This includes research papers, white papers, magazines, journals and other literature available on the internet and relevant to this research.

Data Collection

Data was collected from the KIXP and ISP companies in Kenya.

2.1. The KIXP

The Kenya Internet Exchange Point (KIXP) is the facility which keeps Kenyan Internet traffic in Kenya. It allows Kenyan Internet Service Providers to easily exchange traffic within Kenya, without having to send those messages across multiple international hops to reach their destination while improving connectivity and services for their customers. KIXP is run and operated by the Telecommunication Service Providers Association of Kenya, which is a professional, non-profit organization representing the interests of ISPs and other telecommunication service providers in Kenya.

2.2. The ISPs

An Internet Service Provider is a company that provides access to the worldwide web. Charging a monthly fee, the service provider gives you a software package, username, password and access phone number. Equipped with a modem, you can then log on to the Internet and browse the internet, send and receive e-mail. Additional services are domain name registration and web hosting, internet transit dial-up or DSL access and leased line access. ISP's themselves are connected to one another through Network access points (Naps). ISP's are also called IAP's (Internet Access Providers).

Data was collected from the following ISPs.

i. Access Kenya
ii. Africa Online
iii. Iway Africa
iv. Jambonet

v. Jamii telecom Ltd
vi. Karibunet
vii. Kenyaweb
viii. MyISP
ix. Nairobi net
x. Sahannet
xi. Simbanet
xii. Skyweb
xiii. Swiftglobal (Kenya)
xiv. UUNET
xv. Wanainchi Online

Data Collection Procedures

Two sets of questionnaires were designed and administered to the sampled ISPs by researcher. The researcher also, personally visited the respective ISPs and KIXP to carry out the interviews.

3. Presentation and Analysis of Finding

3.1. Quantitative Savings that will be achieved through an IXP via Peering

3.1.1. International and Local bandwidth Cost

Table 1 is showing International and Local bandwidth cost in USD. International bandwidth cost is more expensive than the Local bandwidth cost.

Table 1. International and Local Bandwidth Cost. (Telkom Kenya, December 2013)

Bandwidth Kbps	International (USD)	Local (USD)
64Kbps	1687	190
128Kbps	2386	274
256Kbps	3000	350
512Kbps	4773	515
1000Kbps	6500	725
10000Kbps	8300	890
100000 Kbps	10300	1015
110000 Kbps	12500	1270

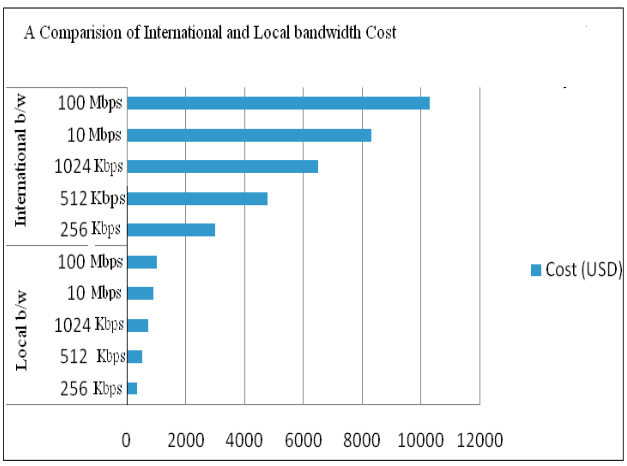

Figure 1. Comparison of International and Local Bandwidth Cost

Using Figure 1, the average international cost/kbps is USD 9.2/kbps whereas the average local cost/kbps is USD 1.043/kbps.

3.2. Peering at KIXP

Table 2 shows the costs involved in setting up a peering link to the (KIXP).An ISP has to pay the joining membership fee and monthly membership fee to the KIXP. The ISP maintains the link that connects to the exchange point. The average costs per kbps for International bandwidth and local bandwidth have been obtained in Figure 1.

Table 2. Peering Cost at KIXP

Membership Fee	KSh.	USD
Joining Membership fee	30,000	400
Monthly Membership fee	20,000	266

3.3. Monthly Savings Obtained via Peering at an IXP

Assume that an ISP is already a member at an IXP. The parameters in table 2 and table 3 have been used to determine monthly savings that will be obtained via Peering at an exchange point.

Table 3. Parameters used in Peering and Transit Models

Parameters	Meaning
TT	Total Traffic(Kbps)
X	Local Traffic (Kbps)
Y	International Traffic (Kbps)
K	Monthly membership fee (USD)
C_L	Average cost of Local Traffic per Kbps(USD)
C_I	Average cost of International Traffic per kbps (USD)
C_p	Cost of Peering (USD)
C_T	Cost of Transit (USD)
S	Monthly Savings (USD)

3.3.1. Case 1: Transit Model

Using Table 2, Table 3 and equation 3.1 the Transit cost was obtained as follows:

Let,

X = 10,000 Kbps

Y = 100,000 Kbps

C_I = USD 9.20 / kbps

C_L =USD 1.043 / kbps

Assume that there is no Peering link at the Kip and all the traffic both X and Y is being sent via the Transit model. The following cost will be incurred

$$CT = C_I (X + Y) \quad (3.1)$$

$$= 9.20\ (110{,}000)$$

$$= \text{USD } 1{,}012{,}000$$

Therefore to Transit 110,000 kbps an ISP incurs USD 1,012,000.

3.3.2. Case 2: Peering Model

Using Table 3.1 and Table 3.3 the Peering cost was obtained as follows

$Cp = (C_I(Y) + C_L(X) + K)$ (3.2)
$= (9.20\ (100{,}000) + 1.04\ (10{,}000) + 266)$
$= (920{,}000 + 10{,}430 + 266)$
$=$ USD 930,696
$S = (C = (C_T - Cp)$ (3.3)
$= (1{,}012{,}000 - 930{,}696)$
$=$ USD 81,304

From equations 3.1, 3.2 and equation 3.3 an ISP is able to save USD 81,304.This shows that savings can be obtained via Peering at an IXP.

3.3.3. Review of Internet Traffic at the KIXP

This Peering traffic at the KIXP has been rising over the years from 2800kbs to 48Mbps.

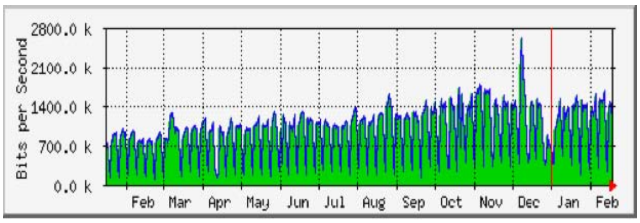

Figure 2. KIXP Bandwidth (2013/2014)

From Figure 2 the annual growth rate was 77%. February 2013 had 900Kbit/s and February 2014 had 1.6Mbit/s.

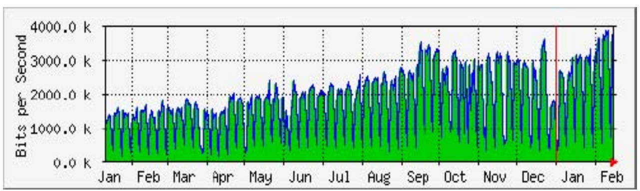

Figure 3. KIXP Bandwidth (2013/2014)

From Figure 3 the annual growth rate was 137%. February 2013 had 1.6Mbit/s and February 2014 had 4Mbit/s.

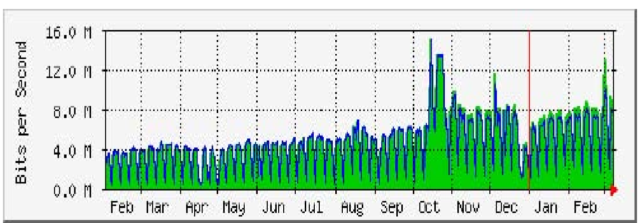

Figure 4. KIXP Bandwidth (2013/2014)

From Figure 4 the annual growth rate was 110.5%.Peering traffic at the KIXP increased from 4Mbit/s in 2013 to 22Mbit/s in 2014

From Figure 5 the annual growth rate was 200% Internet traffic increased from16Mbits in 2012 to 48 Mbits in 2013.

Figure 2 – 4 has shown that the traffic exchanged at the KIXP has increased tremendously over the years. In 2013 the total traffic at KIXP was 2800 Kb and in 2014 the total traffic was 48Mb. The KIXP has enabled the Kenya ISPs to keep local traffic local hence lowered the Internet cost.

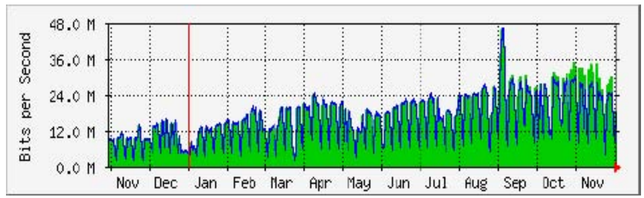

Figure 5. KIXP Bandwidth (2012/2013)

3.4. Model used to determine when to send Traffic via the Transit or Peering Model

Assume that an ISP is handling total traffic of 110000Kbps. X being local traffic and Y being International traffic

Let

CI = USD 9.20, average cost of International traffic per Kbps

CL= USD 1.04, average cost of local traffic per Kbps

Using Table 3, equation 3.1 and equation 3.2 the values shown in Table 4 were obtained.

Table 4. Peering and Transit Cost models

X (Kbps)	Y (Kbps)	$C_P = (C_LX + C_IY + K)$ (USD)	$C_T = C_I(x + y)$ (USD)	$S = C_T - C_P$ (USD)
0	110000	1012266	1012000	(-266)
10000	100000	930666	1012000	81334
20000	90000	849066	1012000	162934
30000	80000	767466	1012000	244534
40000	70000	685866	1012000	326134
50000	60000	604266	1012000	407734
60000	50000	522666	1012000	489334
70000	40000	441066	1012000	570934
80000	30000	359466	1012000	652534
90000	20000	277866	1012000	734134
100000	10000	196266	1012000	815734
110000	0	114666	1012000	897334

The last scenario of local traffic being 110000Kbps and international traffic 0Kbps can rarely happen. If a ISPs obligation is to deliver traffic, there is no point when the ISP will be without International traffic.

From Table 4 Savings increase as the ratio of local bandwidth increases and international bandwidth decrease. Figure 6 was obtained from Table 4.

Figure 6 is a model ISPs will use to determine when to send traffic via the Transit or Peering Model. The unit cost of traffic exchanged is on the Y-axis in $-per-Kbps. The X-axis shows the volume of traffic exchanged in Kbps. The cost of Transit is shown as a flat unit cost line. The sloped line is showing the cost of traffic exchanged in a Peering relationship.

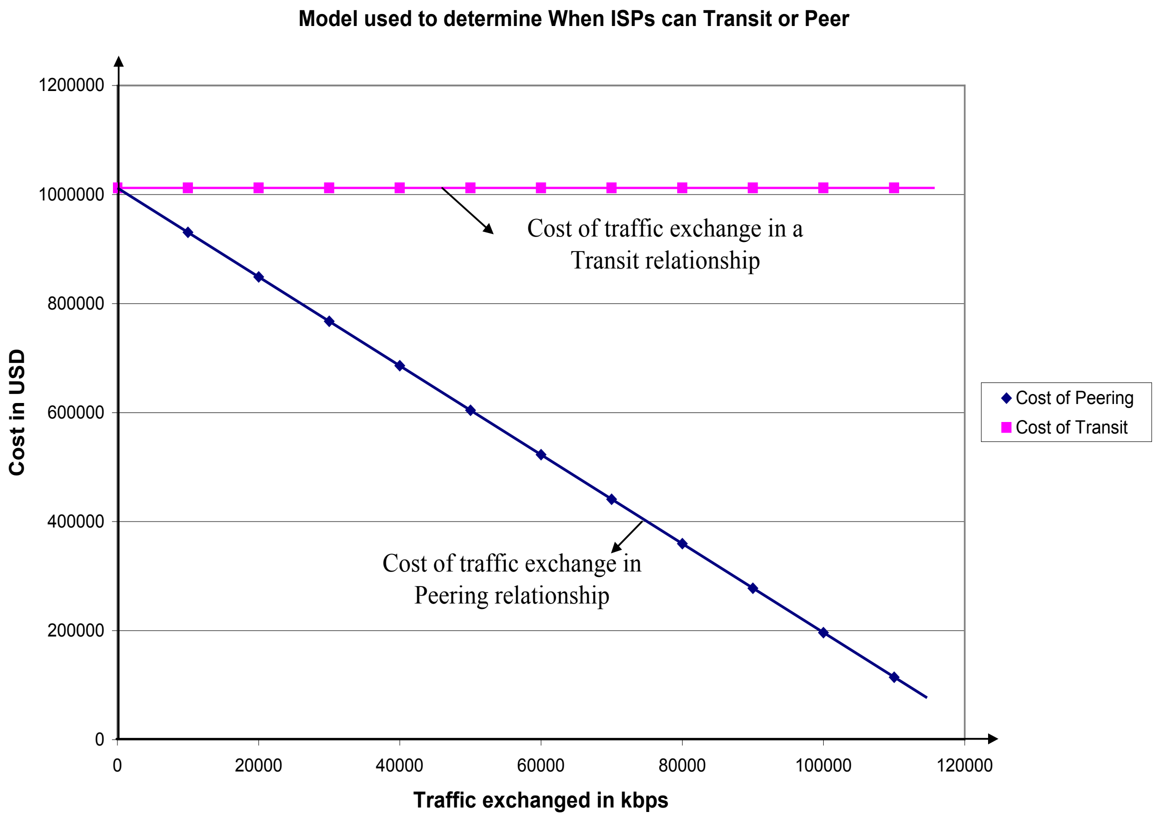

Figure 6. Model used to determine when ISPs can peer or Transit

Peering is cost effective at traffic increases. The more traffic exchanged at the peering point, the lower the unit cost of traffic exchanged. There is a "Peering Breakeven Point" where the cost of Peering and Transit is the same. Once traffic volume for an ISP reaches the breakeven point, ISPs should Transit via an upstream provider to avoid Peering costs such as management fees, Infrastructure fees and monthly membership fees. Peering is preferred when the ratio of local traffic to international traffic is high.

When it costs less to send traffic to an upstream Transit provider, ISPs should send data via the Transit model. When the unit cost of sending traffic to an IX is less, ISPs should send data via the Peering model. Transit model is preferred when there is high ratio of international traffic to local traffic.

4. Conclusions

The researcher has explored the Peering and Transit ISP interconnection models and determined that the Peering model is preferred when there is high ratio of local traffic to international traffic while the Transit model is preferred when there is high ratio of international traffic to local traffic. Savings increase when the ratio of local traffic increases and savings reduce when the ratio of International traffic increases

From the comparative study done on Local and International bandwidth cost, the research has established that the costs incurred by Kenyan ISPs to Transit local traffic are significantly higher than the costs of Peering via the KIXP. The researcher established that ISPs use geographical coverage, minimum capacity requirements, symmetry of traffic exchanged and proximity of exchange points in determining potential Peers. Finally the research has established that bandwidth cost is high in Kenya because of little local content that is generated in the country.

5. Recommendations and Future Research

Kenya has little local Internet content and thus it should shift attention to local content generation and hosting as a way of pushing down Internet connectivity costs. Most developing countries use international bandwidth to exchange data at local levels which is costly. With the use of fiber optic, Internet bandwidth prices will reduce significantly if only Kenya will shift attention to local content generation. Seacom and Teams fiber-optic cables have failed to reduce Internet costs due to monopoly. In future studies a model quantifying local Internet traffic should be developed. This will help us to understand the quantity of total local traffic and international traffic in Kenya. With the East Africa integration, ISPs in the East Africa should peer at common IXP hence keep local traffic local without traversing the expensive International lines.

REFERENCES

[1] AfrISPA, 2002, *The half way proposition policy*, draft, 20 November, Via Africa, Creating Local and Regional IXP to Save Money and Bandwidth, viewed 20 September 2005,

[2] Bell, R 2002, 'A strategy for reducing Africa's International Internet costs', *Balancing Act Africa*, Vol.3, no.130, pp.10-15.

[3] Flickenger, R & Belcher, M 2006, *Internet Access Speed: How to Accelerate your Internet*, Blackwell Publishers, Oxford

[4] Jensen, M 2006, *Open Access: Lowering the cost of International bandwidth in Africa,* Finch Publishing, Lane Cove, and NSW.

[5] Marcus, J 2001, *'Global Traffic Exchange among Internet Service Provider (ISPs)',* OECD update, Vol. 22, no.5, pp.25-60

[6] Michuki, M 2009, Internet Exchange Points: Lowering costs and Promoting Internet Development, *OECD Conference Paris*, Vol.1, no.2, pp. 1- 20.

[7] Norton, W 2000, Internet Service Providers and Peering working paper Uniquix, Vol. 10, no.3, and pp.35-40.

[8] Russell, S 2004, *Creating local and regional IXPs to save money and bandwidth*, draft , 5 December, International Telecommunication Union (ITU), viewed 5 December 2008, http:/www.itu.int/osg/spu/ni/ipdc/study

[9] Thaba, D 2008, *A framework for Optimizing Internet Bandwidth Utilization: A Kenyan Perspective,* Strathmore University.

[10] Woodcock, B 2005, *Telecommunication Policies and Practices,* DiploFoundation publishing, Sage London.

[11] Yoshi U 2005, 'African Internet Service Providers' *Working paper Uniquix*, Vol.10, no.5, pp.16 -25