COMMUNICATIONS COMMISSION OF KENYA

INTERNET MARKET ANALYSIS STUDY

FINAL REPORT

Prepared

by

NETCOM INFORMATION SYSTEMS LTD

for

COMMUNICATIONS COMMISSION OF KENYA

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List of Acronyms

ADSL	Asymmetrical Digital Subscriber Loop
ARCC	Africa Regional Center for Computing
ARPU	Average Revenue Per User
ASP	Application Service Provider
B2B	Business to Business
B2C	Business to Customer
BPO	Business Process Outsourcing
CCK	Communications Commission of Kenya
CEO	Chief Executive Officer
CID	Center for International Development, Harvard University
CIDCM	Centre for International Development & Conflict Management
CIR	Committed Information Rate
CVO	Commercial VSAT Operator
DAI	Digital Access Index
DCNO	Data Carrier Network Operator
DDI	Digital Divide Index
DSL	Digital Subscriber Loop
DVB	Digital Video Broadcast
EAFIX	East Africa Internet eXchange
EDGE	Enhanced Data rates for GSM Evolution
GDI	Global Dispersion of the Internet
GDP	Gross Domestic Product
GM	General Manager
GNI	Gross National Income
GoK	Government of Kenya
GPRS	General Packet Radio Service
HIC	High-Income Countries
IBGO	Internet Backbone and Gateway Operator
ICP	Internet Content Provider
ICT	Information and Communication Technology
IGO	International Gateway Operator
IOI	ICT Opportunity Index
ISP	Internet Service Provider
IT	Information Technology
ITU	International Telecommunication Union
IP	Internet Protocol
IXP	Internet Exchange Point
Kbps	Kilobits per second
KCPE	Kenya Certificate of Primary Education
KCSE	Kenya Certificate of Secondary Education
KEI	Knowledge Economy Index
KENET	Kenya Education Network
KIXP	Kenya Internet Exchange Point
KPTC	Kenya Posts & Telecommunication Corporation

KRA	Kenya Revenue Authority
LIC	Low-Income Countries
LLO	Local Loop Operator
LMC	Lower Middle Countries
MB	Megabytes
Mbps	Megabits per second
MD	Managing Director
MIC	Middle-Income Countries
NDI	Network Readiness Index
NII	National Information Infrastructure
NGO	Non-Governmental Organization
PC	Personal Computer
PDNO	Public Data Network Operator
POP	Pont Of Presence
PPP	Private Public Partnership
RDBMS	Relational Database Management System
SKA	Sender Keeps All
SLA	Service Level Agreement
SMS	Small Message Service
SNO	Second National Operator
TCP	Transport Communication Protocol
TKL	Telkom Kenya Ltd
TTC	Technical Training College
TTI	Technical Training Institute
UA	Universal Access
UMC	Upper Middle Countries
UNDP	United Nations Development Programme
US	Universal Service
USIU	United States International University
VAT	Value Added Tax
VoIP	Voice Over IP
VSAT	Very Small Aperture Terminal

Executive Summary

The Internet market analysis study was undertaken because Internet development is critical to development of the ICT sector and to national socio-economic development; Internet penetration is low and way behind the penetration of other communication services (e.g. mobile) despite liberalization efforts; and there is general lack of information on the Internet service penetration, its impacts and factors that influence its development and diffusion. The study, which focused on the Internet supply side only, was therefore undertaken to create baseline information on the Internet market in Kenya, establish why Internet penetration has been low and create an interactive Internet market database. It is the intention that this database would be updated on a regular basis to become a credible and accurate source of data for policy makers, researchers, existing suppliers, new investors and other stakeholders interested in the Internet market.

The Internet market analysis study was commissioned by CCK in October 2006. The terms of reference were:

a) To review the development of the Internet market from a global, regional and national perspective;
b) To analyze the vertical and horizontal relationships of the Internet market in the country;
c) To analyze Internet service diffusion and usage patterns in different sectors of the Kenyan economy;
d) To forecast the growth of the Internet market in the next five years;
e) To outline general Internet service costing mechanisms employed by operators and service providers at different hierarchies of the market;
f) To identify key factors that hinder Internet market development and propose initiatives to revitalize the sub-sector in the country; and
g) To create an interactive statistical database for the Internet market (supply side) in the country.

Methodology, data collection and analysis

The study was carried out by Netcom Information Systems Ltd, a local ICT and management consultancy firm from November 2006 to March 2007. The framework of indicators used to guide the study was derived by integrating three other assessment frameworks; the CID E-readiness tool[1], Global Dispersion of the Internet (GDI) framework and Network Readiness Index (NRI). The integrated framework used has the following dimensions:

- **Network infrastructure**. This is derived from the CID E-readiness tool. This diagnostic tool has indicators in five categories: Network access, Networked economy, Networked learning, Networked society and Network policy. In this study, we chose Network access as the most relevant category because it measures the adequacy of the network infrastructure. Within this category, we chose three sub-categories as our sub-dimensions:

[1] This is a ready-to-use e-society tool developed by the Information Technology Group, Center for International Development (CID) at Harvard University and used to assess the readiness of a nation or community for participation in the digital economy.

information infrastructure, Internet availability and network speed and quality. We in turn developed indicators that were relevant to the terms of reference in these sub-dimensions.

- **Internet tariffs and affordability**. This is a new dimension with two sub-dimensions; Internet tariffs and Internet affordability. The former is a new sub-dimension we developed to suit the terms of reference while the latter is one of the sub-dimensions in the Network access category of the CID e-readiness tool.
- **Dispersion**. This dimension borrows heavily from the Global Dispersion of the Internet framework. The GDI framework consists of six components, each of which describes an important, somewhat intuitive, and measurable feature of the presence of the Internet in a country. These are Internet pervasiveness, geographical dispersion, sectoral absorption, connectivity infrastructure, organizational infrastructure and sophistication of user. We chose the first three dimensions as the most relevant for our study.
- **Environment**. The environment dimension is one of the components of the Network Readiness Index developed by the World Economic Forum, World Bank and INSEAD business school. The NRI is defined as "the degree of preparation of a nation or community to participate in and benefit from ICT developments." It is a composite index of three components: the *environment* for ICT offered by a given country or community; the *readiness* of the community's key stakeholders (individuals, businesses, and governments) to use ICT; and finally, the *usage* of ICT amongst these stakeholders. For this study, we chose the *environment* component, modified its elements and combined them with relevant elements of the determinants of Internet diffusion as identified by a studies based on the Global Diffusion of the Internet framework.

The indicators developed for each of the above dimensions and their sub-dimensions were used to develop a structured questionnaire that was used for data collection from the licensed operators and service providers. In addition to the questionnaire, data was collected through a roundtable discussion with industry experts and Internet entrepreneurs, review of published documents and review of websites and other electronic resources from the Internet.

In order to compare Kenya with other countries, we developed a basis for selecting the comparator countries. We used the World Bank's classification of countries according to their gross national income (GNI), comparable populations and the ICT Opportunity Index (IOI) as defined by ITU. We chose the following as the comparator countries:

- Ghana and Uganda as the low income countries with low average IOI;
- Morocco and Peru as the lower middle income countries with medium average IOI;
- Poland as an upper middle income country with upper average IOI; and
- Republic of South Korea as the high-income country with high average IOI.

We used a relational database management system (RDBMS)[2] as a software development platform to develop a system to facilitate data capture, storage and analysis. The system

[2] A relational database management system (RDBMS) is a platform used to develop computer-based database applications to meet specific user requirements. In this system, data is stored in a rectangular array of items in form of tables consisting of rows and columns that are related to each other (relational database tables) and that can be easily manipulated to produce reports as required by users. In any column the items are all of the same kind, whereas items in different columns need not to be of the same kind. Each item is a simple number of character string. Columns of a

developed has a database where all data collected is stored. As part of the database, data entry forms were designed, implemented and used to enter data into the database. In addition, query utilities were designed, implemented and used to query the database and provide reports that compute the values of the indicators. The database that was developed will subsequently be used to manage data in the Internet market. In addition to quantitative data analysis, there was qualitative data analysis of the roundtable discussion and data obtained from secondary sources, especially the ITU telecommunication database 2006.

Network infrastructure

The first five years of the new millennium (1999/2000 – 2004/2005) were dominated by Telkom Kenya as a monopoly provider of telecommunication services, with Internet bandwidth and leased line tariffs largely remaining high and unchanged. For example, table 1 below shows the tariffs of leased lines for the incumbent.

Table 1: Selected leased line tariffs for the incumbent from 2000/2001 to 2005/2006

	2000/01	2001/02	2002/03	2003/04	2004/05	*2005/06*
TKL's 64 Kbps leased line tariffs	14,400	14,400	14,400	14,400	14,400	*7,200*
TKL's 2 Mbps leased line tariffs	96,477	81,457	81,457	81,457	81,457	40,728.5

Source: Telkom Kenya and Internet Market Analysis

The situation only changed after TKL's exclusivity period came to an end in 2004 and CCK licensed new operators to compete in both Internet backbone gateway and domestic leased line services. As a result of the ensuing competition in 2005/2006, Internet tariffs began to come down while international Internet bandwidth increased. For example, as shown in table 1, Telkom Kenya's Kenstream line tariffs remained the same until July 2006 when they were reduced by 50%. This reduction can be associated with competition in provision of domestic leased lines following the licensing of several Public Data Network Operators (Waema, 2006). Telkom Kenya was forced to reduce its tariffs as it was losing market share to the new entrants. The other PDNOs followed suit and reduced their domestic leased line tariffs.

The total gateway bandwidth in Kenya has grown gradually to a total of 111.10 Mbps upto 2003/2004, the end of the period of exclusivity. The bandwidth has increased tremendously since the end of TKL's exclusivity period, doubling in 2004/2005 and more than tripled in 2005/2006 to 758.59 Mbps from the previous year. This total bandwidth is skewed in favor of downlink bandwidth, with the ratio of uplink to downlink bandwidth being approximately 1:7 by 2005/2006. This is an indication of high dependence on off shore hosted content. A ratio of 1:4 is normally considered to be acceptable.

The peering bandwidth has experienced tremendous growth in the last three years, with the average peering bandwidth at KIXP increasing from 1 Mbps in 2003/2004 to 3 Mbps in 2004/2005 and to 15 Mbps in 2005/2006. Although the ratio of downlink to peering bandwidth has been decreasing, the current ratio of 44 is still too high. A low ratio of International

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table are assigned distinct names. A row is often called a record, and represents a collection of related data values. Columns are also called fields.

bandwidth to KIXP leased line capacity (or peering bandwidth) would reduce the impact of high international bandwidth prices on Kenyan Internet services.

Dispersion

The study estimates that Kenya has 2.7 million Internet users. A more accurate estimate can be made with a user-oriented or demand study rather than this supplier-oriented one. Nevertheless, this new estimate is way above the conservative ones made by external experts in the past. For example, the 2005/2006 estimate by the ITU is 1.1 million users while CCK has been using an estimate of 1.5 million.

Kenya's Internet penetration was found to be comparable to comparable countries (low income countries with low average IOI). It was however low and had experienced low growth in the last five years in comparison to the middle income countries with medium to upper average IOI countries, e.g. Morocco. The high growth in penetration in these countries can be traced to some deliberate and focused actions and strategies.

With respect to geographical dispersion, the study found that Internet POPs are in 50% of the Kenyan districts. However, ISPs were only in 20 districts (representing less than 30% of all the districts). In addition, the study found that Nairobi had the lion's share (over 80%) of the Internet customers. The Coast province was a distant second with about 9% of the customers. Indeed Nairobi and the Coast province account for about 90% of all Internet customers. Eastern, Western and North Eastern provinces have the lowest number of Internet customers in respective decreasing order, with the last two having a negligible percentage.

In terms of sectoral absorption, the study established that the Commercial sector has the highest number of both leased and dial up lines (about 80% of the total in both cases and a penetration level of over 20%) while the Academic sector has the least penetration (just over 1% of all the institutions in the sector for both leased and dial-up lines). In addition, the overall sectoral absorption of Internet was found to be very low, at 12-13% of all institutions.

Internet tariffs and affordability

Internet services are currently provided by hierarchy of providers from IBGOs/CVOs who purchase bandwidth from the global Internet backbone to ISPs who sell Internet services to the end-users. The costs at each level of the hierarchy are passed down the level below, sometimes with very little value-addition, and ultimately are paid for by the Internet customers or customers. The study found that the average cost of 1 Mbps of asymmetrical International bandwidth costs an IBGO/IGO/CVO US$2,127 (or US$4,254 for 1 Mbps symmetrical bandwidth), with the highest and lowest being US$3,500 and US$625 respectively. The ISPs buy the same symmetrical 1 Mbps at US$5,758 and sell it at US$5,205. The cost is therefore is therefore on average increasing as the bandwidth gets to the customer. At the same time the cost is increasing, the study also established that the quality was decreasing as the bandwidth is passed onto the customer. It was found that for every 1 Mb/s purchased from the global Internet, IBGOs/CVOs connect 2 customers using 1 Mb/s links and that for every 1 Mb/s purchased from

the IBGOs, the ISPs connect about 6 customers using 1 Mb/s links. Therefore the quality of the links has been degraded by a factor of 12 by the time it gets to the customer.

In terms of the average costs of dial-up Internet services (mobile or fixed) as a percentage of GNI per capita (a good indicator of affordability), the results show that fixed dial-up Internet services are not as affordable at over 200% of GNI per capita. The study further illustrates that once we remove the timed local telecommunication charges, the figure comes down to less than 40% of GNI per capita. This demonstrates that local telecommunication charges constitute the largest component of a fixed dial-up service. Although mobile Internet and SMS services were found to be more affordable at less than 9% of GNI per capita, they are still very expensive for the ordinary person.

Dominance of operators and service providers

The dominance of operators and service providers in the various market segments is summarized in table 2 below.

Table 2: Dominance of operators and service providers

Nature of dominance	Dominance	Conclusion
Dominance of PDNOs by geographical presence	▪ PDNO 1 – 29 districts ▪ PDNO 2 – 18 districts ▪ PDNO 3 – 2 districts ▪ PDNO 4 – 2 districts	Only two PDNOs are dominant by geographical presence
Dominance of ISPs by geographical presence	▪ ISP 1 – 15 districts ▪ ISP 2 – 8 districts ▪ ISP 3 – 6 districts ▪ ISP 4 – 6 districts	Only one ISP is dominant by geographical presence
Dominance of ISPs by leased lines	▪ ISP 1 – 1,500 leased lines ▪ ISP 2– 1,138 leased lines ▪ ISP 3– 370 leased lines	Only two ISPs are dominant by leased lines sold
Dominance by dial-up lines	▪ Network Operator 1 – 150,000 dial-up lines ▪ Network Operator 2 – 140,000 dial-up lines ▪ Network Operator 3 – 84,000 dial-up lines ▪ ISP 1– 18,000 dial-up lines ▪ ISP 2– 6,000 dial-up lines	The network operators dominate the dial-up market
Dominance of IBGOs by total international bandwidth	▪ Network Operator 1 – 111 Mbps ▪ Network Operator 2 – 108 Mbps ▪ Network Operator 3 – 89 Mbps ▪ Network Operator 4 – 85 Mbps	Four IBGOs are competing fiercely in provision of International bandwidth, especially downlink bandwidth
Dominance of CVOs by total international bandwidth	▪ VSAT Operator 1– 91 Mbps ▪ VSAT Operator 2– 74 Mbps ▪ VSAT Operator 3– 32 Mbps	The two top VSAT operators add to the fierce competition by IBGOs in the provision of International bandwidth

Key factors in growth of Internet services

The study found one of the key challenges facing Internet growth from 2000 is that the costs of Internet services are have remained relatively remained high and are generally unaffordable to the average customer. Another key factor is the regulatory and licensing framework. More specifically, licensees cited the following as the regulatory and licensing framework factors that hindered the growth of the Internet market; the inability to regulate the unfair competition and business practices in the market, the poor management of the frequency spectrum, the bureaucracies and delays in licensing, the unfairness and biases of licensing, and the issuance of stand-alone licenses as opposed to unified licenses.

A further key factor is the limited locally relevant content. As an illustration, the Internet traffic in Kenya as monitored at KIXP increased drastically when the Ministry of Education released the Kenya Certificate of Secondary Education results via the web in March 2007. Other key factors include the limited availability and reliability of the local access network, the fact that ISPs have focused on Internet access rather than Internet services and applications and the limited penetration ICT penetration in academic, commercial, health, government and other sectors.

Forecasts

We have forecast that, with the right strategy, the number of Internet users can grow from the current estimate of 2.7 million to about 8 million, which is more than double the current penetration level. This user forecast is based on the need to achieve a penetration comparable to the current penetration of middle income countries (MICs), e.g. Morocco. The forecast is based on supply-side data. A better estimate would be obtained with additional data from the demand side. The corresponding total bandwidth in the next five years is 10 gigabits per second (Gbps) from the current 0.7 Gbps.

Although the licensees did not give accurate investment levels, especially the historical data, the study found that the investment by licensees has been very low. For example, in the last five years, all licensees have only invested about US$32 million. In order to connect the 8 million Internet users forecast above, the study forecast the total investment required is forecast at approximately US$700 million. In addition, the forecast in the government sector assumes that a national fibre backbone will be implemented and an international sub-marine cable will land in Mombasa. As part the forecast, three strategic applications will need to be implemented in order create locally relevant content, namely e-learning, e-government and e-commerce.

Recommendations

The recommendations are grouped according to the three broad categories identified in the integrated indicator framework in Section 3. The recommendations in the Network Infrastructure category are:

- Implement a national information infrastructure (NII) project as an integral part of the priority socio-economic development plans based on the ECA's NICI framework
- Develop a legal instrument for implementation of national fibre backbone

- Strengthen the competition laws
- Make the DCNO license technology neutral, e.g. change clause 4.3 in the DCNO license to read: "Dedicated domestic and International links to licensed network operators, internet service providers and corporate entities" by dropping the term "VSAT".
- Grant network operators DCNO licenses in order to provide leased line capacity to end-users and ISPs
- Develop regulation to promote fair competition (e.g. cost of leased lines is the same for all ISPs irrespective of ownership, appropriate revenue sharing arrangements, etc.)
- Provide support to KIXP as a common network services resource on a PPP basis
- Require operators to maintain less than 10% dropped packets
- Require that SLAs be introduced at all levels
- Monitor and announce the quality of Internet services provided by operators and service providers

With respect to Tariffs and Affordability, the recommended interventions are:

- Require all tariffs to be published on licensee websites
- Require IBGOs to unbundle their offerings
- Educate customers on Internet services
- Require flat rate telecommunication charges or volume-based pricing for fixed or mobile dial-up Internet services
- Increase competition in the fixed network
- Increase competition in the mobile market

The recommendations in the Dispersion category are:

- Fund an annual national demand baseline survey using the Partnership for Measuring ICT for Development Framework, starting 2007
- Develop and implement an Internet strategy clearly linked to the priority socio-economic development plans
- Design and implement consumer awareness campaigns for the role of Internet
- Review and implement the UA/US strategy
- Provide incentives from UA/US funds to Internet access providers to provide broadband Internet services to at least 50% of secondary schools in every district and all TTCs and TTIs
- Provide incentives from UA/US funds to content providers to develop public educational content
- Intensify the implementation of e-government services
- Create the necessary legal framework to support e-commerce transactions
- Create consumer awareness of the benefits of Internet applications, e.g. e-commerce

Other recommended interventions include:

- Ensure that licensing and regulatory processes, procedures and decisions are fair, transparent, efficient and effective

- Ensure that the database is updated every year from annual returns by licensees and from both supply- and demand-side surveys
- Publicize the database so that CCK becomes the reference point for data
- Establish collaboration and data exchange mechanisms with KRA and CBS

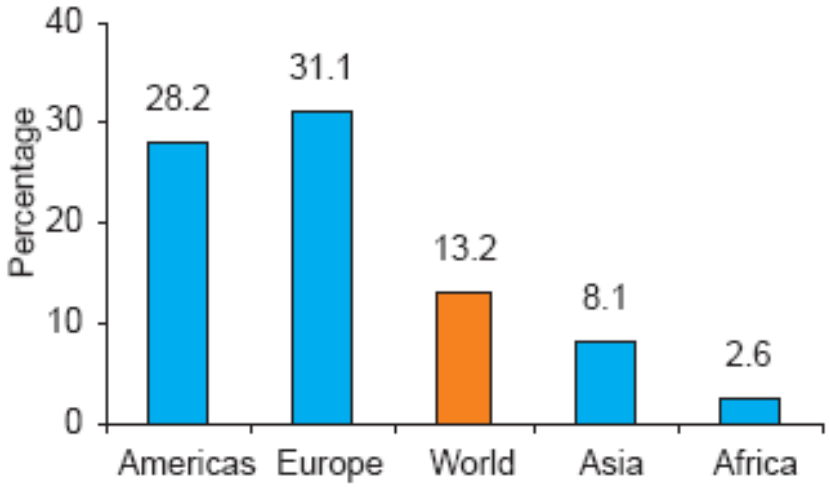
1. Background

1.1 General

Internet[3] services have permeated almost all sectors of economies in different countries worldwide. Advances in communication technologies and the rapid communications equipment cost reductions, coupled with market innovations, have created many opportunities for increasing access to the Internet in rural, remote and poor urban areas. For example in most countries, costs have been brought down by a number of schemes (taxation regimes, incentives, etc.) as well as liberalization and hence competition in the provision of services and deployment of technologies to overcome the constraints of locations and business viability.

The Internet is a communication platform riding on network access technologies such as fixed line, mobile cellular, wireless terrestrial and satellite. It is made up of a number of components which include connectivity links, servers, content and end user devices. The Internet has increasingly gained widespread recognition as a knowledge infrastructure. For example, by the end of 2004, there were an estimated 840 million Internet users in the world, representing 13.2 percent of the total population. The highest penetration rates were in Europe and the Americas, where almost one third of the population is online. The lowest penetration rates were in Africa where, on average, only 2.6 per cent of an estimated 850 million population is online, as shown in Figure 1.1 (World Telecommunication Development Report 2006).

Figure 1.1: Internet penetration by region, 2004



Source: World Telecommunication Development Report 2006, ITU

The widespread adoption and diffusion of the Internet calls for interplay of a number of internal and external factors covering the constituent components as well as socio-economic issues. This poses significant challenges to studies seeking to establish the status or performance of the

[3] Defined as "the interconnection of computer networks using a standard packet switching protocol for communications".

Internet market. It is therefore necessary to establish an investigation framework which addresses the different dimension of the service to cover areas like connectivity, pervasiveness, geographic dispersion, sectoral absorption, organizational infrastructure, and sophistication of users, among others [Wolcott et al, 2001]. The variables required to inform each of these dimensions can be collected from a variety of sources and their analysis and presentation can be used for different purposes.

The results of a comprehensive and facts based study of the Internet market are useful for all the stakeholders. For instance, policymakers get better idea of what needs to be done to eliminate bottlenecks and purposely influence and shape the growth and use of the services. In as much as the Internet, like other globalization phenomena, has subverted sovereignty of nations and blurred boundaries, governments still make policies that have profound effects on the diffusion and absorption of the Internet services.

On the other hand entrepreneurs and investors need to formulate a clearer picture of the environment and its readiness to participate in the e-economy as they embark to invest and do business. In addition, this Internet market study will be useful to inform on the status of the availability, affordability and quality of services as provided by the operators to the different user categories in the country. These include urban and rural/remote areas as well as those users whose demand is affected by a number of social and economic factors, not least of which are incomes levels, level of education, competences and computer skills.

The government of Kenya has identified the contributions of the info-communication sector, including the Internet, as key to the development of the economy. There is therefore a need to clearly understand the local Internet market environment and to identify the national opportunities and weaknesses in the endeavor to leverage on information and communication technologies (ICTs) for socio-economic development.

1.2 The Internet Market in Kenya

The telecommunications market in Kenya was liberalized in 1999. This led to the formalization of market structures and advent of activities geared towards the development of the telecommunications markets in total. On the Internet front, ISPs were licensed to operate formally and the incumbent was given the monopoly to operate the Internet Backbone as well as the provision of access circuits (leased lines, VSAT, etc) for 5 years until July 2004. Though Telkom Kenya developed and expanded a national backbone, the coverage area was limited to the main urban centres and for a long time availability, reliability and quality of the services provided was way below average. During this period, the Internet market in Kenya, spearheaded by commercial service providers (ISPs), witnessed rapid expansions and the user base grew to over 500,000 users (estimated). Nevertheless credible data on the Internet industry is not readily available. This is one of the objectives of this study.

The Internet market is part of the communications industry, which is regulated by the Communications Commission of Kenya (CCK). The communications industry in Kenya is broadly structured in two bands, i.e. *facilities-based and services-based operators*. Specifically, the Internet market has the following operators and service providers:

- **Gateway operators**. These are licensed to operate International gateway licenses for data (Internet). Currently they serve as the main providers of Internet connectivity to the country through satellite-based earth stations. Internet Backbone and Gateway Operators (IBGOs) and VSAT operators are in this category.
- **Access infrastructure operators**. These are licensed to provide in-country communication links i.e. carry traffic between different geographical locations and regions as well as local loop connectivity. This category includes public data network operators (PDNOs), mobile operators, local loop operators (LLOs) and VSAT network operators.
- **Applications providers**. These provide services, content and all other related applications to the end users. ISPs are in this category.

The different license categories are governed by guidelines and license fees as stipulated by the regulator[4]. Due to the rapid changes in the Internet market domain, the regulator has been active in continuously updating the applicable guidelines and fees. In some cases, such as the setting up and operating of ISPs in the rural areas, all applicable fees are waived.

In this study, a detailed analysis of the interaction between operators and service providers at the different levels of operation, services provided at each level, bandwidth and the costs involved were carried out, with a view to recommending possible applicable approaches for the growth of the Internet in Kenya. The outcome of this study has been an Internet Market database that contains all of the data required for analysis of the Internet Market as contained in the terms of reference. Section 2 gives an overview of the study, including why the study as necessary, the terms of reference and the project team. The next section describes the conceptual and methodological frameworks that guided the study. Section 4 provides a brief history of Internet in Kenya. Sections 5, 6 and 7 present and discuss the results of the study, focusing on network infrastructure, geographical dispersion and sectoral absorption, and tariffs and affordability. The next section outlines the dominance of operators and service providers in the various services and forecasts the growth of the Internet in the next five years. The final section presents conclusions and recommended interventions that must be acted upon in order to grow the Internet market and have it contribute more to the socio-economic development of Kenya.

[4] http://www.cck.go.ke/html/tele_reg_req_jun_2005.pdf

2. Overview of the Study

2.1 Why the Study?

This Internet market analysis study was undertaken because Internet development is critical to development of the ICT sector and to national socio-economic development. For example, studies have shown that a 1-percentage point increase in the number of Internet users boosts total exports by 4.3 percentage points. It also increases exports from low-income countries to high-income countries by 3.8 percentage points. The study was also undertaken against the backdrop of the many liberalization efforts which have resulted in a vibrant communications market in Kenya. For example, the mobile network surpassed the fixed network in 2000/2001 and has since then experienced phenomenal growth. By 2006/2007, the mobile network was over twenty (20) times the size of the fixed network in terms of teledenity. However, despite liberalization in the Internet market segment, there is still concern that Internet penetration still lags behind penetration by other communication services (e.g. mobile), with most providers concentrating in the major towns at the expense of the rural areas where the majority of the Kenyans are. Some questions that may need to be answered include: What has been the impact of Internet regulation on growth of Internet? Is the Internet market a competitive market?

In addition, there is a general lack of information on the Internet service penetration, its impacts and factors that influence its development and diffusion. While most developed nations now have regular Internet user surveys, in developing nations estimating users is usually a matter of guesswork, often based on a multiple of the number of customers. However, with no benchmark reference, differing methodologies result in widely varying estimates (World Telecommunication Development Report 2003). This study was therefore aimed at getting baseline information on the Internet market in Kenya. The information obtained would be used to influence policy and regulatory decisions and interventions.

Finally, the study was to create a baseline or reference for a "perpetual" interactive Internet market database that will be useful to policy makers, researchers, existing suppliers, new investors and other stakeholders interested in the Internet market. In addition, this database will provide credible and accurate data to other bodies that calculate the Networked Readiness Index for different nations. It is the intention of CCK to update this database on a regular basis.

This study will however create a database based on the supply-side only. It is therefore important that there is a follow up study on the demand side so that the database created is more comprehensive and useful.

2.2 Terms of Reference

The Internet market analysis was to cover all active operators and service providers in the Internet market, including: Internet Service Providers (ISPs); Internet Exchange Points (IXPs): Commercial VSAT Operators; Public Data Network Operators (PDNOs); Internet Backbone and Gateway Operators; Local Loop Operators (LLOs); and Mobile Operators. In Particular, the study entailed:

a) To review the development of the Internet market from a global, regional and national perspective
b) To analyze the vertical and horizontal relationships of the Internet market in the country
c) To analyze Internet service diffusion and usage patterns in different sectors of the Kenyan economy
d) To forecast the growth of the Internet market in the next five years
e) To outline general Internet service costing mechanisms employed by operators and service providers at different hierarchies of the market
f) To identify key factors that hinder Internet market development and propose initiatives to revitalize the sub-sector in the country; and
g) To create an interactive statistical database for the Internet market (supply side) in the country.

3.0. Conceptual and Methodological Frameworks

3.1 Conceptual Frameworks

3.1.1 Internet Interconnection Models

The Internet interconnection[5] and peering[6] environment somewhat defines the Internet market segments in many markets the world over. Based on a hierarchical simple model of interconnection, payment is in one direction as a client pays the provider for services rendered (contrast this with the prevailing interconnection arrangements between traditional telecommunications providers where there is a settlement arrangement between the originating provider and the terminating provider). This supplier/customer interconnection model is prevalent in the Internet market and has resulted in the creation of levels of hierarchy *–(tiers)* where each ISP purchases services from a provider(s) at the next higher tier (upstream) and sells services to multiple customers at the next lower tier (downstream) as shown in figure 3.1 below.

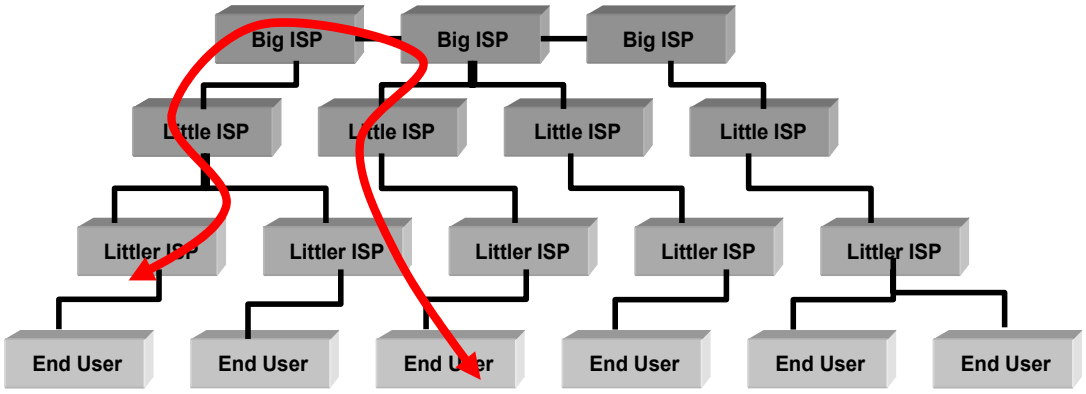


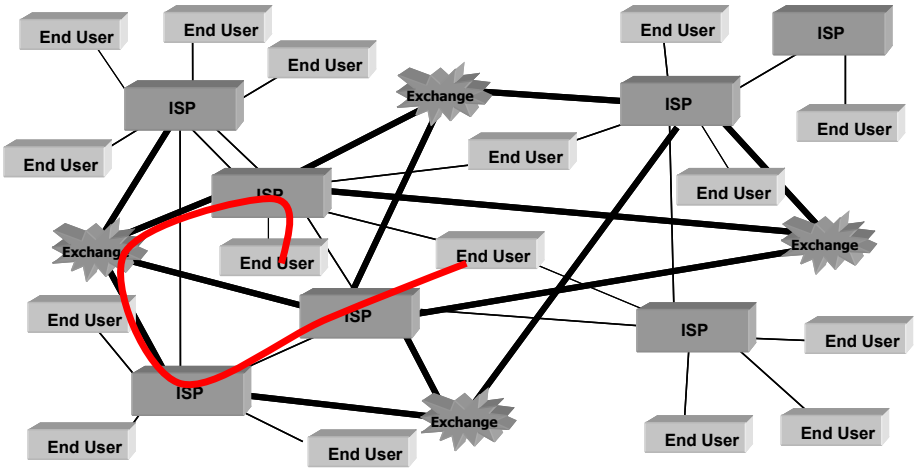
Figure 3.1 ISPs Hierarchy Model

As communication markets liberalize, the markets and technological developments are breaking this customer/supplier relationship and today many ISPs at different tiers have more than one supplier and the tiering of wholesale providers is no longer present. At the same time, providers are peering at the different levels of the tiered hierarchy at no cost as shown in figure 3.2 below.

[5] Internet interconnection occurs when Internet Service Providers (ISPs) connect their networks to each other in order to exchange traffic between their customers and the customers of other ISPs. 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. Interconnection enables the Internet as a whole to be ubiquitously fully connected, despite the fact that no single network operator could possibly provide Internet access in every part of the world.

[6] Peering is a type of Internet interconnection. The most common type of peering is one where there is no financial settlement, which is known as "Sender Keeps All (SKA)" or "Bill and Keep" arrangement.

Figure 3.2 Evolved ISPs Interconnection Structures



Source: Changing structure of Internet –Geoff Houston

These changes in the communications industry are continuously affecting and defining the Internet market in different ways. As the Internet market develops in Kenya, the interactions between the global services providers, local providers and the end users have taken different formats progressively. For instance, today, most local service providers have access to more than one upstream providers, can monitor their traffic usage and throughput comprehensively, can peer (or choose to peer) with other local providers locally through the Kenya Internet Exchange Point (KIXP), and so on. This scenario also holds true for the end users who have gradually become more informed and empowered. We take the view that Kenyan model should become more peering at KIXP and other IXPs and less of the hierarchy of providers, that is a flatter model.

3.1.2 Network Readiness Index Framework

At a global level, a lot of work/studies have been carried in an effort to measure the development of Internet in different countries and sectors. The focus of most of these studies cuts across:

- Readiness – communication infrastructure, skilled manpower, Internet hosts, etc.
- Intensity – Intensity of Internet users, value of use, etc.
- Impacts – effects on firms performance, perceived benefits, etc.

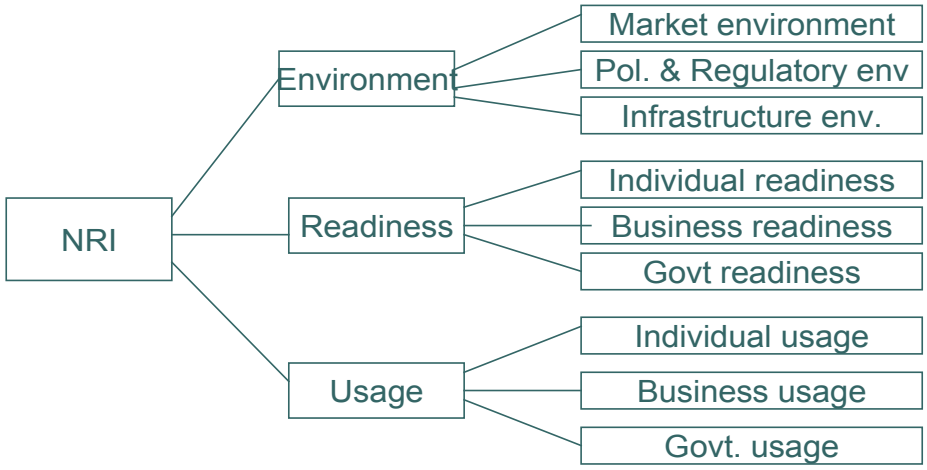
In most cases the set of measures concentrate on a range of predefined indicators which can be integrated into a wider framework of economic and social performance measures. These indicators for instance can be used to measure or predict changes in markets, individuals' consumption, globalization, etc. Outcomes of these measurements have been widely used in different reports and rankings of countries such as:

- E-readiness - this is the degree to which a community is prepared to participate in the networked world based on indicators such as Internet diffusion.
- Effect on knowledge economy index (KEI)

- Networked Readiness Index (NRI)

Of particular relevance in this study is the Networked Readiness Index (NRI). This is defined as "the degree of preparation of a nation or community to participate in and benefit from ICT developments." As shown in Figure 3.3 below, the Index is a composite of three components: the *environment* for ICT offered by a given country or community; the *readiness* of the community's key stakeholders (individuals, businesses, and governments) to use ICT; and finally, the *usage* of ICT amongst these stakeholders.

Figure 3.3: Network readiness index framework



Source: GIT report 2003-2004

In a nutshell, these measures tend to capture from a global perspective a country's competitiveness and development. This is progressively influencing decisions such as investors' choice of a destination, effective Internet regulation or stimulation, as well as identification of investment opportunities.

One key element in all these studies is the availability of credible hard facts data. For Kenya, the Internet market analysis database will now be considered one of the credible sources of Internet use data from Kenya and could improve the accuracy of the ranking. This is important especially for investors (both foreign and local) and the government.

3.1.3 The CID E-readiness Tool

Readiness is the degree to which a community is prepared to participate in the Networked World. It is gauged by assessing a community's relative advancement in the areas that are most critical for ICT adoption and the most important applications of ICTs. E-readiness assessment tools required for the assessment can be classified into two broad categories, namely:

(a) E-economy readiness tools that focus on a nation's readiness to exploit Information and communication technologies (ICT) for economic development (i.e., to take part in the digital economy)

(b) E-society readiness tools that measure the ability of the overall society to benefit from ICT

In general, E-society tools could also be used to assess the readiness of a nation or community for participation in the digital economy. In this project, we have selected the ready-to-use e-society tool developed by the Information Technology Group, Center for International Development (CID) at Harvard University available at http://www.readinessguide.org. The tool is appropriately titled *"Readiness for the Networked World: A Guide for Developing countries"* and we shall refer to it as the CID tool.

The CID tool defines 19 categories of indicators of the degree of E-readiness of a community or country. The 19 categories of indicators are split into five main categories as follows:

(i) **Network access** group that measures readiness of the ICT infrastructure in terms of bandwidth, availability, reliability, pricing etc. The indicators here address the question: What are the availability, cost and quality of ICT networks and services?

(ii) **Networked economy** group measures the use of ICT by businesses and the government for commerce (B2C or B2B) and/or delivery of services. The indicators here address the question: How are businesses and governments using ICTs to interact with the public and with each other?

(iii) **Networked learning** group that aim to measure the level of access to ICT by educational institutions, the ICT related programs and utilization of ICT in teaching and learning. The indicators here address the questions: Does the educational system integrate ICTs into its processes to improve learning? Are there technical training programmes in the community that can train and prepare an ICT workforce?

(iv) **Networked society** group will measure the degree to which people and organizations in Kenya are using ICT. It will assess the level of the country in terms of availability of local content, use of Internet technologies by organizations, employment opportunities for those with ICT skills and other e-activities in the country. The indicators here address the questions: To what extent are individuals using ICT at work and in their personal lives? Are there significant opportunities available for those with ICT skills?

(v) **Network policy** group will be used to assess the ICT policies and/or legislation and the success or failure of the regulatory environment. The indicators here address the question: To what extent does the policy environment promote or hinder the growth of ICT adaptation and use?

In this project, we have chosen a few of the indicators as the most appropriate, largely from Network Access category.

3.1.4 Global Dispersion of the Internet Framework

The Global Dispersion of the Internet (GDI) framework consists of six components, each of which describes an important, somewhat intuitive, and measurable feature of the presence of the Internet in a country (Wolcott P. et at., 2001). These dimensions are outlined below.

(a) **Pervasiveness**. Pervasiveness is a function principally of the number of users per capita. The intent is to depict the portion of a population that uses the Internet. Accurate user counts are not readily available. However, it is often possible to obtain or reasonably estimate the number of users accessing the Internet through switched (dial-up) and fixed (LAN) connections by extrapolating from numbers of customers.

(b) **Geographical dispersion**. Geographic dispersion describes the physical dispersion of the Internet within a country.

(c) **Sectoral absorption**. Sectoral absorption focuses on the extent to which organizations in four major sectors[7] - academic, commercial, health, and public (government) have made a tangible commitment to Internet use. The sub-sectors describe the major social and economic divisions in society as depicted in table 3.1 below. It is to be noted that individual use is not considered in this dimension.

Table 3.1: Sectors and sub-sectors

Sector	Sub-sector
Academic	Primary, Secondary, Tertiary (middle level colleges and universities)
Commercial	Distribution, Finance, Manufacturing, Retail, Service
Health	Hospitals, Clinics, Medical Research Centers, Physicians/Practitioners
Government	Central Government, Local Authorities, Parastatal Organizations and Other Public Organizations
Other *	International NGOs, Local NGOs, Religious Organizations and Other Community-based Organizations

Key:

* "Other" sector has been introduced to take care of anything else that could not classified into the standard sectors

(d) **Connectivity infrastructure**. Connectivity infrastructure assesses the extent and robustness of the physical structure of the network, and comprises four components: the aggregate bandwidth of the domestic backbone(s), the aggregate bandwidth of the

[7]Health, commercial, and academic were initially selected because they corresponded to categories in the United Nations Development Programme (UNDP) human development index. The public sector is obviously a very important user, potentially comparable in size to the others. See **http://www.undp.org/**.

international IP links, the number and type of inter-connection exchanges, and the type and sophistication of local access methods being used.

(e) **Organizational infrastructure**. The Internet services infrastructure is the "middleware" between the basic telecommunications infrastructure and users that makes the raw "pipes" useable. The measure of organizational infrastructure has traditionally been centered on the number of Internet Service Providers (ISPs) and their competitive environment. We have extended this focus to all operators and service providers in the Internet market. It tries to assess the robustness of the market and services themselves, and recognizes that when strong competition is present, more services will probably be offered. ISPs and other operators and service providers may be transforming themselves into Internet content providers (ICPs) and application service providers (ASPs), and the array of services offered at this level is expanding.

(f) **Sophistication of use**. This looks at Internet from the user perspective – individual and organizational. This is the demand side and beyond the scope of this study.

The conceptual framework we shall use for the study is an integration of the above concepts, as will be explained in the next sub-section.

3.1.5 Integrated Conceptual Framework

We have borrowed concepts from the NRI, E-readiness CID and GDI frameworks outlined above to create an integrated framework that was used in this study. At the highest level, this framework has the following dimensions:

(a) Network infrastructure
(b) Dispersion
(c) Internet tariffs and affordability
(d) Environment

The *Network infrastructure* dimension is derived from the CID E-readiness tool. In this study, we chose Network access as the most relevant category because it measures the adequacy of the network infrastructure. Within this category, we chose three sub-categories of indicators as our sub-dimensions: information infrastructure, Internet availability and network speed and quality. We in turn developed indicators that were relevant to the terms of reference in these sub-dimensions. The *Internet tariffs and affordability* dimension is a new dimension with two sub-dimensions; Internet tariffs and Internet affordability. The former is a new sub-dimension we developed to suit the terms of reference while the latter is one of the sub-categories in the Network access category of the CID e-readiness tool. The *Dispersion* dimension borrows heavily from the GDI framework. The GDI framework consists of six components, each of which describes an important, somewhat intuitive, and measurable feature of the presence of the Internet in a country. For this study, we chose Internet pervasiveness, geographical dispersion and sectoral absorption components as the most relevant for our study.

Each of the dimensions has a number of sub-dimensions and indicators. As shown in the table 3.2, we have chosen indicators that are commonly used by the ITU (see, for example, the World Telecommunication/ICT Report 2006: Measuring ICT for Social and Economic Development)[8]. This will allow for comparison with other countries regionally and globally as well as with other countries in almost similar geo-socio-economic conditions as Kenya, as demanded by the study terms of reference.

Table 3.2: Integrated framework of assessment indicators (first three dimensions)

Assessment Dimension	Sub-dimension	Indicators
Network infrastructure	Information infrastructure	1. Mobile teledensity
		2. Landline teledensity
	Internet availability	3. International gateway uplink bandwidth per inhabitant (bps per inhabitant)
		4. International downlink bandwidth per inhabitant (bps per inhabitant)
		5. Leased line bandwidth per user
	Network speed and quality	6. Total national IXP bandwidth per 100 inhabitants
		7. Peering bandwidth per user
		8. Ratio of international to peering bandwidth
		9. Ratio of bandwidth purchased to bandwidth sold at each hierarchy of the market
Internet tariffs and affordability	Internet tariffs	10. International bandwidth tariffs
		11. End-user Internet bandwidth tariffs
		12. Percentage of licensees who publish their tariffs
	Internet affordability	13. Average revenue per user (ARPU)
		14. Average dial up Internet access tariff for 20 hours of use as a % of GNI per capita
		15. Average mobile Internet access cost per Megabyte as a % of GNI per capita
		16. Cost of 100 local SMSs as a % of GNI per capita
Dispersion	Internet pervasiveness	17. No. of Internet users per 100 inhabitants
	Geographical dispersion	18. Percentage of districts with Internet POPs
		19. Percentage of Internet customers in a province
	Sectoral absorption	20. Percentage of sector organizations with leased line Internet connectivity
		21. Percentage of sector organizations with dial up Internet connectivity

The last assessment dimension, *Environment*, focuses on the influence of the environment on the development, diffusion and growth of the Internet. Most of the indicators in this dimension, which are largely qualitative, are partly derived from two main sources. The first is an extended version of the CID E-readiness assessment tool referred to as the National Readiness Index

[8] http://www.itu.int

(NRI) outlined above (see also the Global Information Technology Report of 2002-2003[9]). We chose the Environment component, modified its elements and combined them with relevant elements of the determinants on Internet diffusion as identified by a Ghana study that was based on the Global Diffusion of the Internet (GDI) framework developed by Mosaic[10]. The indicators for this dimension are shown in table 3.3 below. What is shown on this table is not an exhaustive list of factors and we expect other contextual factors to come up during the data collection exercise.

Table 3.3: Assessment indicators/factors for the Environment dimension

Assessment Dimension	Sub-dimension	Indicators/Factors
Environment	Legal and regulatory frameworks	22. Existing laws and regulations
		23. License conditions and pertinent regulatory decisions
		24. No. of licensees in each market segment
	Market	25. Rate of duties and taxes on communications equipment
		26. Availability of skilled labour
		27. Investment requirements
		28. Factors influencing pricing

3.2 Methodological Framework

3.2.1 Data Collection

The indicators developed for each of the above dimensions and their sub-dimensions were used to develop a structured questionnaire that was used for data collection from the licensed operators and service providers. After the piloting, the questionnaire was adjusted and the final copy was used in the field to collect data from the different licensees. This questionnaire was also available in electronic form in the CCK website[11] and is shown in Annex 1. Table 3.4 shows a summary of the licensees from whom data was collected and their various license categories. It also shows that a third of the operators and service providers are non-operational while 8% could not be traced.

Table 3.4: Summary of status of operators and service providers in the various license categories

	License category	Total licensed	Operational licensees		Non-operational licensees		Not traced	
			No	%	No	%	No	%
1	Public data network operators (PDNOs)	20	9	45.00	8	40.00	3	15.00
2	Internet service providers (ISPs)	51	39	76.47	9	17.65	3	5.88
3	Local loop operators (LLOs)	19	4	21.05	13	68.42	2	10.53
4	International voice gateway operators (IVGOs)	3	3	100.00	0	-	0	-

[9] http://wforum.org
[10] http://mosaic.unomaha.edu/gdi.html
[11] http://www.cck.go.ke/UserFiles/File/Questionnaire3.pdf

	License category	Total licensed	Operational licensees		Non-operational licensees		Not traced	
			No	%	No	%	No	%
5	Internet gateway and backbone operators (IBGOs)	8	4	50.00	4	50.00	0	-
6	Commercial VSAT operators (CVOs)	6	5	83.33	1	16.67	0	-
7	Leased circuit resale service providers	3	1	33.33	2	66.67	0	-
8	Internet exchange point (IXP) service providers	2	1	50.00	0	-	1	50.00
9	Others	1	1	100.00	0	-	0	-
	TOTAL	**113**	**67**	**59.29**	**37**	**32.74**	**9**	**7.96**

Source: Internet market analysis study

We used five experienced research assistants, with one of them coordinating the data collection exercise. The responsibility for data collection from the licensees was shared among the research assistants, with each having an average of 20 licensees.

The data collection was initially planned to take three weeks. However, the process of collecting data took over two months. One of the reasons for this long delay was that the contacts given for most of them licensees were not current. Most licensees had different telephone contacts and had moved offices several times. On the ground more than a day or two were spent trying to locate their new addresses. For those contacted on their mobile phone contacts, it was difficult to establish their actual physical addresses. Most licensees were weary of why they are being sought.

The second key reason for the delay was the low buy-in into the study by the licensees, even after the inception workshop was organized for all the stakeholders. In almost all cases, it took more than 4 visits to get the process started and an average of two weeks to get some data. The low buy-in manifested itself in several forms, including:

- arguments that the data required was too comprehensive;
- designing and signing non-disclosure agreements as most licensees argued that most data was confidential;
- arguments that CCK had the information from the licensee returns;
- claims that CCK had collected similar information in the past;
- the fact that one had to collect data from a number of people in different functional areas (senior management (CEO/MD/GM), finance, technical, operations and marketing) of a firm, depending on the size of the firm;
- having appointments that were not honoured, postponed several times or cancelled in the last minute;
- claims that the licensee staff did not have time to complete the questionnaire; and
- blatant refusal to provide the information.

In all cases, we gave regular reports to CCK for intervention. In most cases, there was increased cooperation after CCK's intervention.

Finally, there were informational problems. The key challenges with respect to information were that:

- Wrong information provided for some of the questions - This was detected during questionnaire checking and data entry and action taken to get the right information.
- Most licensees did not keep the information in the format required, e.g. most did not sectoral details of their customers.
- Lack of historical information, e.g. tariffs, revenue and so on.
- Blatant refusal to provide the information, especially financial and customer information – In such situations, the relevant cases were passed on to CCK for intervention.
- services for different licenses were not unbundled, e.g. Telkom Kenya.
- mergers and acquisitions – it was not clear for which company to associate with the data provided.

The data collection can be summarized as in table 3.5 below and details are provided in Annex 2.

Table 3.5: Data collection summary

Licensee category	Total licensed	Completed questionnaires	Passed on to CCK for intervention	Not traced	*Non-operational* *
Public data network operators (PDNOs)	20	12	4	3	*8*
Internet service providers (ISPs)	51	42	9	3	*9*
Local loop operators (LLOs)	19	16	2	2	*13*
International voice gateway operators (IVGOs)	3	2	1	0	*0*
Internet gateway and backbone operators (IBGOs)	8	6	2	0	*4*
Commercial VSAT operators	6	5	1	0	*1*
Leased circuit resale service providers	3	2	1	0	*2*
Internet exchange point (IXP) service providers	2	1	0	1	*0*
Others	1	1	0	0	*0*
TOTAL	***113***	***87***	***20***	***9***	***37***

Source: Internet market analysis study

Key:

* Non-operational operators also completed questionnaires

The following observations can be made from this report:

- A significant number of licensees were either non-operational or had done a pilot and were planning to roll out in the future. A total of 37 licensees were in this category, representing about a third (32.7%) of the licensed operators and service providers. In all cases, we got these firms to answer as many questions in the questionnaire as possible.

- Nine (9) licensees (8%) could be traced even after CCK gave an updated address.
- A total of 20 licensees (17.7%) were passed on to CCK for intervention.
- The most uncooperative licensees were the big firms in every category, except for Telkom Kenya Ltd. These were subsequently passed on to CCK for intervention. In all cases, we obtained most of the data after CCK's intervention.
- The most cooperative licensees were the small firms, and especially those that were not operational.

This study used a comprehensive questionnaire to collect data from the licensees. The data collection challenges notwithstanding, the licensees eventually provided all the data required to support the analysis included in this report. However, the two mobile operators, Safaricom and Celtel, did not provide revenue data required in Q10 and Q11 of the questionnaire. It appeared that the operators do not treat Mobile Internet as a separate revenue stream and that the data was therefore not easily available. This means that we could not, for example, calculate the average revenue per user (ARPU) for mobile Internet customers. Although the ARPU will be an important indicator in the future, especially for DCNO licensees, it did not affect the Internet market analysis results presented in this report. Overall, most of the licensees were reluctant to provide the revenue and expenses data in Q10 and Q11 of the questionnaire for the different license categories and it seems to be best to collect it as part of licensee annual returns. We note that AccessKenya was not reluctant to provide all the relevant revenue data, possibly because of its Initial Public Offer (IPO) plans.

In addition to the questionnaire, a second method was used to collect data on the historical development of Internet in Kenya. This was a roundtable discussion among experts. The agenda and the list of participants are presented in Annex 3. The objectives of the discussion was to construct the key drivers and challenges the Internet market development in Kenya in the last 5 years and to capture the lessons learned for each of the identified issues. The roundtable discussion lasted two hours. The outcome of the discussions was analyzed to enrich the historical development of Internet in Kenya and the factors that have hindered the development of Internet.

Finally, additional data was obtained from secondary sources. These sources included:

- Licenses of the various licensee categories
- Published reports, including ITU's annual telecommunications/ICT development reports, World Bank annual development reports, etc.
- Published cases of ICT development in various comparator countries
- Articles published on the Internet, especially on the history of Internet in Kenya
- Government of Kenya publications, including the Statistical Abstracts, Economic Reviews, etc.

3.2.2 Choice of Comparator Countries

One of the requirements of the study is to compare with other countries. We chose three dimensions as the bases of choosing the countries with which to compare Kenya. One was gross national income (GNI) per capita. We used the World Bank Classification (World Bank, 2007), which classifies countries as follows:

- Low-income countries (LIC) - Less than or equal to US$875
- Middle-income countries (MIC) - US$876 – US$10,725
  - Lower middle countries (LMC)
  - Upper middle countries (UMC)
- High-income countries (HIC) - Equal to or more than US$10,726

The second dimension was population. We were interested in countries that had comparable populations. The final dimension was ICT Opportunity Index (IOI). The IOI is the result of the merger of two well-known projects, ITU's Digital Access Index (DAI) and Orbicom's Digital Divide Index (DDI). It is a composite index of ten indicators that seek to measure access to and usage of ICT by individuals and households (ITU 2007). As per ITU 2007, countries are classified and ranked into low, medium, upper and high average depending on their computed IOI values using 2005 data as shown below:

- High average - IOI greater or equal to 249 (country ranks 1-29)
- Upper average - IOI between 150 – 248 (country ranks 30-57)
- Medium average - IOI between 68 – 149 (country ranks 58-120)
- Low average - IOI between 12 – 67 (country ranks 121-183)

The comparator countries as shown in table 3.6 below.

Table 3.6: Comparator countries

	Low income countries (LIC) <=$875	**Lower middle countries (LMC) $876 -**	**Upper middle countries (UMC) $ x– 10725**	**High-income countries (HIC) >$10,726**
Low Average ITU IOI	*Ghana (22m)* *Uganda (29m)* ***A***			
Medium Average ITU IOI		*Morocco (30m)* *Peru (28m)* ***B***		
Upper Average IOI			*Poland (38m)* ***C***	
High Average IOI				*S. Korea (48m)* ***D***

Source: ITU 2007 and World Bank 2007

The populations are shown in brackets. It is to be noted that we chose countries that we believe show the transitions Kenya must make; from level ***A*** to level ***B***, to level ***C*** and finally to level ***D***. The initial transitions from a low income country to a middle income country are in line with Kenya's Vision 2030.

3.2.3 Data Entry and Analysis

A relational database management system (RDBMS)[12] was used as a software development platform to develop a database system to facilitate data capture, storage and analysis. ORACLE is the RDBMS that was chosen because it is the corporate RDBMS platform for CCK. The database system developed consisted of the database, which is the repository for all the data collected and subsequently updated. The database was designed and implemented in ORACLE in line with the questionnaire. The structure of the database developed is shown in Annex 4. The database system also consisted of data entry forms. These were also designed and implemented in line with the questionnaire. The data entry forms were used to enter data into the database. Details how to enter data into the database are contained in a user manual of the database system developed that is submitted separately together with the database system.

The key steps that were followed in entering data into the database, verification of the data and analysis of the database were:

- **Checking of the questionnaires**. Netcom's project Team Leader checked each completed questionnaire for completeness and accuracy of the data. In situations where questionnaires did not capture the critical data required by the indicators or data was perceived to be incorrect, the respective questionnaires were given back to the Research Assistants for the necessary update. This process continued for two to three rounds until there was considerable degree of comfort that the data was correct. After this the questionnaires were passed on to the data entry staff.

- **Data capture and verification**. Data was captured using the data entry forms developed under the relational database management system platform. This data entry exercise was carried out by Netcom's ORACLE development staff and supervised by the most senior Research Assistant. The data entered was printed and compared with that in the questionnaires. Any errors in data entry were corrected. In situations where there was suspicion that the data may be incorrect, the key persons who provided the data were called on telephone to confirm. In some situations, it was necessary to make an additional visit to a licensee to collect missing or information that was perceived to be incorrect.

- **Data analysis**. Query utilities were developed and tested using the ORACLE relational database management system to compute the values of the indicators given in sub-section 3.1.5. The queries used to calculate the values of the indicators are outlined in Annex 5. Data analysis was conducted using these query utilities. The outputs of these queries were checked as the last step to ensure data accuracy and any suspicious pieces of data were confirmed with the licensees. This was repeated until there was confidence that the

[12] A relational database management system (RDBMS) is a platform used to develop computer-based database applications to meet specific user requirements. In this system, data is stored in a rectangular array of items in form of tables consisting of rows and columns that are related to each other (relational database tables) and that can be easily manipulated to produce reports as required by users. In any column the items are all of the same kind, whereas items in different columns need not to be of the same kind. Each item is a simple number of character string. Columns of a table are assigned distinct names. A row is often called a record, and represents a collection of related data values. Columns are also called fields.

queries were producing accurate data. Further data analysis was carried out by exporting the results of the queries to Excel and making any further computations as well as drawing the desired charts. Finally the queries were packaged as part of the database system to be handed over to CCK.

In addition to quantitative data analysis using, there was qualitative data analysis of the roundtable discussion and data obtained from secondary sources as explained in sub-section 3.2.1 above.

The draft final report was presented to the stakeholders for their inputs. A summary of the report was hosted on the CCK website for two weeks following the stakeholder workshop to give an opportunity to the stakeholders to give their inputs before the final report was produced. Comments were received from a number of operators and service providers. Responses to these comments were given through CCK and are attached to this report as Annex 6.

4. Overview of Historical Development of Internet in Kenya

4.1 Overview of Global Historical Trends in Internet Development

The Internet origin and growth started in the USA and was nurtured through research during the period 1968 -1990. Funding was provided by the government (through DARPA). In the 1970s there were substantial developments in architecture and technology as well as progressive growth in number of computers and traffic in the interconnection network. In the 1980s the Internet infrastructure became well established and rapid growth occurred. During this time, research ad university communities in several countries (mainly Europe) established full TCP/IP connections with Internet nodes in the USA making the Internet international at these early stages. It is imperative to note that Universities and research institutions were the innovators and early adopters of the Internet. This was the case in other countries such as Singapore, Australia, South Korea and many other countries.

In most of the developed economies, the connection of commercial enterprises to the Internet started in the late 1980s where as the real take off of commercial Internet access was first offered in the early 1990. In the USA, a major boast to the adoption of the Internet took place in 1993 when the Clinton administration launched the National Information Infrastructure (NII) initiative. This was a major boast to the migration of Internet from the academic and research domain to the public and private sectors. It also reorganized the business model which hitherto had relied on research funding and grants for development and sustainability.

This shift called for a change in the use policies of the network to allow for more liberal usage which could attract paying users and allow fro business enterprises to thrive. For instant in 1994 (one year latter), there were 3 corporations in the USA providing backbone services. By mid 1995, there were 12 providers.

Entrepreneurs in the form of returning students to the African continent were among the pioneers of Internet services in most countries during the period 1992 - 1995. This was the case in Kenya and Ghana where the major Internet breakthroughs were in the form of commercial setups (Africa Online, NCS, etc respectively).

Table 4.1: Trend of the Internet Growth in the 1990s

Year	Major Event
1969	The US government through the National Science Foundation Commissions DARPA (Defense Advanced Research Project Agency) to build a computer network that could survive a nuclear attack. This is the precursor to the present day Internet
1990	First commercial Internet Dial-Up Access launched
1991	World Wide Web developed at CERN – Switzerland
1993	Media & Businesses take notice of Internet

Year	Major Event
1995	▪ The Internet declared the fastest ever growing medium in world, acquiring over 50Million users in less than 5 years. (The radio took 38 years) ▪ The US government stops funding development of the Internet declaring it self sustaining and commercially viable. ▪ The Vatican goes on-line: www.vatican.va ▪ Success is claimed in carrying voice "free" over the Internet causing concern over the future of Telco's voice business. ▪ KPTC forms a team to study and advice on the way forward in the wake of this "new Internet Phenomena".
April 1995	ITU Symposium on Telematics is held in Addis-Ababa. World Bank, USAID among other donors state that funding for building the Internet were readily available from the donor community

4.2 Internet in Kenya in the 1990s

4.2.1 Chronology of Events

Internet was introduced in Kenya in the early 1990s. By 1992, only e-mail was available. As with many other African states, Internet development in Kenya was primarily led by Kenyans returning from overseas studies, Western ex-patriots, and IGO and NGO personnel. Individuals in these groups had been exposed to Internet, and upon their return or arrival in Kenya demanded Internet access. The only means of accessing the Internet then was through a service known as Gopher which offered access to text based information. The access then was through either international leased lines or through X.25 connection to ITUs TIES (Mweu, 2000).

As early as 1992, email services were used by a few enthusiasts in Kenya. NGOs and IGOs who were in need of establishing communication with their counterparts elsewhere were among the early adopters of Internet. These also included services offered by HealthNet, email services for the staff of Institute of Computer Science at the University of Nairobi, as well as ARCC13 email services based on dialup connection to FIDOnet. In October 1995, ARCC established the first full Internet services connection in Kenya. Soon after (1995-1996) a number of commercial ISPs led by FormNet and Africa Online entered the market with an array of dialup access and leased circuits offerings. One of the most lucrative businesses for FormNet then was to sell modems for dial-up, then retailing at Ksh 24,000, as per the roundtable discussions. If one adds this to the cost of PC, then the end-user equipment was very pricy.

Soon competition increased with the entry of three other ISPs. The commercial operators leased analogue and/or digital data links to the USA and UK to access the Internet backbone. Local dedicated lines were predominantly analogue lines leased ranging in capacity from 28.8 Kbps to 64Kbps mainly. The high costs of services to the providers from the incumbent monopoly constituted a major expense. The same high costs were passed to the consumers. This acted as the major deterrent for the uptake of Internet services by the larger populace and the inherent perception of the service as being for the elite. The notable early adopters included

[13] Africa Regional Center for Computing (ARCC) an NGO focused in development and provision of ICT services, http://www.arcc.org

import/export sector, industries which had overseas operations and clients and the academic sector (mainly University of Nairobi and USIU, who could afford). Most of these users were confined to Nairobi.

From the roundtable discussion of experts, it was clear that the target for the first commercial ISPs was to reach everyone with a PC. However, Africa Online had a vision to reach everyone and achieve similar levels of Internet penetration as the economically developed countries. For example, through its e-touch centre concept, Africa Online wanted to attain at least one million Internet users in ten years, on average the figure doubling every six years. Other later entrants like Wananchi Online, wanted to have everyone ("mwana nchi") connected. The key limiting factor was then the communications infrastructure, the limited penetration of PCs (less than 2,000 PCs by 1995/96), and the high cost of end-user equipment.

Africa Online established e-touch centers in partnership with commercial bureaus. Africa Online would give the bureaus a subdomain where they were able to create accounts for their customers. In the e-touch centers a variety of services were offered such as e-mail, Internet, fax, photocopying, printing and telecommunication services.

In order to get an insight into what was happening in the early to mid-1990s, table 4.1 below is an overview of Africa Online's e-touch concept (Ochola, 2000), the pre-cursor to the present day cyber cafes.

Table 4.2: An Overview of Africa Online's e-touch centre concept

Issue	**Details**
Target audience profile	They have a need to communicate with friends and family They may or may not know about e-mail and the internet They do not have access to a personal computer Not satisfied with existing communication options, including postal option
Primary target audience	Male and Female Ages 25 - 40 Urban national who lives in a township High school education and possibly some college education Self-employed
Secondary target audience	High School and college students 16 – 30 years
Tariffs	Opening e-mail address – no charge Sending one email – Ksh30 (later was Ksh50) Checking if you have an email – no charge Reading or receiving an email – Ksh10 Browsing the web – Ksh10 per minute (was earlier Ksh7 per minute)
Potential users (opportunity)	20 million users on the continent within next ten years
Target Internet users	350,000 by the end of 2000

Source: Strategies for Success in the E-Commerce Age: Case Study - Africa Online e-touch®, Ochola, 2000

By 2000, of the 261 e-touch centres, about 130 were based in Nairobi and its surroundings while the others were widely distributed in the major towns. The rural e-touch centres were few and far between and those that are there catered largely for tourists who needed to keep in touch with their home countries. There were about 30,000 e-touch users by 2000.

When the first commercial Internet services were offered they were met with mostly negative perception from those unfamiliar with the Internet. At the time, in 1995, international Internet media reportage focused on stories about pornography, dangerous chat-rooms, and radical and sometimes illegal political movements all over the world. This drew the concern of Kenyan policy makers who, like their Western counterparts, were understandably concerned about these deleterious uses as well as the potential for criminal applications. To counter this perception Internet access was made available to journalist for educational purposes. This tactic seemed to have been successful in bringing attention to and publicizing the many positive aspects of the Internet (CIDCM, 1998).

A chronology of significant milestones in the Kenyan Internet development in the 1990s is summarized in table 4.3 below (CIDCM, 1998):

Table 4.3: Chronology of events in the 1990s

1990 – 1994	1995
▪ 1990 Health net covers Uganda, Tanzania, Zambia, Zimbabwe and Kenya ▪ 1990-91 LEO technology applied ▪ 1992 duty on computers are reduced ▪ 1992 HealthNet ▪ 1992 Staff at Institute of Computer Science have e-mail access ▪ 1992-93 ARCC e-mail Fidonet ▪ 1993 Internet access is available ▪ 1994 Africa On Line founded	▪ 1995 Internet service unreliable ▪ 1995 ARCC inaugurates Internet access- with about 100 accounts ▪ 1995 East African Internet Association formed. ▪ 1995 ARCC receives funding from ODA for international dedicated line to provide Internet Services on a commercial basis. ▪ 1995 Form Net Africa founded and launches local bulletin board, and store and forward Internet e-mail service ▪ 1995 KPTC announces contract for building a Kenyan Internet Backbone
1996	**1997**
▪ 1996 local phone rates reduced ▪ 1996 April 64 Kbps link on-line ▪ 1996 reliable Internet service ▪ 1996 Africa On Line and Form Net come on line with full Internet services ▪ 1996 EAIA forms Kenya Internet Services Ltd (KISL) to provide a hub for low cost shared access for ISPs and NGOs ▪ 1996 KPTC publishes REP for provisioning a Kenya Internet Backbone to service approximately 40 ISPs and 50,000 users	▪ 1997 early 10,000 users ▪ 1997 University of Nairobi Students acquire e-mail access ▪ 1997 May number of smaller ISPs come on-line ▪ 1997 Indications are that the KPTC Internet Backbone order will soon be awarded ▪ 1997 late 15,000 to 50,000 users

Source: Centre for International Development & Conflict Management (CIDCM), 1998

From the roundtable discussions, one of the key events in the late 1990s was the assembly and release into the market of at least 100 PCs per month by Diamond Systems, a local IT firm. This number of PCs helped in the uptake of Internet.

The Kenya Posts & Telecommunication Corporation (KPTC) was the monopoly of provision of telecommunication infrastructure within the country as well as international circuits. The corporation also carried out regulatory functions which included licensing of entrants (ISPs), frequency spectrum management, etc. This made it difficult for the commercial services providers to operate freely without some hindrances from the incumbent who did not have capacity to regulate as well as enter the market as a player. The need for an Internet backbone

access locally became eminent with the increased demand for bandwidth and in December 1998, KPTC launched the East Africa Internet eXchange (EAFIX)[14] together with it Jambonet15 (Mweu, 2000). This led to lowering of costs for ISP operations and an increase in the number of ISPs active in the market. Competition resulted in slightly better prices for the end users.

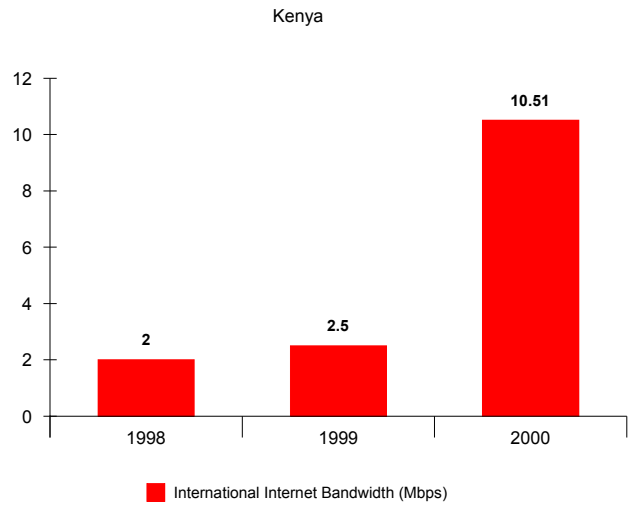
The international bandwidth available at EAFIX comprised of 3 routes as follows:

- Teleglobe 2Mbps bi-directional
- BT 512Kbps bi-directional
- USEI 2Mbps upstream and 8Mbps downstream

The total International Internet bandwidth had remained about 2Mbps in the 1990s but by 2000 it had grown to 10.5 Mbps as shown in figure 4.1

Between 1998 and 2000, the monthly cost of leasing a 64 Kbps link decreased from a high of $12,500 to $4,500. At the same time, many cyber cafes mushroomed all over the main towns and competition among the service providers was evident.

Figure 4.1: International Internet bandwidth for Kenya (Mbps)



Source: ITU

In July 1999 the government officially liberalized the telecommunications market in Kenya. The Communication Commission of Kenya (CCK) was formed to regulate the sector. The ISPs which had never been officially acknowledged, were now authorized to operate after obtaining a license from CCK. However, Telkom Kenya, formed from the telecommunications arm of the former KPTC, was allowed a monopoly to operate an Internet backbone for five years, until 2004. With the liberalization, the number of ISPs grown to 31, with 20 more awaiting licensing (Mweu, 2000).

[14] The aim of KPTC in establishing EAFIX was to serve the whole of the East Africa region.
[15] Jambonet is the Internet backbone in Kenya which offers access PoPs in several towns countrywide

4.2.2 Challenges in the 1990s

The key challenges in the 1990s were:

- **High cost of Internet usage**. This included significant resource expenditures on both computer hardware and ISP connectivity. While the 1992 tariff reduction on computer hardware had an important impact on reducing the cost of computers, computers still represented a significant investment. For the cost of Internet connectivity a 32kbps leased line cost about US$1,500 (over Ksh100,000!) per month. Individual access accounts ranged from $5 to $8 per hour (off peak/peak) (or Ksh6 – Ksh10 per minute) to $125 (or Ksh9,300) per month for "unlimited use". One of the interesting revelations from the roundtable discussions was that Africa Online started a dial-up at Ksh500 but had to increase it over time to over ten times because of the costs of the challenges they faced as an ISP.
- **Limited penetration of PCs**. The number of PCs were too few. Often these computers were donated and too slow (e.g. 286 and 386 or slower) to be useful for Internet applications.
- **Inadequate local fixed line infrastructure**. There were not enough phone lines into ISPs - dial in expansion potential was limited. An ISP could request KPTC to provide a block of lines to expand dial-up services but in most situations, these lines were not available. In addition, most ISPs were in Nairobi, largely due to lack of Internet POPs in the other parts of the country.
- **Low disposable incomes**. For example, 3 hours of browsing (Ksh1200 - Ksh1,800) was the average monthly income for most rural Kenyans. This left Internet services for a few young, educated and urban elite.
- **Poor quality infrastructure**
- **Policy and Regulatory environment**. There was no regulator and communications infrastructure was owned by a monopoly. In addition, the roundtable discussion established that there was a lot of mistrust between the ISPs and the monopoly operator, Telkom Kenya. The roundtable discussion also established that there were initially widespread fears about what the Internet could do, especially from a security standpoint. This was expected, especially in the earlier years of one party rule. The generally accepted view in most government circles was that Internet “must be controlled”, according to the roundtable discussions.
- **Duties and taxes**. The total duties (customs and excise duties and VAT) on communication equipment and computers were very high.
- **Human resources**. There were no well trained personnel that the ISPs could employ and be productive immediately. ISPs had to invest in training before the personnel could be productive.

4.3 Internet in Kenya in 2000 - 2006

4.3.1 Trends

During the exclusivity period, Telkom developed and expanded a national backbone. The coverage area was limited to the main urban centers and for a long time availability, reliability and quality of the services provided was way below average. During this period, the Internet market in Kenya witnessed rapid expansions and the user base grew to over 500,000 users. Most players in this sector feel that the incumbent would have fostered much higher growth and adoption of Internet services if more resources had been put into the connectivity access infrastructure. Lack of resources and a bloated workforce at Telkom are blamed for the institution's poor response to the opportunity which existed to exploit Internet services based revenues during the monopoly period.

On average the cost of full unlimited dial up Internet account per month was Ksh5,000 plus VAT per month in the year 2000 plus the telecom usage charge. This has now reduced to a cost of Ksh1,000 plus VAT per month. With access from a cyber café, this cost has reduced from Kshs 5.00-10.00 per minute in 2000 to the current cost of between Ksh0.50-1.00 per minute[16]. This reduction in consumer tariffs has improved access to many low income earners.

By 2005, Telkom Kenya revised its domestic leased line tariffs (bought by ISPs and corporate organizations that were allowed connect directly to Jambonet like ISPs, e.g. Universities) through its Jambo Telkom subsidiary. Prior to the revisions, the tariffs had been constant from year 2000. The Kenstream charges (dedicated point-to-point domestic links) remained the same until July 2006 when Telkom reduced them by 50% as shown in table 4.4 below. This reduction can be associated with competition in provision of domestic leased lines following the licensing of several Public Data Network Operators (Waema, 2006). Telkom Kenya was forced to reduce its tariffs as it was losing market share to the new entrants. The other PDNOs followed suit and reduced their domestic leased line tariffs.

Table 4.4: Key trends from 2000/2001 to 2005/2006

	2000/01	2001/02	2002/03	2003/04	2004/05	*2005/06*
Number of licensed ISPs	34	66	72	76	78	*51*
Internet Users	100,000	200,000	400,000	1,000,000	1,054,920	*2,770,296 (Internet study)*
TKL's 64 Kbps leased line tariffs	14,400	14,400	14,400	14,400	14,400	*7,200*
TKL's 2 Mbps leased line tariffs	*96,477*	*81,457*	*81,457*	*81,457*	*81,457*	*40,728.5*

Sources: ITU World Telecommunications database 2006, Telkom Kenya, CCK Internet Market Study

The trends in Internet in Kenya in the last five years are summarized in table 4.4 above. As can be observed, ITU's estimates of the number of users shows that there was no growth from 2003/04 to 2004/05. Although it not clear how these estimates were done, it is still reasonable to

[16] These reductions in Internet costs to the end-user have nothing to do with the supply side, which was the subject of this study.

maintain that the number of Internet users has not grown appreciably, for example, in comparison to the mobile telephone users. It can also be observed from the above table that number of licensed ISPs has been very high, with a significant proportion being non-operational. For example, this study found that out of the 51 licensed operators, only 39 (76%) were operational. One notable trend in table 4.4 is the sharp reduction in the number of licensed ISPs between 2004/05 to 2005/06. During this period, the number reduced by more than a third (34.6%). This reduction can be explained as follows. In January 2006, the ISP licenses were modified to permit VoIP services. Before the modified licenses could be issued, all licensed ISPs were required to make their outstanding statistical returns to CCK. Those ISPs that did not meet the requirements were deregistered through a gazette notice. According to the Kenya Gazette Notice dated 6th October, 2006, CCK revoked the licenses of 30 ISPs.

Until 2005, only ISPs could offer Internet services. However, the situation has changed since CCK issued a new licensing framework in late 2004 after the TKL's monopoly came to an end in June 2004. For example, two Internet Backbone Gateway Operators were licensed in December 2004 and Telkom Kenya, through its subsidiary Jambo Telkom, moved into the Internet market in 2005/2006. Mobile companies Safaricom and Celtel can now offer mobile Internet services in the form of GPRS and EDGE (Waema, 2006). All one needs now is a GPRS-enabled mobile phone. This study established that mobile operators had over 200,000 mobile Internet customers, more than the total number of fixed dial-up customers.

Since the end of Telkom's monopoly in 2004, Kenya has lost several opportunities that in all likelihood would have led to increased growth in the Internet market. One of these opportunities was the planned licensing of a Second National Operator (SNO) to compete with Telkom Kenya. This failed in 2004 and has continued to fail since then for different reasons. The second opportunity that was lost was the planned privatization of a majority stake in Telkom. This was postponed to 2006 and is still outstanding. Given that the mobile operators have become major players in Internet access provision, the failure to license the country's third mobile operator represents the third missed opportunity.

On the positive side, the key successes during this period have been:

- the lifting of the ban on VoIP;
- Telkom Kenya's monopoly in the provision of Internet backbone and international bandwidth services expired, with the entry of new operators leading to reductions and improved quality of services; and
- enormous growth in the mobile telephony sector.

4.3.2 Challenges

From the roundtable discussion, the key challenges in the last five years or are:

- **Cost of Internet services**. The cost of Internet services is still too high, in comparison to the income levels of Kenyans. This will be illustrated in Section 7.
- **Local content**. The Internet is dominated by foreign content. If we are to experience increased usage of Internet, then Kenya needs to tremendously increase its amount of

relevant local electronic content. Internet growth can be further fueled by growth in e-government as well as e-commerce services.

- **Narrow focus of ISPs**. ISPs have focused on primarily re-selling bandwidth with very little value addition. It is necessary to re-orient the business focus of ISPs to services to the customers.
- **Regulatory and licensing framework**. The licensing framework is not in line with convergence of technologies. In addition, the regulator has not been sufficiently driven by competition, market and commercial issues.
- **Interconnection**. Interconnection processes take long (some cases have taken more than one year), and often business opportunities are lost.
- **Business environment**. The business environment, especially the independence of the regulator, has not been predictable. Investors are looking for a more stable, consistent and predictable business environment.
- **Local access network**. The last mile connectivity has been a problem and has hindered the growth of the market. It is possible that the mobile operators will dominate the Internet market given that they do not have local access network problems.

4.4 Summary

As a summary, the factors that have influenced growth of Internet in Kenya (both positively and negatively) are outlined in table 4.5 below.

Table 4.5: The factors that have influenced growth of the Internet

Factor	Positive factor details	Negative factor details	Year of action/comments
Early adopters of Internet	Public, academic and research sectors		1992 -1993
Enabling regulatory and licensing environment	▪ Creation of a regulator ▪ Liberalization ▪ Onset of competition ▪ Lifting of the ban on VoIP ▪ Licensing of new PDNOs and IBGOs		▪ 1999 ▪ 1999 ▪ 2005 ▪ 2005 ▪ 2006
Enabling legal and policy environment	▪ Communications Bill ▪ ICT policy ▪ ICT Bill		▪ 1998 ▪ 2006 ▪ In progress
Incumbent		▪ Weak incumbent – e.g. inadequate and poor quality infrastructure	▪ Throughout
ISPs		▪ Focus on access issues rather than services and applications	▪ Lack of innovative competing strategies (rely on churn)
Connectivity infrastructure		▪ Limited local access infrastructure ▪ Limited geographical diffusion of Internet POPs ▪ No collocation and sharing policies in	

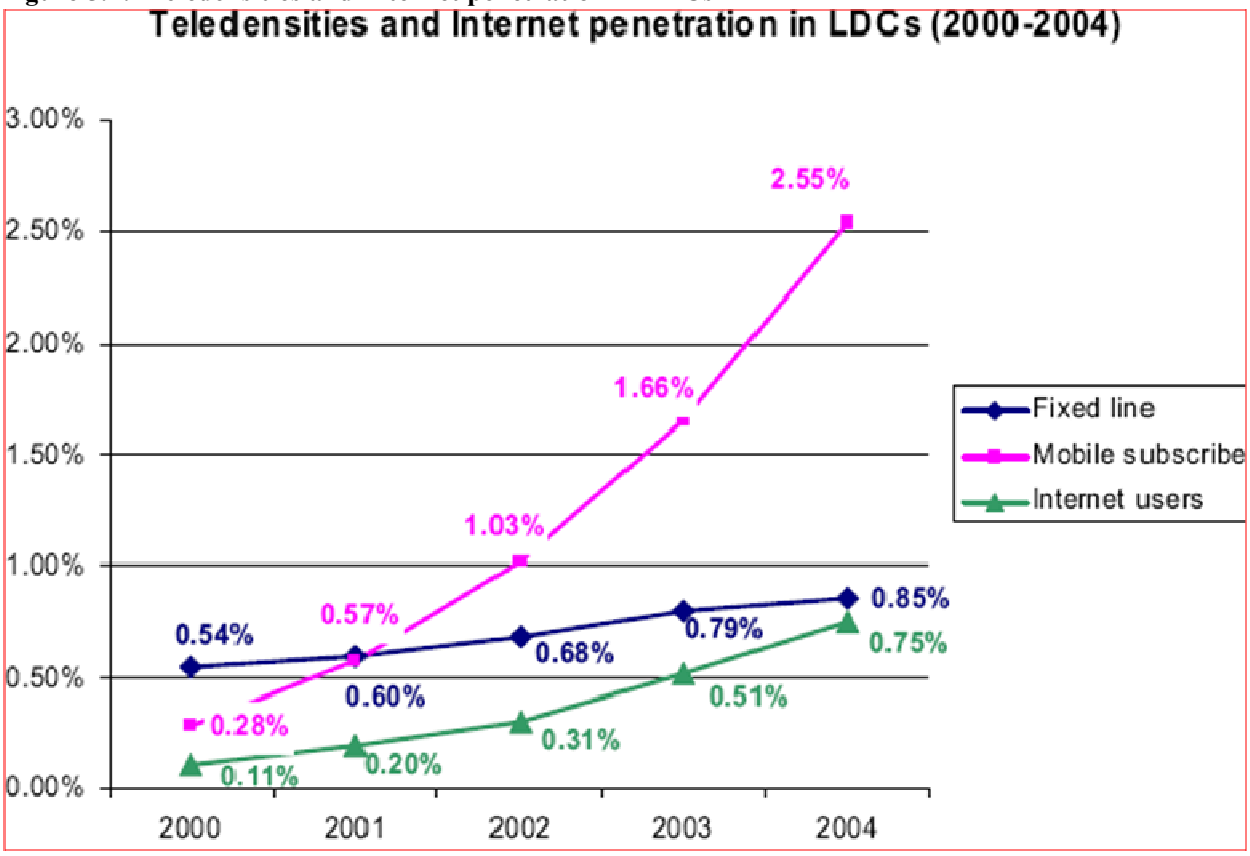
Factor	Positive factor details	Negative factor details	Year of action/comments
		place	
Tariffs		▪ High Internet tariffs	
PCs		▪ Low penetration ▪ High cost	
Collaboration of stakeholders	▪ Creation of KIXP ▪ Creation of ccTLD (KENIC)		▪ Created due to similar challenges faced by service providers
High speed National backbone		▪ Does not exist	▪ A national infrastructure initiative is currently being planned
UA/US strategy	▪ UA/US strategy implementation in progress		▪ 2005 (strategy in place)
Cyber cafes	▪ Provide Internet services for people without fixed phone lines, computers, or electricity ▪ Tariffs are relatively affordable		▪ Early 1990s with Africa Online e-touch centres & have mushroomed
Mobile operations	▪ High growth of mobile Internet		▪ 2005/2006 (Mobile Internet speeds are limited)
E-commerce		▪ Legislation lacking ▪ Payment systems inadequate	
Local content		▪ Dominance of foreign content	

5. Network Infrastructure

5.1 Fixed and Mobile Teledensities and Internet Penetration

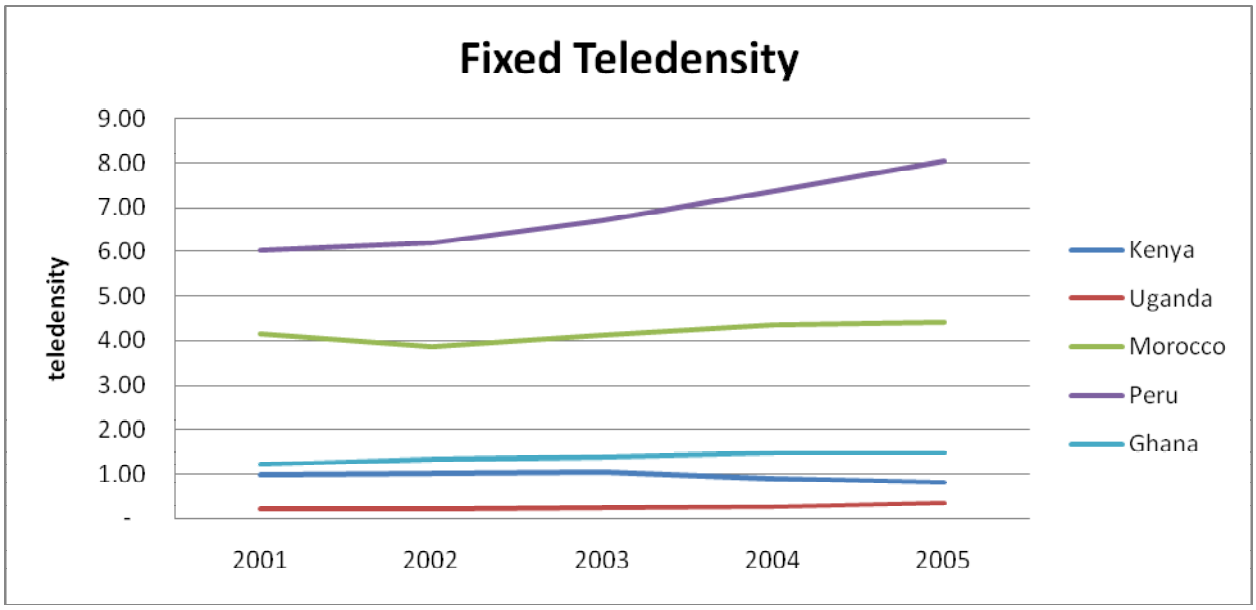
In most countries, Kenya included, fixed telephone lines formed the platform upon which Internet services were developed, as shown in figure 5.1 for least developed countries (LDCs). Dial-up connectivity and analog leased lines were the initial set of Internet access services offered. That is, the fixed line teledensity influenced the adoption and growth of the Internet users. However, fixed digital leased lines later became the dominant mode of providing permanent internet connections to organizations. For example, in Morocco the incumbent telecommunications operator Maroc Telecom leveraged on the existing last mile copper cable infrastructure to deliver Asymmetric Digital Subscriber Lines (ADSL) broadband and permanent Internet services widely at an early stage. In comparison Telkom Kenya, the incumbent in Kenya, introduced such value-additions late in 2004 and in very limited capacities. This was despite the fact that Kenya had a comparatively lower fixed line teledensity of 1% as shown in Figure 5.2. Thus, unlike Morocco, the combination of lower teledensity and introduction digital lines (e.g., ADSL or ISDN) resulted in much lower penetration of Internet services in Kenya.

Figure 5.1: Teledensities and Internet penetration in LDCs



Source: ITU World Telecommunications Database 2006

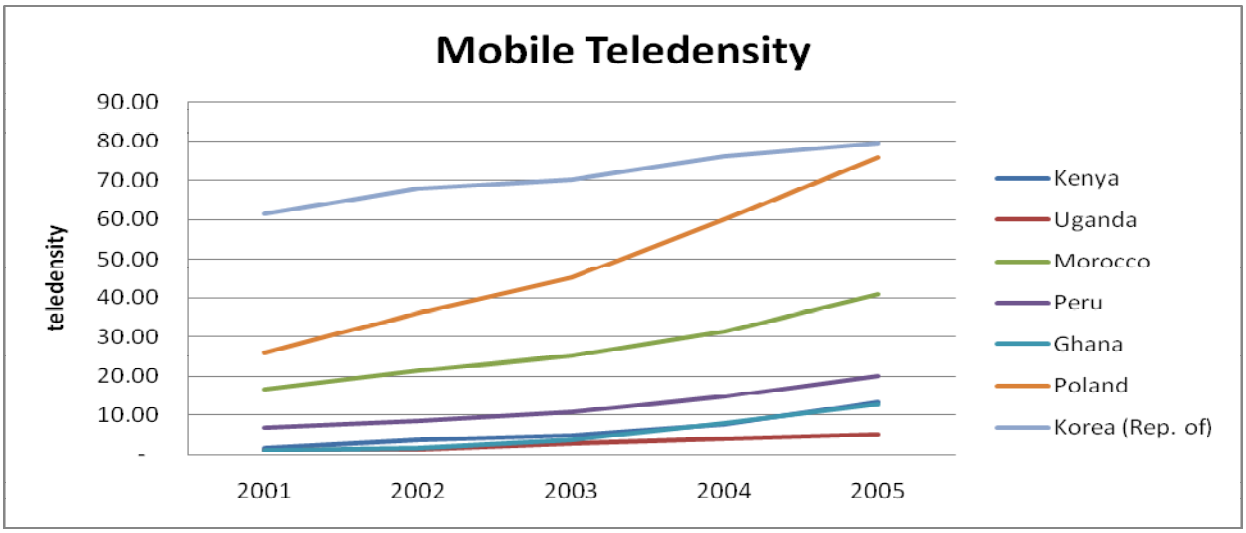
Figure 5.2: Fixed line teledensities comparisons (omitted Poland and Korea as their values were high)



Source: ITU World Telecommunications Database 2006

Kenya liberalized its telecommunications sector in 1999 after the Kenya Communication Act 1998 became operational. Two mobile operators, Safaricom and Celtel, were licensed and continue to operate as a duopoly. The mobile sector in Kenya has experienced tremendous growth as shown in Figure 5.3. The figure shows that the growth has been especially high in the last two years. However, the current mobile teledensity of Kenya of 20% is still half that of Morocco (40%) and one-third that of Poland (60%). Dial-up mobile Internet services were introduced by Kencel (now Celtel) in early 2001 but were expensive because of the per-minute mobile charges. In the period 2005-2006, the mobile operators introduced Mobile Internet services using GPRS and EDGE technologies and with flat volume-based pricing. This has increased the number of Mobile Internet customers to over 250,000 in the last one year. This number is higher the total number of fixed dial-up Internet customers. It is likely, that the growth of Internet services in Kenya will follow the growth of Mobile telephone services.

Figure 5.3: Mobile teledensities with comparator countries

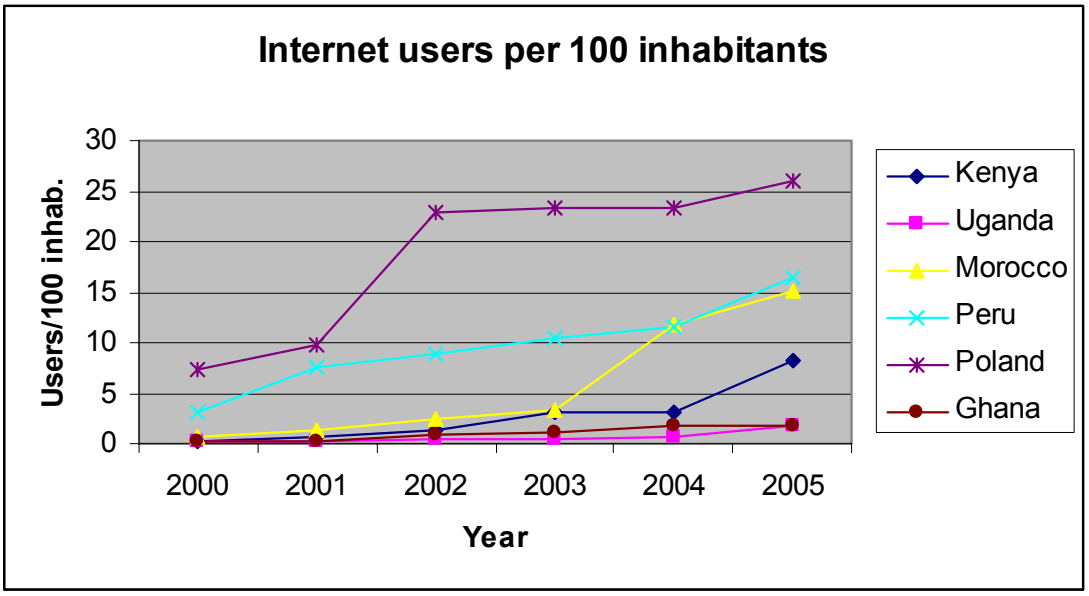


Source: ITU World Telecommunications Database 2006

5.2 Internet Users

In most of the countries considered for comparison, the number of Internet users in the 1900s to early 2000 was at comparable levels (see figure 5.4). As the development of Internet progressed, some of the countries like Morocco registered phenomenal growth in the number of Internet users after the year 2003 as shown in figure 5.4. This can be traced to some deliberate actions and strategies undertaken by the respective countries towards increased access and deployment of Internet services.

Figure 5.4: Comparison of Internet users per 100 inhabitants

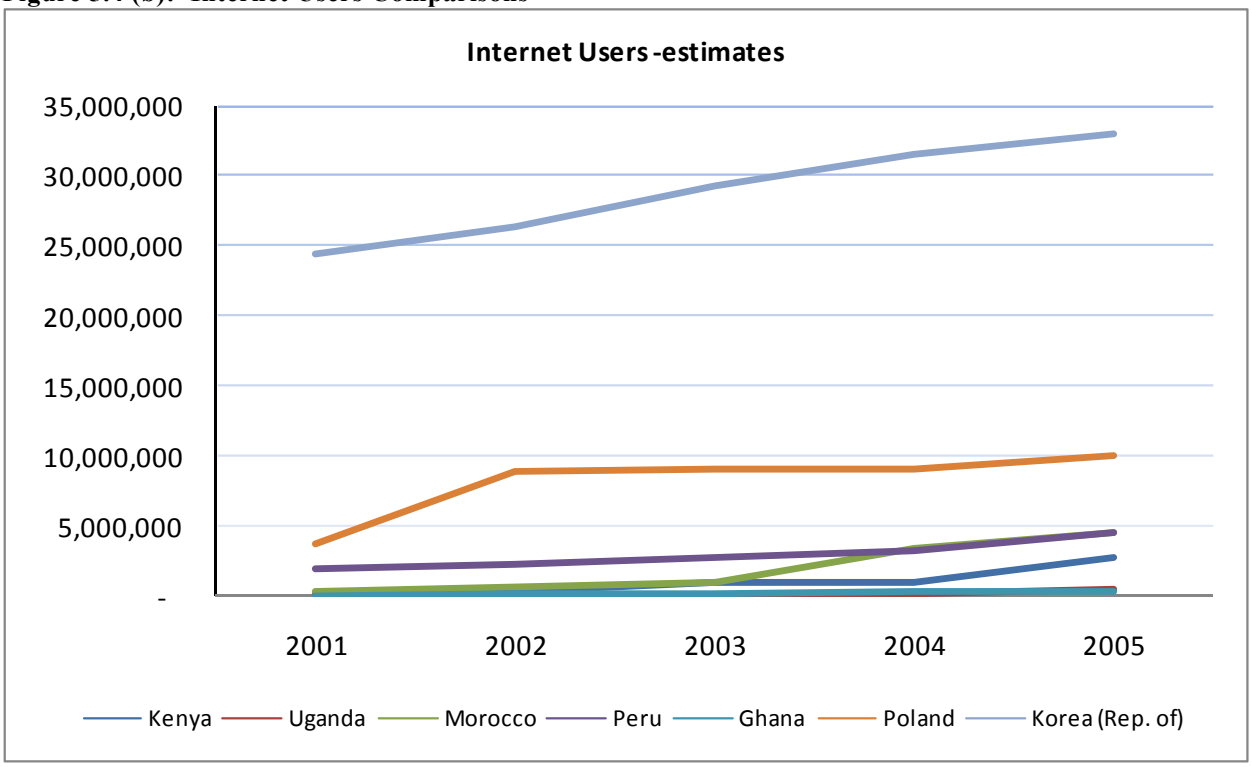


Source: ITU database and Internet Analysis Study (for 2005/2006 value for Kenya)

For example, in a bid to implement its National Economic Growth vision, the Government of Morocco invested started investing heavily in ICT infrastructure in 2004. This was mainly to support the business process outsourcing (BPO) industry that the government had identified as a strategic economic sector. The government developed a national broadband infrastructure and established BPO parks in different cities in Morocco. In addition, the government subsidized international Internet bandwidth for BPOs and educational and research institutions (McKinskey Quarterly Report, 2004).

Another example is the Republic of Korea. Early introduction of competition through liberalization in early 1980s led to fierce competition among the operators and the new entrants were forced to innovatively target the un-served market rather than compete for the existing users. Broadband Internet services provided the best growth option for the new entrants. This led to deployment of competitive and reliable technologies as well as lower prices to the end users. The government of Korea also played a key role in stimulating demand by engaging in Internet literacy program in early 2000. This program cut across a number of sectors and targeted 10 million people. It was fairly successful with over 3.4 million people having been trained by the end of 2000 (Ministry of Information and Communication, Korea, 2000).

Figure 5.4 (b): Internet Users Comparisons

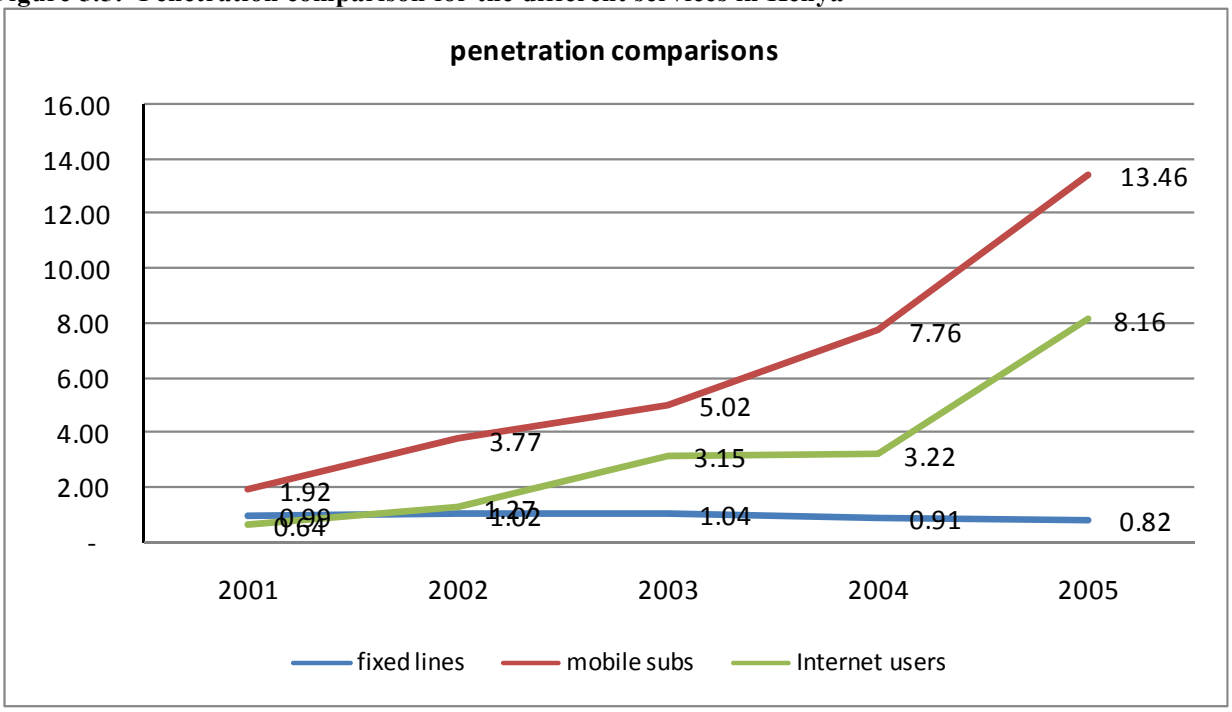


Source: ITU 2006 report (and Internet Market Survey 2006 for data relating to Kenya)

Thus, the combination of liberalization and promotion of Internet services in the different comparator countries have resulted in dramatic increase in the number of Internet in the past two years as shown in figure 5.4. Kenya could also experience similar dramatic increase in Internet users if the current growth of fixed and mobile networks is sustained. For example, we expect that Internet penetration in Kenya will track the growth and penetration of the mobile network as

shown in Figure 5.5. Our data shows that the mobile Internet customers from zero to over 250,000 in the year 2006 only. In addition, the mobile network infrastructure could be used to provide fixed Internet services in all areas covered by the mobile network. This is a major opportunity for the growth of Internet in Kenya. Later in this report, we recommend that mobile operators be allowed to provide leased line Internet services to end-users and ISPs.

Figure 5.5: Penetration comparison for the different services in Kenya



Source: ITU database and Internet Market Survey 2006 for Internet users in the last year

5.3 International Internet Bandwidth

All International Internet bandwidth in Kenya is satellite-based because Kenya does not have an undersea optical fiber connection to the global Internet. Satellite Internet bandwidth costs per month in Kenya are on average about US $2,100 per Mb/s. This is a high Internet bandwidth cost when compared to the minimum satellite bandwidth cost in Kenya of only US $625 per Mb/s and under US$ 500 per Mb/s per month possible with an undersea optical fiber (Kenya does not yet have an undersea optical fiber connection to the global Internet). Consequently, Internet gateway operators use asymmetrical configurations to reduce the total cost of international Internet bandwidth. The ratio of uplink to downlink bandwidth is about 1:6. Moreover, operators purchase bandwidth in only small quantities (total 100 Mb/s in 2005) because of the relatively high cost. Although this study did not address quality of service (requires Internet users survey), it is clear that the speed and quality of Internet services in Kenya is low.

The total gateway bandwidth in Kenya has grown progressively to a total of 758.59 Mbps as at 2005/2006 as shown in table 5.1. It is to be noted that this bandwidth has increased tremendously since the end of TKL's exclusivity period, doubling in 2004/2005 and more than doubling in 2005/2006 from the previous year.

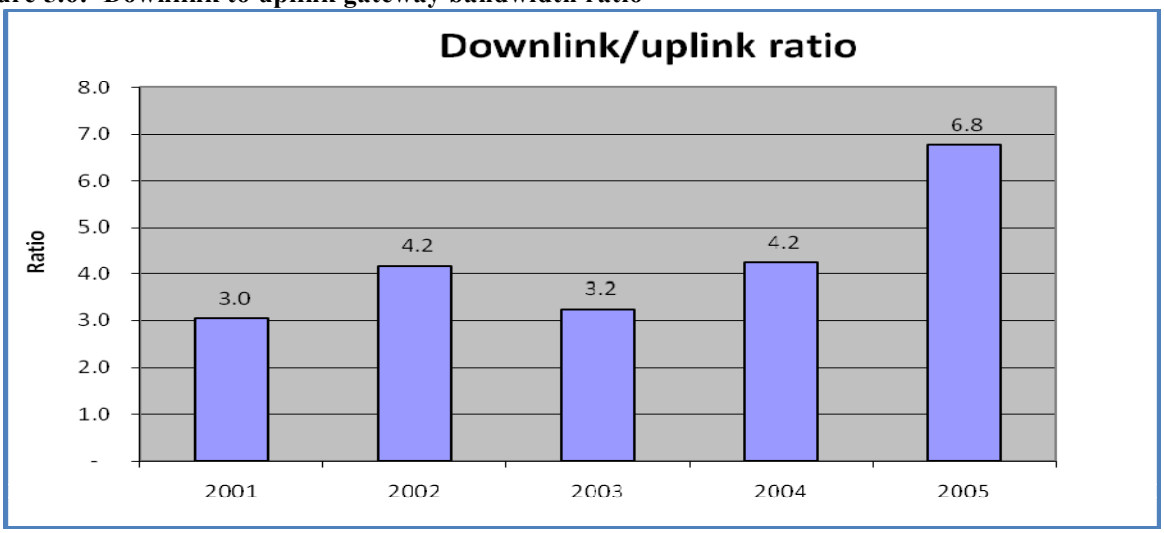
Table 5.1: International gateway bandwidth

	2001/02	2002/03	2003/04	2004/05	2005/06
International gateway downlink bandwidth (Mbps)	62.24	102.32	84.91	180.75	660.83
International gateway downlink bandwidth per inhabitant (bps)	2.06	3.33	2.70	5.64	20.26
International gateway uplink bandwidth (Mbps)	20.51	24.61	26.20	42.63	97.77
International gateway total bandwidth (Mbps)	82.75	126.92	111.10	223.38	758.59
Ratio of downlink to uplink bandwidth	3.03	4.16	3.24	4.24	6.76

Source: Internet Analysis Study

The asymmetrical configuration is skewed in favor of downlink bandwidth. The ratio of downlink to uplink bandwidth remained fairly constant at about 1:4 during TKL's monopoly period and increased to about 1:7 in 2005/2006 as shown in figure 5.6. Thus, although IBGO and CVO licensees are purchasing higher bandwidth in total, the asymmetry is increasing. The asymmetry could be an indication of high dependence on off shore hosted content (see figure 5.6) and/or poor quality of Internet services. The baseline survey of Internet users recommended later in this report would measure the local content and quality of service indicators as a result of the high asymmetric of the bandwidth configurations.

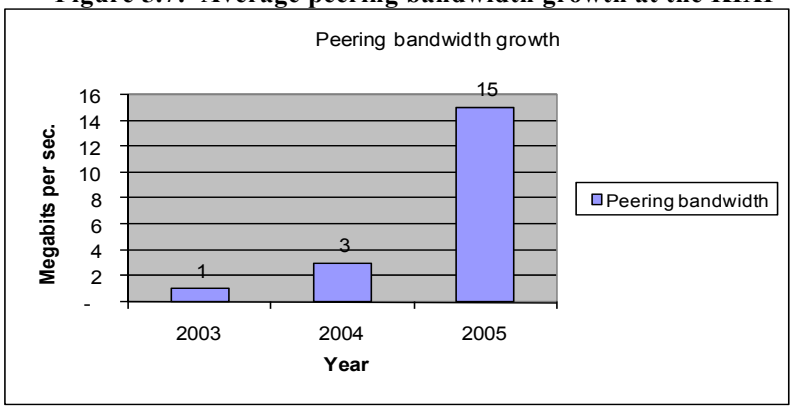
Figure 5.6: Downlink to uplink gateway bandwidth ratio



Source: Internet Analysis Study

In the recent past, there has been discernible increase in local traffic as measured at the Kenya Internet Exchange Point (KIXP) as shown in figure 5.7.

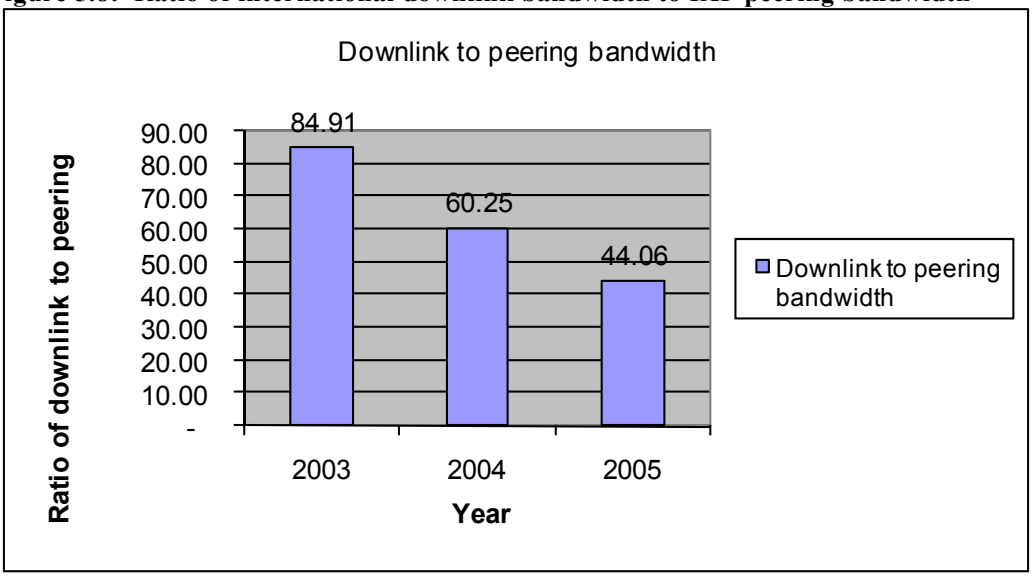
Figure 5.7: Average peering bandwidth growth at the KIXP



Source: Internet Analysis Study

Although the ratio of downlink to peering bandwidth has been decreasing as shown in figure 5.8, the current ratio of 44 is still very high. A low ratio of International bandwidth to KIXP leased line capacity (or peering bandwidth) would reduce the impact of high international bandwidth prices on Kenyan Internet services. This is because leased lines are considerably cheaper than international bandwidth as will be explained in Section 7.

Figure 5.8: Ratio of international downlink bandwidth to IXP peering bandwidth



Source: Internet Analysis Study

Despite the growth in International bandwidth in Kenya in the year 2005/2006, the total amount is still very small in comparison to comparator countries. This means it is difficult to compete with counties like Morocco in the call center or BPO business opportunities. The current national optical fiber and undersea optical fiber connections will increase total bandwidth and the competitiveness of Kenya as a destination for BPO.

5.4 Analysis of the Internet Market Segments in Kenya

The Internet market structure has a layered structure with two distinct service layers;

- the access infrastructure layer – comprising of the gateway and local loop components
- the services or applications layer – comprising of value-added and content offerings.

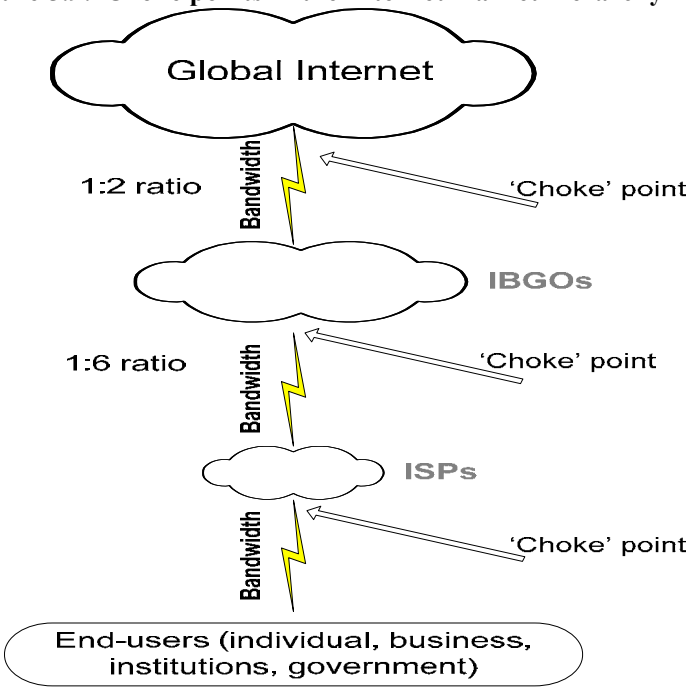
The access layer licensee consists of the IBGO, CVOs and PDNOs and ISPs who deliver Internet services to the end users. This structure has two cost streams, namely, the local loop charge and the Internet components. Any inefficiencies at either of these levels impact directly on the quality and cost of services to the end user. For instance congestion at the gateway level is propagated all the way down to the ISPs. Similarly congestion at the ISPs level is propagated down to the users.

The network structure and hierarchy in the market place lacks a high speed National Internet Infrastructure interconnecting the different networks at high speeds. The international bandwidth purchased by IBGO is progressively shared by ISPs and end-users. Data shows that each Mb/s of international bandwidth is shared by up to 12 end-users who each purchase 1 Mb/s connections from the ISPs as shown in Figure 5.9 This structure renders itself to the establishment of 'choke' points in the network hierarchy at the interface points between the connections to the ISP, connections to the IBGOs/CVOs and the overall connections to the global Internet [see figure 5.9].

Initiatives to address these 'choke' points call for communication infrastructure expansion efforts as well as development of common network service facilities such as IXPs and network root servers. A high speed national backbone and broadband connectivity to the end users is also critical to the development and operation of a suitable Internet nationally. High capacity connection to the IXP by the different operators can act as a major relieve to the pent up demand for high speed inter-connectivity nationally. The provision of such a broadband backbone Internet infrastructure would result in an increase in locally hosted and relevant content. This would also mean rapid growth of Internet use in Kenya.

With the introduction of the KIXP in 2001, national inter-ISP traffic remains local (in Kenya) and the value to the user is high speed access to local content. Similarly, a high percentage of domain names resolution is done locally via the dot KE ccTLD registrar infrastructure and the root server infrastructure. For example, the f-root and j-root servers were introduced at the KIXP by KENIC in the year 2005. These systems contribute greatly towards the creation of a more 'flat' Internet structure as opposed to the traditional hierarchical structure. However, the benefits KIXP and the root servers can only be fully realized with a dramatic increase in national Internet bandwidth and an increase in locally hosted content, including locally hosted e-mail servers.

Figure 5.9: Choke points in the Internet market hierarchy



The KIXP has witnessed tremendous growth in traffic in the last two years as shown in figure 5.7. Most of the major ISPs are connected to IXP and their connection bandwidth has been growing progressively. Although the peak traffic level stands at between 15-18 Mbps as of 2005/2006, our study found that the leased line connectivity to KIXP currently stands at 63 Mbps as shown in table 5.2. This is about four times the average peering bandwidth by 2005/2006.

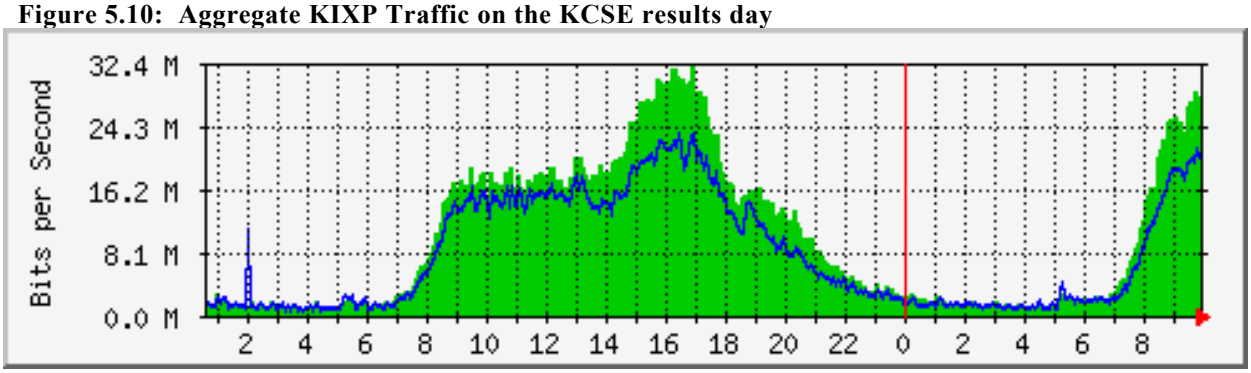
Table 5.2: Peering bandwidth capacity (Mbps)

	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006
ISPs	2.768	3.088	7.024	17.044	59.892
LLOs	-	-	-	-	2.000
Mob. operators	-	-	-	0.128	0.512
Others	-	-	0.256	0.512	1.000
Total	**2.768**	**3.088**	**7.280**	**18.584**	**63.404**

Source: Internet market analysis study

This capacity will continue to increase as most of the operators/consumers continue to upgrade their links as local peering gains ground. The opportunity for the IXP growth is immense as more local content continues to be made available and hosted locally. In particular, the Kenya Revenue Authority's (KRA's) automation and availability of online transactions have contributed to the demand and high usage of KIXP (KRA is connected to KIXP and admits that this connection has enabled it to increase revenue collections). Similarly, the effect of the decision of the Kenya National Examination Council to release national primary and secondary school certificate results via the Web resulted in an increase in local traffic at the KIXP. This is an indicator of local content on Internet usage in Kenya. Figure 5.10 shows the increase in traffic when the Kenya Certificate of Secondary Education (KCSE) results were recently released. It is to be noted that the traffic hit an all time high of 32 Mbps.

Figure 5.10: Aggregate KIXP Traffic on the KCSE results day



Source: KIXP Statistics 2007

Due to the high dependency on off shore hosted content, downlink bandwidth is still the highest demand service in the Kenyan Internet setup. The trend in relation to the KIXP traffic is quite positive as it has been decreasing progressively with time. As more and more operators and the big service providers like KRA host their content locally and connect adequately to the IXP, the local peering bandwidth is expected to grow substantially and form a building block of the Local Internet.

5.5 Dominance of Various Players

The dominance of operators and service providers in the various market segments was analyzed and the results are summarized in table 5.3 below.

From the table 5.3, it is evident that there is considerable competition in the provision of International bandwidth by both IBGOs and CVOs. Data we obtained from the mobile operators shows that with their international gateway operator (IGO) license, they purchase international bandwidth from existing IBGOs as well as external international bandwidth providers (e.g. Intelsat). However, these operators do not participate in provision of international bandwidth to ISPs and corporate organizations. That is, they purchase what they need for their operations and do not re-sell it. This can be interpreted to mean that mobile operators obtained the IGO license largely to diversify their sources of International bandwidth but not to re-sell this bandwidth. This defeats the original intention of the IGO license of increasing competition in provision of international Internet bandwidth.

At the ISP level, only one ISP is dominant by geographical presence. The other ISPs are concentrated in selected districts, with most ISPs concentrating on Nairobi and Mombasa. In addition, only two ISPs are dominant by leased lines sold. Interestingly, the dial-up Internet market segment is dominated by the network operators, with the ISPs having an insignificant market share.

Table 5.3: Dominance of operators and service providers

Nature of dominance	Dominance	Conclusion
Dominance of IBGOs by total international bandwidth	▪ Network Operator 1 – 111 Mbps ▪ Network Operator 2 – 108 Mbps ▪ Network Operator 3 – 89 Mbps ▪ Network Operator 4 – 85 Mbps	Four IBGOs are competing fiercely in provision of International bandwidth, especially downlink bandwidth
Dominance of CVOs by total international bandwidth	▪ VSAT Operator 1 – 91 Mbps ▪ VSAT Operator 2 – 74 Mbps ▪ VSAT Operator 3 – 32 Mbps	The two top VSAT operators add to the fierce competition by IBGOs in the provision of International bandwidth
Dominance of PDNOs by geographical presence	▪ PDNO 1 – 29 districts ▪ PDNO 2 – 18 districts ▪ PDNO 3 – 2 districts ▪ PDNO 4 – 2 districts	Only two PDNOs are dominant by geographical presence
Dominance of ISPs by geographical presence	▪ ISP 1 – 15 districts ▪ ISP 2 – 8 districts ▪ ISP 3 – 6 districts ▪ ISP 4 – 6 districts	Only one ISP is dominant by geographical presence
Dominance of ISPs by leased lines	▪ ISP 1 – 1,500 leased lines ▪ ISP 2 – 1,138 leased lines ▪ ISP 3 – 370 leased lines	Only two ISPs are dominant by leased lines sold
Dominance by dial-up lines	▪ Network Operator 1 – 150,000 dial-up lines ▪ Network Operator 2 – 140,000 dial-up lines ▪ Network Operator 3 – 84,000 dial-up lines ▪ ISP 1– 18,000 dial-up lines ▪ ISP 2 – 6,000 dial-up lines	The network operators dominate the dial-up market

Due to the problems experienced in getting leased domestic lines from the PDNOs, most of the ISPs have acquired PDNO licenses using related companies. This is an attempt to provide quality Internet access to their customers. That is, the ISPs do not **trust** the PDNOs to provide the quality of leased line service required. Most of these ISPs who have obtained PDNO licenses are not reselling leased line capacity but are using it only for their own customers. The results show that there are only two dominant PDNOs with infrastructure that covers a considerable proportion of the country and who are selling leased lines to ISPs. The other PDNOs are small and concentrate on providing access links to the ISPs having the same ownership and some corporate organizations. Again, this defeats the original purpose of licensing more PDNOs. These vertical structures need to be broken down via regulation in order to create real competition. The new Data Carrier Network Operator (DCNO) might solve the problem of lack of competition among PDNOs (except for the two dominant PDNO)

5.6 Summary of Actions taken by Key Comparator Countries

We have chosen two key countries to compare the actions taken to increase growth of the Internet. These countries are Morocco and Republic of Korea, which are in levels B and D respectively. Table 5.4 summarizes the actions taken by countries that have an effect an effect on the growth of the Internet.

Table 5.4: Comparison of actions taken by key comparator countries

	Korea	Morocco	Kenya
Public Sector Actions			
▪ Liberalization & competition	▪ Liberalization early (1980s) and full competition in the 1990s	▪ Liberalization introduced in 1998 followed soon after by full competition in 2000	▪ Liberalization introduced in the 1999 and full competition did not take place until 2005
▪ National Infrastructure Initiatives	▪ Setup a NII in 1993 to provide a high speed national infrastructure as a foundation for building a knowledge based society	▪ Embarked on a National Infrastructure in 2002	▪ High speed national infrastructure lacking. Plans to develop underway
▪ Promotion activities ▪ Incentives for entrepreneurs	▪ Government deployed promotion policies consisting of training on IT literacy and awareness –around 2000	▪ Adopted targeted capacity building in ICTs (driven mainly by the BPO industry) through provision of resources for training ▪ Tax incentives provided to the ICT industry (with designated techno parks)	▪ There has not been activities and promotion to address literacy and increase usage of Internet
Private Sector Actions			
▪ Multiple players aggressive strategies: - @application level - @access infrastructure level - @gateway service level ▪ Common services promotion: - IXP - TLDs registrar services - demand support activities (eg training, promotions, etc)	▪ Competition through multiple players resulted in aggressive and innovative strategies in the market place. E.g. the second local carrier leveraged on broadband services as a niche market since the incumbent was too strong on local calls. ▪ For Internet services, there has been minimum regulation and any player was allowed to provide high speed Internet access and related services following a simple registration procedure	▪ Innovative competition between the operators for the provision of services and creation of new markets	▪ Operators have been competing for the same clients instead of innovatively creating 'new' customers. Most of the competition has been concentrated on access leaving value additions and applications development at a low level ▪ There has been good collaboration (PPP) in the development of the IXP and ccTLD registrar development ▪ Little has been done towards user support activities in the form of training and value added promotions.

Table 5.4 shows that the high growth of the Internet in Korea at the turn of the 21st century can be attributed to the following actions and factors:

- High penetration of broadband access
- Falling equipment prices (e.g. Korea Telecom bought ADSL equipment at 50% discount from Samsang Electronics and Hanaro)
- Competitive marketing activities by service providers

(a) **Competition in broadband Internet**. There was competition in high-speed Internet access infrastructure by broadband Internet providers. This led to low prices, which in turn led to high demand. The government ignited this competition by monitoring and announcing the services provided by the companies.
(b) **Promoting demand**. The government implemented promotion policies, including IT literacy and especially Internet literacy targeting housewives, the elderly, military personnel, farmers and prisoners. The government implemented this promotion by granting subsidies to IT/Internet firms to provide the training.
(c) **Cyber cafes**. The emergence of high-speed and low cost cyber cafes ("PC Bahngs") got many people to give up their slow dial-up lines and troop into the cyber cafes.
(d) **Social and cultural environment**. The following social and cultural environment encouraged the adoption of the Internet:

    - Government incentives in the form of tax benefits and low rate loans to Internet ventures;
    - Concentration of about 50% of Koreans in high-density apartments, making deployment of broadband easy (ADSL has maximum of 4 km from the local exchange); and
    - Strong emphasis on education and academic performance by Korean families. Students were therefore able to have access to educational resources from home.

Thus, although broadband Internet infrastructure is a pre-requisite for growth of the Internet, there is a need to implement e-government services that increases locally relevant content. It is also necessary to improve the Internet entrepreneurial environment, extend Internet to residential areas and connect schools and colleges to the Internet. We have included some of these initiatives in the list of recommendations.

6. Dispersion

6.1 Internet Pervasiveness

Given that this study was focused on the supply side, it was not meant to obtain the number of users. However, given there is no accurate estimate of the number of Internet users, we have attempted to make an estimate using data obtained from the study as shown in table 6.1 below.

Table 6.1: Estimate of the number of Internet users

	Customers	Factor	Users
Dial-up	169,078	x5	845,390
Mobile Internet (est)	236,220	x2	472,441
Leased lines	9,724	x1,000 Academic sector	1,412,500
		x100 Other sectors	
LLO	7,999	x5	39,965
Total estimated users			**2,770,296**

Source: Internet Market Study

The above estimate is based on the following assumptions:

- We used the international definition of Internet access as using the Internet at least once in a period of 12 months.
- In the academic sector, a leased line to an academic institutions provides Internet access to 1,000 users. For large institutions like universities, this is an underestimate because the leased line provides at least e-mail access to all students at least once in a year. With a university enrollment of 130,000 for the 17 universities, the users should be 130,000. Given the high enrollment rates in both secondary and primary schools, we therefore think the 1,000 figure is reasonable but will be confirmed by a demand side field survey.
- There would be an average of 100 users behind every leased line customer for all the sectors except that the Academic sector.
- There are five users behind every fixed dial-up line and LLO line. This is in line with the 1999 census which shows that each household has on average five persons.
- There is two persons sharing a mobile dial-up Internet line.

A demand survey would confirm the accuracy of the above estimate.

6.2 Geographical Dispersion of Internet POPs

The districts and provinces in which licensees who provide Internet services have a presence are shown in table 6.2. The geographical dispersion of ISPs and PDNOs is shown in table 6.3. As can be observed in this table, ISPs were only in 20 districts, representing less than 30% of all the districts.

Table 6.2: Presence of operators and service providers in districts and provinces

Licensee Category	No. of districts in there is presence	No. of provinces in which there is presence	% of districts
ISP	20	8	28.57
LLO	2	2	2.86
PDNO	33	7	47.14
VSAT	57	8	81.43
Districts ISPs are & PNDOs are not	2		2.86
No. of districts with Internet POPs (ISPs and PDNOs)	35		50.00

Source: Internet analysis study

Table 6.3: Presence of ISPs and PDNOs in districts and provinces

Province	Districts in which ISPs have a presence	Districts in which PDNOs have a presence
Central	Nyandarua	Kiambu
	Nyeri	Murang'a
	Thika	Nyeri
		Thika
Coast	Kilifi	Kilifi
	Kwale	Kwale
	Malindi	Lamu
	Mombasa	Malindi
		Mombasa
		Taita Taveta
Eastern	Embu	Embu
	Isiolo	Isiolo
	Machakos	Kitui
	Meru Central	Machakos
		Meru Central
		Meru North
Nairobi	Nairobi	Nairobi
North Eastern	Garissa	
Nyanza	Kisii Central	Homa Bay
	Kisumu	Kisii Central
		Kisumu
		Migori
		Siaya
Rift valley	Kericho	Baringo
	Nakuru	Kajiado
	Narok	Kericho
	Uasin Gishu	Nakuru
		Nandi
		Narok
		Turkana
		Uasin Gishu
Western	Kakamega	Bungoma
		Busia

Province	Districts in which ISPs have a presence	Districts in which PDNOs have a presence
		Kakamega
Total	20	33

Source: Internet analysis study

As can be observed in table 6.2, Internet POPs are in 50% of the Kenyan districts. This is 2.5 times the situation in 2002 when Kenstream nodes (the only way ISPs could have presence in districts) was only available in 14 districts (E-readiness report, 2002). However, this level of penetration of Internet nodes is way below the 100% planned by 2010 (all districts to have an Internet POP) as per the Universal access strategy (Waema, 2004).

Other observations that can be made from the data and the table above are:

- ISPs are located where PDNOs are located except two districts. These districts are Nyandarua and Garissa (i.e. there are ISPs and no PDNOs)
- PDNOs are in all provinces except North Eastern
- ISPs and VSAT Operators are in all provinces
- LLOs are in Nairobi and Mombasa

We recommend that a widespread national backbone infrastructure that covers all districts in the next two years be implemented in line with the Universal access strategy.

6.3 Geographical Dispersion of Internet Customers

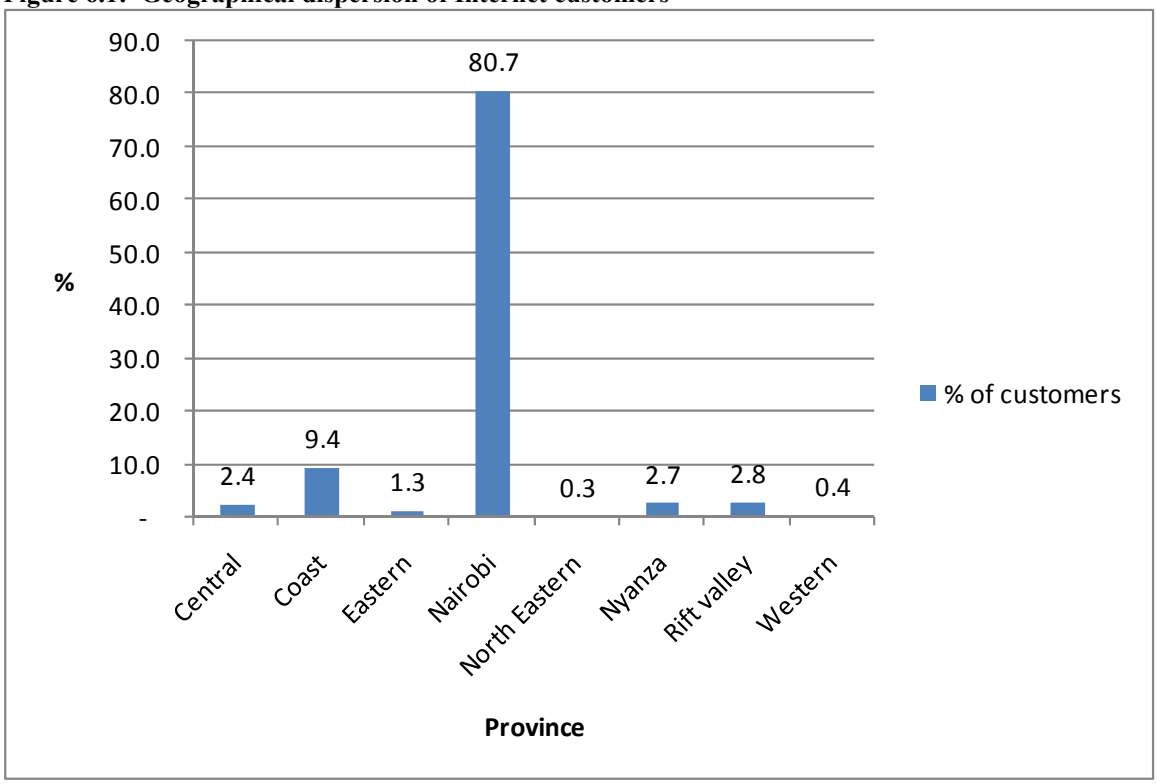
This study was focused on the supply side and was therefore not meant to obtain the number of users. It was however possible to get the number customers or customers. Table 6.4 and figure 6.1 show the geographical dispersion of Internet customers across all the provinces.

Table 6.4: Geographical dispersion of Internet customers

Province	No. of customers	Percentage
Central	1,299	2.43
Coast	5,036	9.42
Eastern	677	1.27
Nairobi	43,136	80.71
North Eastern	150	0.28
Nyanza	1,444	2.70
Rift valley	1,476	2.76
Western	229	0.43
TOTAL	**53,447**	**100.00**

Source: Internet analysis study

Figure 6.1: Geographical dispersion of Internet customers



Source: Internet analysis study

From the data above, Nairobi has the lion's share (over 80%) of the Internet customers. The Coast province is a distant second with about 9% of the customers. Indeed Nairobi and the Coast province account for about 90% of all Internet customers. Eastern, Western and North Eastern provinces have the lowest number of Internet customers in respective decreasing order, with the last two having a negligible percentage. It can be assumed that the dispersion of Internet users follows the same pattern.

We believe that if these disparities are not addressed, they are likely to lead to a worse digital divide and national socio-economic disparity. It is recommended that CCK takes a strategy to address the above huge regional disparities, especially through a revised universal access/service strategy.

6.4 Sectoral Absorption of Internet Connectivity

In the questionnaire, we asked licensees to show the distribution of their Internet customers (both leased line and dial up customers) according to sectors. The academic, commercial and health sectors were selected because they are commonly used sectors. They, for example corresponded to categories in the United Nations Development Programme (UNDP) human development index. The public or government sector is obviously a very important user, potentially comparable in size to the others. We then lumped local and international NGOs, religious institutions, community-based and social institutions and others that cannot be classified into the four sectors above into an "Others" category. Data on the number of institutions in each sector was obtained from the Statistical Abstract, 2005.

Two key problems were experienced in collecting this data. First, most firms did not have an accurate database of their customers, especially their categorization into the above sectors. Secondly, and related to the first problem, it was not possible to establish the sectoral distribution of customers in previous years. The data collected was therefore for 2005/2006.

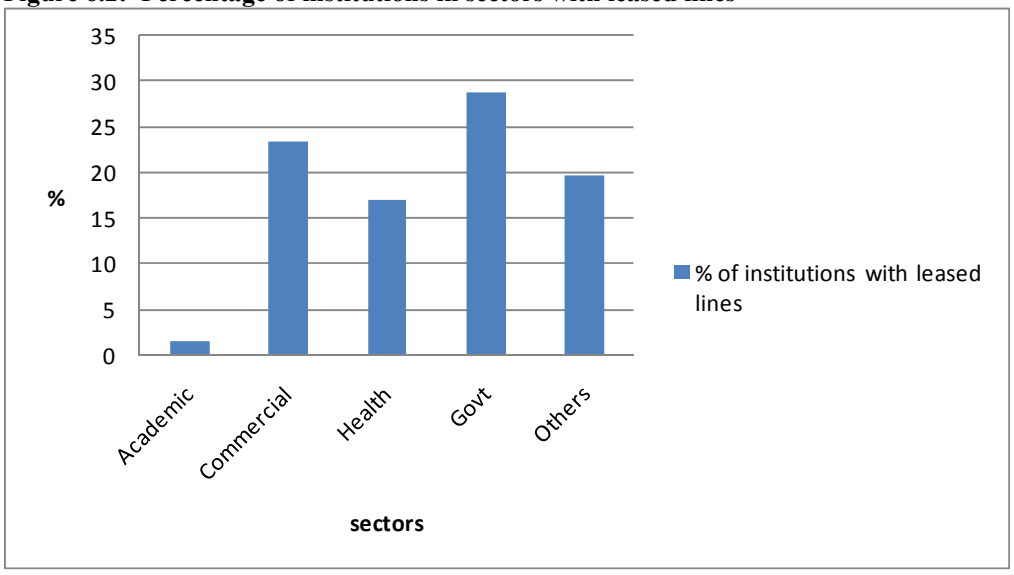
The results are shown in tables 6.5 and 6.6 and figures 6.2 and 6.3.

Table 6.5: Leased lines in sectors

Sectors	**Academic**	**Commercial**	**Health**	**Govt**	**Others**
Total leased lines in sectors	414	6,978	149	743	591
Percentage of leased links in sector	**4.66**	**78.63**	**1.68**	**8.37**	**6.66**
No. of institutions in sector (Statistical Abstract, 2005, p. 105)	29,912	29,820	880	2,590	3,009
% of institutions in the sector with leased lines	**1.38**	**23.40**	**16.93**	**28.69**	**19.64**

Source: Internet analysis study

Figure 6.2: Percentage of institutions in sectors with leased lines



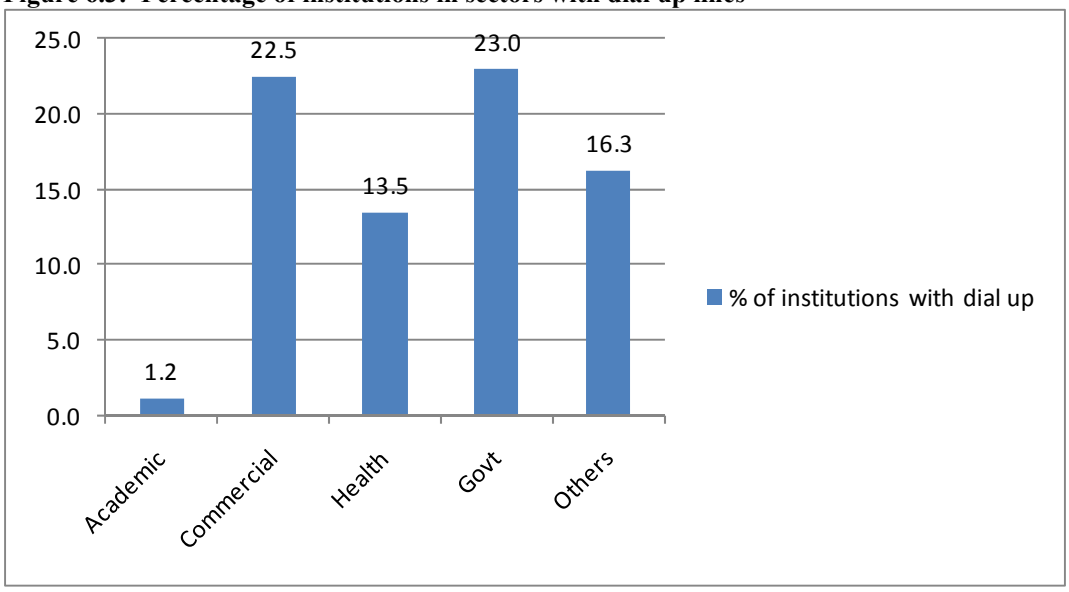
Source: Internet analysis study 2006

Table 6.6: Dial up lines in sectors

Sectors	Academic	Commercial	Health	Govt	Others
Total dial-up lines in sectors	352	6,712	119	595	490
Percentage of leased links in sector	**4.26**	**81.18**	**1.44**	**7.20**	**5.93**
No. of institutions in sector (Statistical Abstract, 2005)	29,912	29,820	880	2590	3,009
% of institutions in the sector with leased lines	**1.18**	**22.51**	**13.52**	**22.97**	**16.28**

Source: Internet analysis study

Figure 6.3: Percentage of institutions in sectors with dial up lines



Source: Internet analysis study

The following remarks can be made from the results:

- Most licensees did not keep an accurate database of their customers, especially sectoral details.
- The Commercial sector has the highest number of both leased and dial up lines (about 80% of the total in both cases) while the Education sector has the least number (just over 1% of the total).
- In terms of the percentage of institutions in the sector with leased or dial up lines, the Commercial sector still dominates, with over 20% in both cases.
- The relatively high penetration of both leased line and dial-up Internet connectivity in the Public sector is surprising. This however can be attributed to the small number of Government institutions. It is not clear how the Statistical Abstract counts public institutions, especially the ministries.
- The percentage of academic institutions with either dial-up or leased lines is very low (about 1% in both cases). We believe that this will be even worse if there was a further disaggregation into universities, research institutions, tertiary colleges, secondary schools and primary schools. We would expect very high levels of absorption in the first three categories and very low levels amongst the schools.

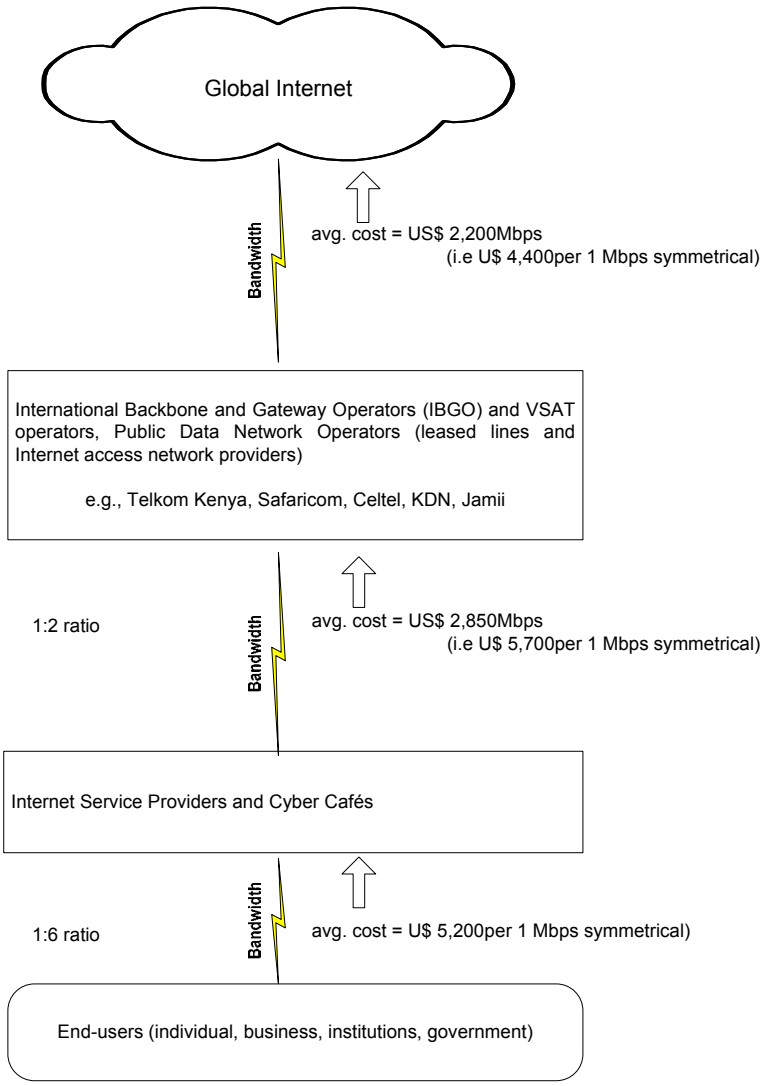
Overall, the sectoral absorption of Internet is very low (12-13% of all institutions). This could be attributed to a number of factors, including limited infrastructure, lack of relevant content, high tariffs and so on. It is recommended that a demand study is carried out to establish the details of the use of the Internet by sectors as well as by individuals. This will enable CCK to create a baseline database which will be updated on a regular basis and be a basis for targeted intervention. In addition, CCK should work with other stakeholders to implement an e-rate for education and research institutions.

7. Internet Tariffs and Affordability

7.1 Introduction

Internet services are currently provided by hierarchy of providers that correspond to the licenses granted by the regulator. We have analyzed the Internet tariffs and costs at each level of the hierarchy and also calculated the costs of Internet services to end-users (i.e., institutions or individuals). Figure 7.1 shows the layered structure of operators and providers as currently defined by the regulator.

Figure 7.1: Hierarchy of Internet services providers



Source: Internet Market Analysis Study

The costs at each level of the hierarchy are passed down the level below and ultimately are paid for by the Internet customers or customers. The tariffs at each level therefore determine the affordability of the Internet services to the customers, and in some cases, the quality of services. Each of the operators and Internet services providers develops a business case for the Internet

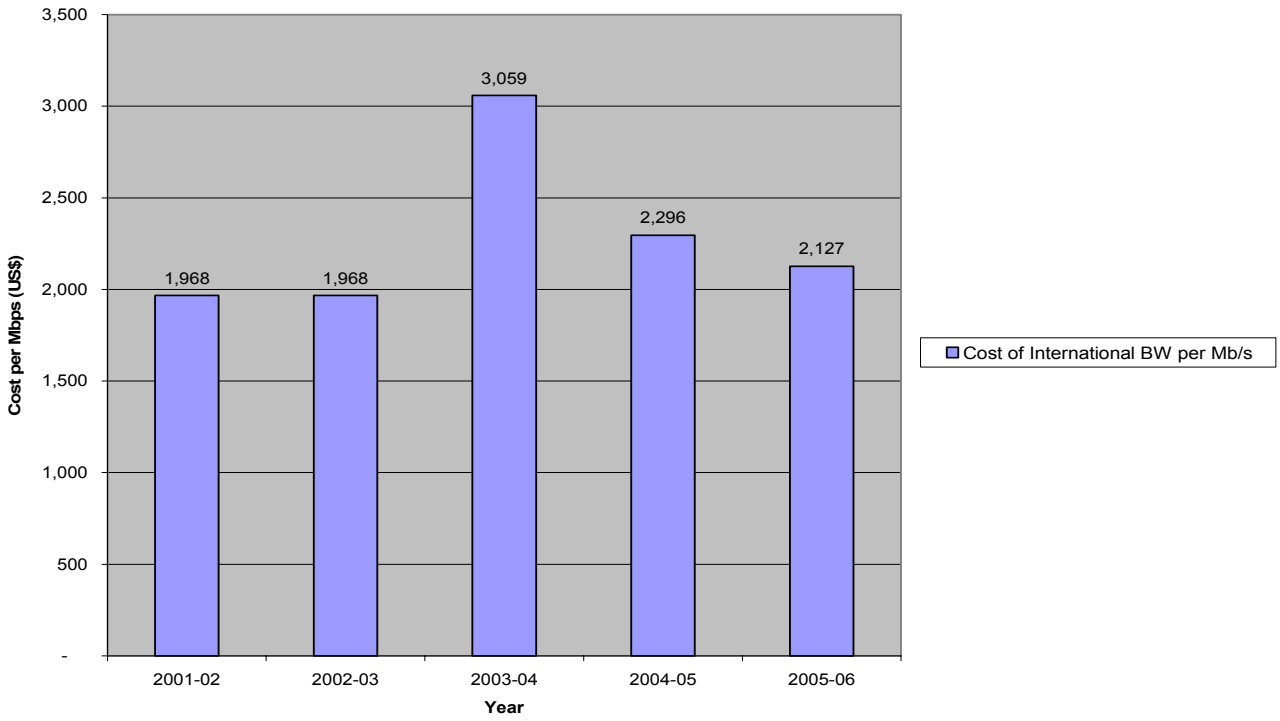
services. The business case for the operators and ISPs can be expressed in terms of the Average Revenue Per User (ARPU). The ARPU of different services is a good indicator of the profitability of the services.

Affordability depends on the purchasing power of the users or customers. We measure affordability by dividing the average costs of the services with the GNI per capita (i.e., average income of the customer). Specifically, the average costs of dial-up Internet services (mobile or fixed) divided by the GNI per capita is a good indicator of affordability to individual users. In a business, affordability is normally measured by the percent of total operational budget or expenditure allocated to Internet access. However, we could not calculate affordability for business because most respondents did not provide expenditure data. In the following sections, we analyze the trends in Internet tariffs and the affordability indicators. Our results show that Internet services are not as profitable as voice services or even SMS services. Internet services, especially dial-up Internet services, are not affordable by most of the users in Kenya.

7.2 Trends in Internet Tariffs

Internet Backbone and Gateway Operator (IBGO) and Commercial VSAT Operator (CVO) licensees sell International Internet bandwidth to ISPs or directly to end-users. Figure 7.2 shows the trends in the average International Internet bandwidth costs per Mb/s in the past 5 years (one way).

Figure 7.2: Average cost of International uplink Internet bandwidth per Mb/s per month



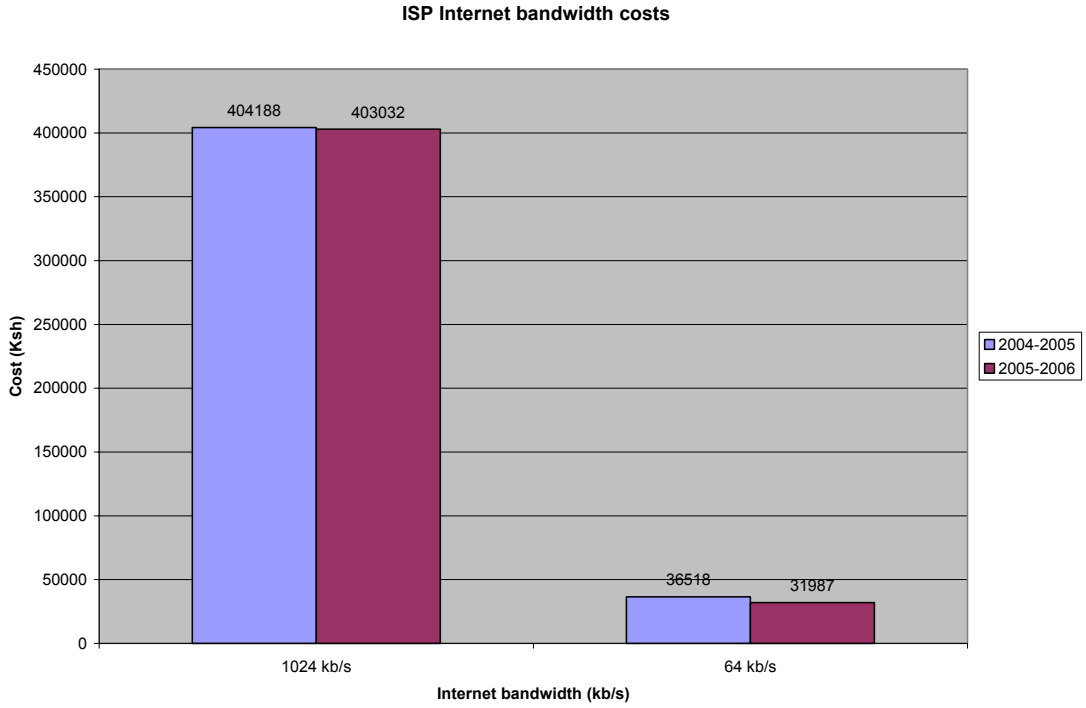
Source: Internet Market Analysis Study

The figure shows that International Internet bandwidth costs have not been falling in any significant way even as the number of IBGO licensees has been increasing. In fact, data shows that the newer IBGO licensees are paying higher per Mb/s prices than the incumbent IBGO. This could be due to the fact that new IBGO's tend to purchase bandwidth in small quantities and there are therefore no bulk-purchase advantages. For example, data shows that the lowest price negotiated by an IGO licensee was US$ 625 per Mb/s while the maximum was $3,500.

It is to be noted that the average Internet tariff per Mb/s shot up in 2003/2004. A closer examination of the data shows that this was as a result of the incumbent IBGO purchasing new international bandwidth from a new satellite bandwidth provider at more than twice the existing tariffs per Mb/s.

IBGOs sell bandwidth to the Internet Service Providers at a profit depending on their business plans. ISPs are connected to the IBGO using digital leased lines provided by the public data network licensees. Figure 7.3 shows the trends in the average costs of the Internet bandwidth (including the leased lines) for 64 Kbps and 1024 Kbps. These shows that the international bandwidth costs in the period 2004-2006 did not change significantly. In addition, the price of Ksh 403,032 (equivalent to US$ 5700 at exchange rate of Ksh 70 to 1 US$) is about 1.4 times more than the average symmetrical purchase price of international bandwidth by the IBGOs (Figure 7.2 shows US$ 4200). IBGOs do not purchase symmetrical bandwidth. Assuming a ratio of 1:4 for uplink to downlink bandwidth purchased, then the local price for ISPs is about 2 times the international purchase price by IBGOs. Although we did not get credible data on the ratio between bandwidth purchased and bandwidth sold, it is common knowledge that they use a ratio of at least 2. That means that in real bandwidth terms, ISPs pay for international bandwidth at a cost that is at least 4 times the costs that IBGOs purchase bandwidth. That is, IBGOs have a 4 times mark-up on bandwidth costs without any significant value addition as they are simply bandwidth resellers.

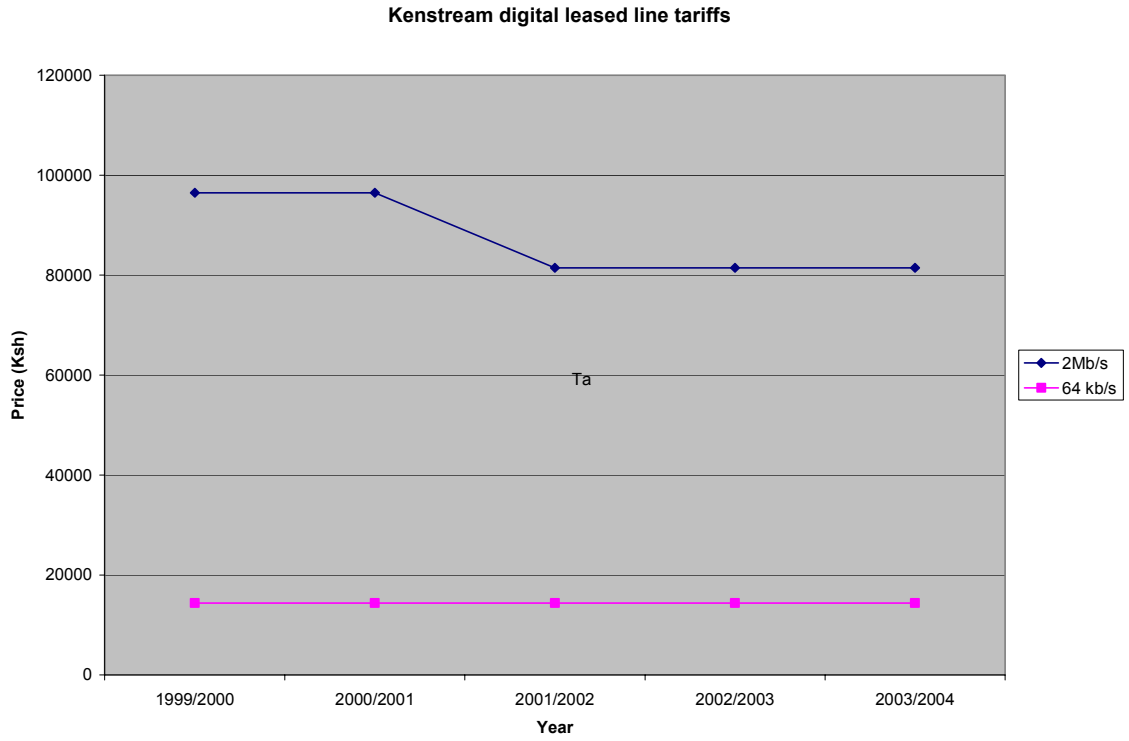
Figure 7.3: International bandwidth costs per Mb/s for ISPs



ISPs in Kenya are interconnected via peering arrangements at the Kenya Internet Exchange Point (KIXP). In Kenya, peering requires purchase of digital leased line capacity provided by the Public Data Network Operator (PDNO) licensees (e.g., Telkom Kenya or KDN). It is therefore possible to achieve high Internet speeds for local traffic without paying for additional international bandwidth provided by the IBGOs. However, data shows that the ratio of international download bandwidth to peering capacity (i.e. KIXP leased line capacity) was 1:44 in the 2005-2006 as was illustrated in Figure 5.8.

One reason why the ISPs might not buying adequate leased line capacity to the KIXP is the relatively high cost of digital leased lines. For the period 1999-2004, digital leased lines services were a monopoly service and the prices did not fall as shown in Figure 7.5. The Kenstream digital leased tariffs have now dropped to about Ksh 7,200 for a 64 kb/s line and Ksh 48,904 for a local (< 20 Km) 2048 kb/s leased line because of competition in the supply of leased line services by other PDNOs.

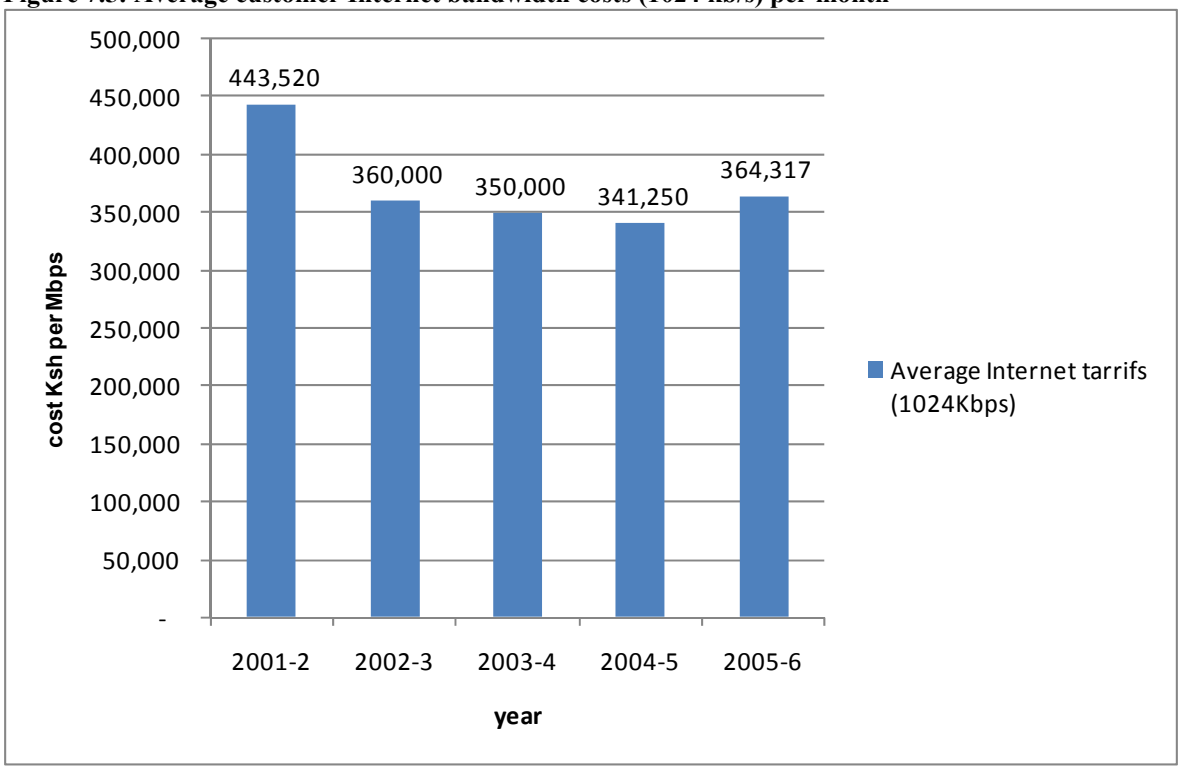
Figure 7.4: Trends in digital leased line tariffs in a monopoly period (1999-2004)



A low ratio of International bandwidth to KIXP leased line capacity (or peering bandwidth) would reduce the impact of high international bandwidth prices on Kenyan Internet services. This is because leased lines are considerably cheaper than international Internet bandwidth. For example, in the period 2005-2006, the cost of a 1 Mb/s leased line from Telkom Kenya was Ksh 34,580 compared to Ksh 403,032 that ISPs pay for international bandwidth (see Figure 7.3). This is a ratio of 1 to 11 (it is 11 times cheaper but would speed up local traffic). Unfortunately, the peering bandwidth is still quite low compared to international downlink bandwidth at 44 times less in the period 2005-2006 as shown in figure 7.4. This partly explains the high prices of Internet services in Kenya as we show in a later section.

Large Internet customers often have a permanent connection to the Internet using digital leased lines. In effect, the customers purchase international Internet bandwidth from the ISPs who terminate connections. Figure 7.5 shows the trends in 1 Mb/s Internet bandwidth costs to the customers or end-users. This includes the cost of the leased line as well as the ISPs termination charges or routing charges.

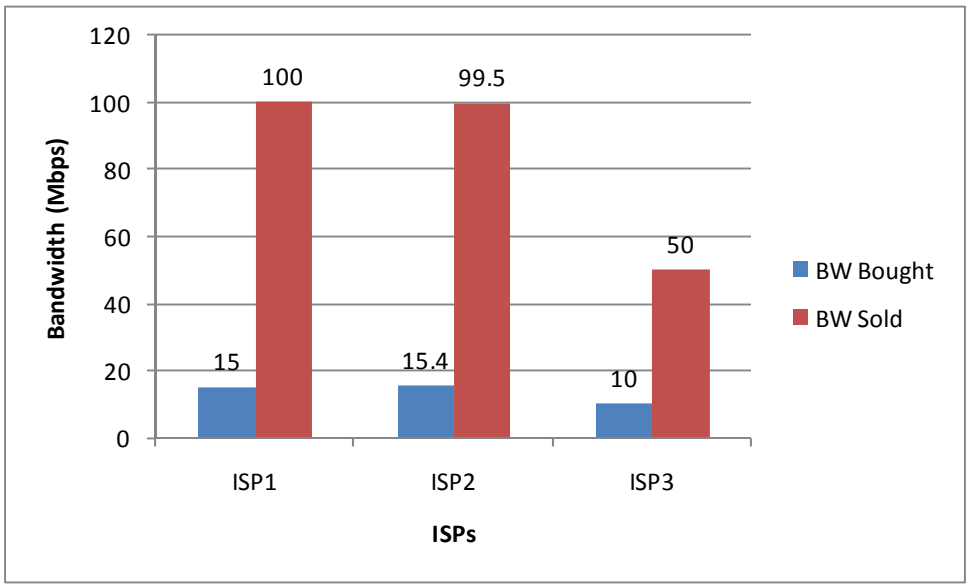
Figure 7.5: Average customer Internet bandwidth costs (1024 kb/s) per month



Source: Internet Market Analysis Study

Although the average price of Ksh 364,317 ($5,200) appears lower than the Ksh 403,032 that ISPs pay to the IBGO's, data shows that for every 1 Mb/s purchased from the IBGO, the ISP connects about 6 customers using 1 Mb/s links as shown in figure 7.6 for three ISPs. That is, there is a ratio of at least 1 to 6 between bandwidth purchased and bandwidth sold.

Figure 7.6: Comparison of bandwidth purchased and bandwidth sold for 3 selected ISPs



Source: Internet Market Analysis Study

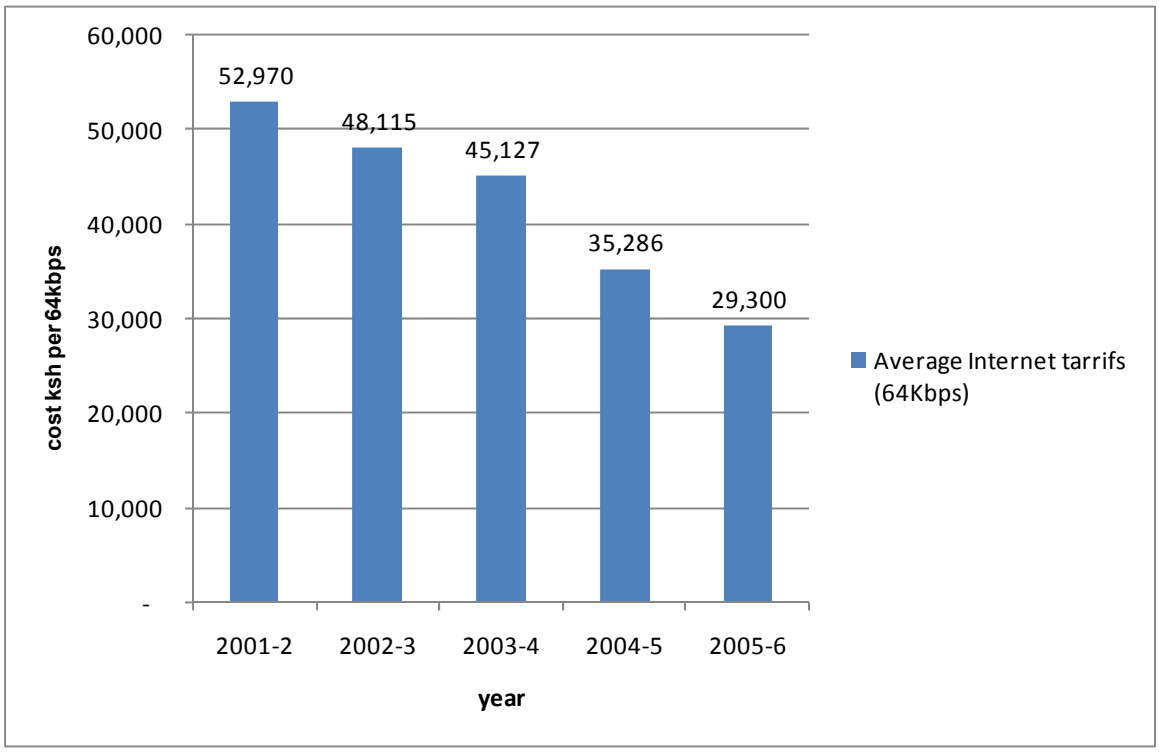
We make the following observations:

a. The ratio of average cost of 1 Mb/s to the end-user to the purchase price from the ISP is almost equal to the International bandwidth purchase price from the IBGO (US$5,204 compared to US$5,760, respectively).
b. The minimum international bandwidth is a mere US$ 625 compared to the average of over $2,100. That means the bulk purchasing capacity and use of long-term contracts with satellite providers can reduce cost of international bandwidth by about 3 times.
c. The price of US$5,204 paid by the end-users is about twice the asymmetrical International Internet bandwidth cost of US$2,700 paid by the IBGO (assuming an asymmetry ratio of 1:4). That is, the hierarchy shown in figure 7.1 has increased the price of Internet bandwidth to the end-user significantly.
d. The ratio of 1 to 6 used by the ISPs means that ISPs can generate 6 times more revenue without significant value addition beyond switching the customer traffic.
e. The 1 Mb/s bandwidth purchased by the IBGO is shared by about 12 end-users connected at 1 Mb/s to the ISPs. Since the large customers normally do not purchase the bandwidth they need but the bandwidth they can afford, this means the quality of service is very low.
f. The retail price to the end-users has not been decreasing significantly in the past 5 years, and in fact has increased slightly to Ksh 364,317 in 2005 compared to Ksh 360,000 in 2002 for 1024 Kb/s (see figure 7.5 above)

This suggests lack of competition at both the IBGO level and the ISP level. It could also mean lack of economies of scale in the Internet business. At the 64 kb/s bandwidth, the tariffs have been falling gradually as shown in figure 7.7. However, customers who purchase 64 kb/s paid an average of Ksh 29,300 compared to the equivalent price of Ksh 22,770 per 64 kb/s for businesses or institutions that purchase 1024 Kb/s bandwidth. Every 64 Kbps is therefore about Ksh 6,000

more expensive than if 1024 Kbps bandwidth was purchased. This ratio is worse if we considered 2 Mbps or higher. Most of the leased line customers in Kenya can only afford 64 kb/s or less Internet bandwidth and therefore pay higher prices. This is normal for customers without bulk purchasing power.

Figure 7.7: Average end-user Internet bandwidth costs for 64 kb/s per month



Source: Internet Market Analysis Study

7.3 Affordability of dial-up Internet Services

We identify two main classes of customers:

1. Dial-up customers (dial-up services provided by fixed or mobile operators). These are mostly individuals or micro-enterprises
2. Leased line Internet customers normally connected via permanent links such as leased lines or wireless links. These could be Small and Medium-Sized Enterprises (SMEs), large businesses or other corporate organizations and institutions.

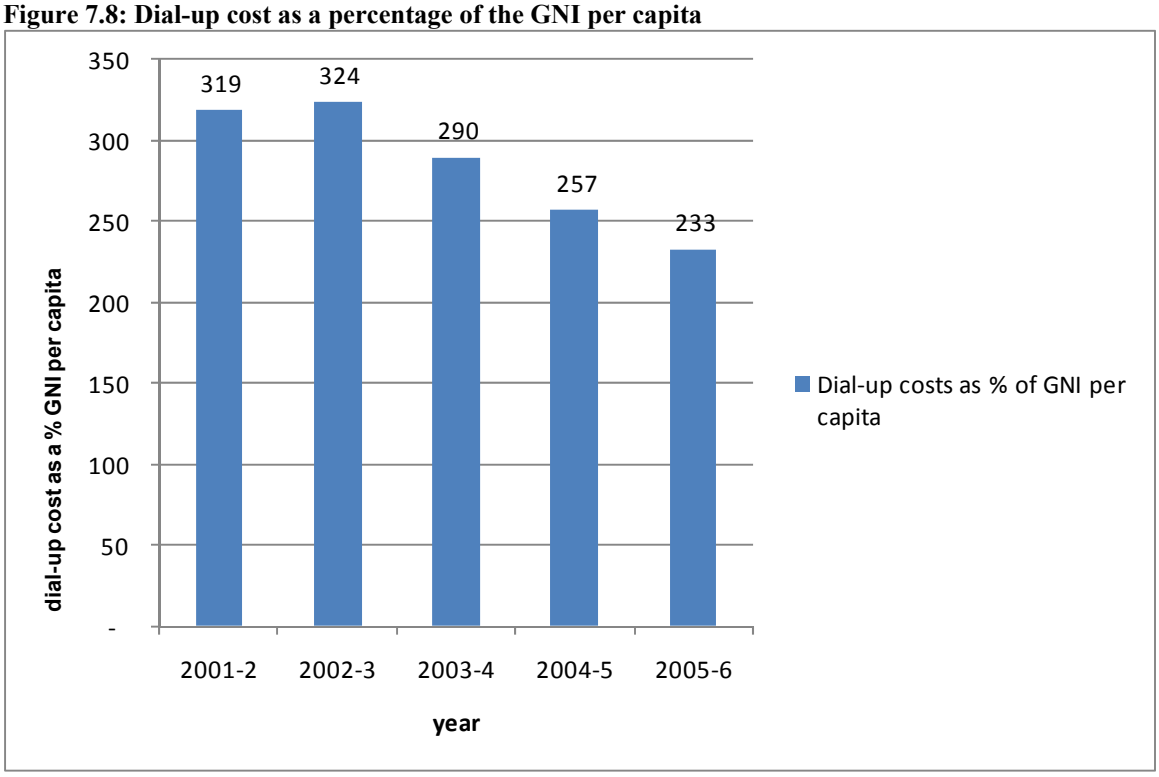
Since most leased line customers are businesses, it is difficult to determine the affordability of the Internet services without conducting a business survey to establish the percentage of operational expenditure allocated to Internet access. We have therefore calculated affordability for dial-up customers only because the per capita GNI is known. In general, individuals are ready to spend up to 2.5% of their local income (GNI per capita) on communications which includes voice and data services according to the Infodev Telecommunications Regulations Handbook on Regulation (Intven 2000).

The average Internet cost for fixed dial-up customers as a percentage of the GNI per capita is shown in table 7.1 and figure 7.8. This is also the average revenue per dial-up user (ARPU) as a percentage of GNI for the ISP.

Table 7.1: Average dial-up cost as a percentage of GNI per capita

	2001/2002	2002/2003	2003/2004	2004/2005	2005/2006
Average analog dial-up (Ksh)	21,820.89	18,628.00	15,179.75	14,329.79	14,547.80
TKL telephone usage cost for 20 hrs	72,000	72,000	72,000	72,000	72,000
Total avg in US$	1,340.30	1,294.69	1,245.43	1,233.28	1,236.40
GNI per capita	420	400	430	480	530
Average analog dial-up as % of GNI per capita	**319.12**	**323.67**	**289.63**	**256.93**	**233.28**
Average analog dial-up (without TKL charges) as % of GNI per capita	**74.22**	**66.53**	**50.43**	**42.65**	**39.21**

Figure 7.8: Dial-up cost as a percentage of the GNI per capita



Source: Internet Market Analysis Study

The results show that fixed dial-up Internet services were 233% of the GNI per capita in the 2005-2006. This is very expensive and not affordable by most Kenyans. It is also possible that small business (micro-enterprises) would find the dial-up services very expensive.

One of the reasons why fixed dial-up Internet is that expensive is because of the high telecommunication charges of the fixed operators (at about Ksh 5 per minute) as shown in figure

7.9. We note that Mobile Internet at 8.33% of GNI per capita is much more affordable than fixed dial-up Internet at 39% of GNI per capita without the telecommunications charges (the calculations for mobile Internet and SMS are shown in tables 7.2 and 7.3). This partly explains the fast growth of mobile Internet customers. From the data collected, there are currently an estimated 236,220 mobile Internet customers compared to the 169,078 fixed dial-up customers. That is, mobile dial-up Internet customers already dominate the dial-up Internet market after only one year of operation. We estimate the equivalent average cost of mobile Internet users to be $47 per year, which is only 8.9% of the GNI per capita as shown in table 7.2. Thus, Mobile Internet services are currently priced much cheaper than fixed dial-up Internet services.

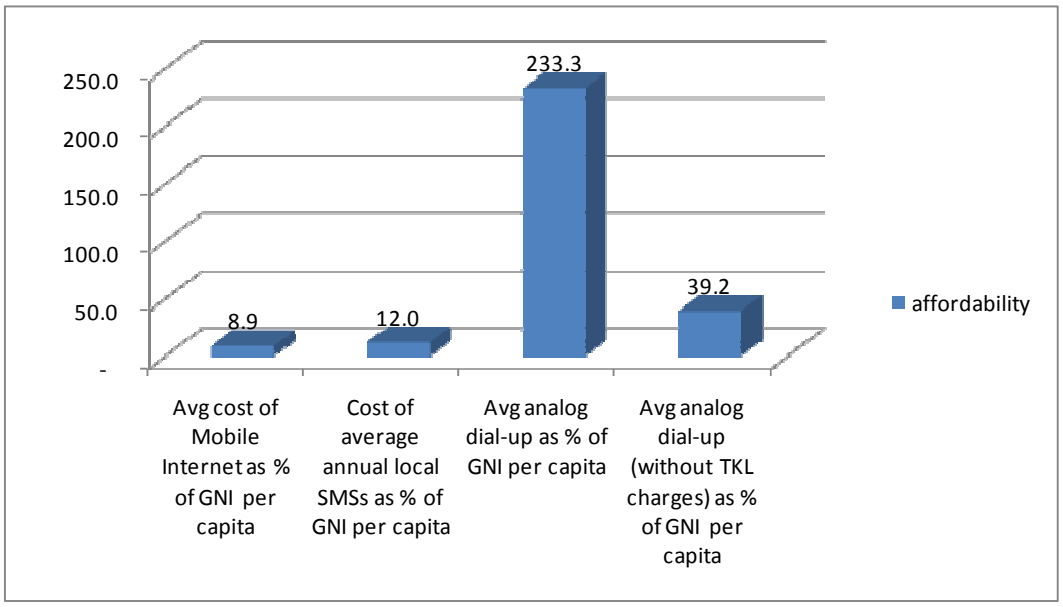
Table 7.2: Average mobile Internet cost as a percentage of GNI per capita

	Operator 1	**Operator 2**	**Source**
Mobile Internet tariffs per MB (Ksh)	10.00	10 (150MB), 12 (25MB)	Operator websites
		Source	**Comments**
Average cost per MB in US$	0.16		
Average annual cost of Mobile Internet in US$	47.14		Assume 25 MB per month for an ordinary user
GNI per capita 2005/06	530	World Bank	
Avg cost as % of GNI per capita	**8.89**		

Table 7.3: Average SMS cost as a percentage of GNI per capita

Total SMSs in 2006	4,114,119,325		
SMSs per subsciber per year	639		
SMSs per subsciber per month	53		
SMSs per subsciber per day	1.75		
	Operator 1	**Operator 2**	**Source**
Cost of 1 local SMS (Ksh)	2.50 off-peak, 5 (same net), 10 (to others)	5.13 (pre-paid), 5.34 (post-paid)	Operators websites
Average cost of 1 SMS in US$	0.072		
			Source
GNI per capita 2005/06	530		World Bank
Cost of 100 local SMSs as % of GNI per capita	1.365		
Cost of average annual local SMSs as % of GNI per capita	**8.722**		

Figure 7.9: Affordability of mobile, fixed dial-up, and SMS services



Mobile dial-up Internet is priced very differently from the fixed dial-up Internet. In this case, Mobile operators charge customers for the data received or transferred and not the duration of the call. This is a big advantage especially considering that Internet speeds are low and even just checking e-mail could take up to 5 minutes.

Although ADSL services have been introduced by some ISPs and operators, the number of customers is still very low (Telkom has about 5,000 ADSL customers). In fact, most of the ADSL connections are being used to provide leased lines. Broadband Internet to the customers is therefore not yet available.

7.4 Internet Access Revenues

Although the licensees did not give accurate figures on investment levels, especially the historical data, the study found that the investment by licensees has been very low. For example, the study results show that in the last five years, all licensees have only invested just over US$32 million on the Internet market. Table 7.4 shows the total Internet market revenue in the last five years. It also shows the average revenue per user (ARPU) based on estimated users by ITU. In comparison to ARPUs from other markets, this ARPU is relatively low. For example, the ITU 2006 World Telecommunication/ICT Development Report shows that the ARPU for the telecommunications market in Kenya in 2004 was US$222. This may partly explain why Internet services have not been attracting significant Foreign Direct Investments.

Table 7.4: ARPU per GNI for Internet communication services

	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006	Source
Internet users	400,000	1,000,000	1,054,920	1,111,000	2,770,296	ITU estimates for Y1 .. Y4. Internet study for Y5
Approx. total Internet market revenue (Ksh)	1,556,109,556	1,962,525,350	2,256,549,493	3,495,641,619	4,949,472,726	Internet Market Study
ARPU (US$)	55.58	28.04	30.56	44.95	25.52	

Sources: ITU and Internet Market Study

It is also clear that the Internet access business requires large numbers of customers. The current ISPs and fixed operators have a relatively small customer base and this means that Internet charges are not likely to drop even with an increase in the number of ISPs. It is therefore likely that it is the mobile operators who are most likely to succeed in the Internet access business.

In this study, we were unable to get credible data on other income streams for ISPs. However, the data confirmed that ISPs were fully reliant on dial-up Internet, leased line and e-mail services for their income. The only other revenue streams are web hosting and VoIP services, which, gauging from the small number of customers constitutes a very small proportion of their revenue. Thus, although many ISPs claim to offering other services, it appears that most of their revenues are from Internet access business rather than services, such as web hosting or content provider services.

We note that the value added services do not require the same economies of scale as Internet access. There is a need for ISPs to focus on application and content provider services and to leave the access business to the large operators. This will benefit the end-users because large operators can purchase bandwidth in bulk and do not need the large ratios of 6 or 12 to be profitable.

8. Key Factors in Development, Spread and Growth of Internet Services

8.1 Introduction

The Internet Service Provider and other Internet access providers were asked to rank some of the important factors that limit the growth of their business. ISPs in particular identified the following factors as being the most important:

a. Regulatory and licensing framework (53.8%)
b. Limited access to capital (34.5%)
c. Quality of human resources (14.3%)

We also analyzed the ranking by the different categories of licensees of other factors such as access to technology, rapid changes in technology, and business-related factors (e.g., competition, penetration of ICT in businesses, limited local content, affordability etc.). The results of the top two ranked factors for the different license categories are shown in table 8.1 below.

Table 8.1: Top two factors that have affected Internet for the various license categories

	IBGOs	**ISPs**	**LLOs**	**PDNOs**	***CVOs***
Access to capital				☑	☑
Access to technology					
Rapid changes in technology					
Human resources					
Regulatory and licensing framework	☑	☑		☑	☑
Policy	☑		☑		
Legal framework					
Other factors		☑	☑		

Thus, the licensees perceive that the most critical factor hindering development of the Internet is the regulatory and licensing framework.

Comments on how the factors shown in table 8.1 affected the various categories of licensees were analyzed and the results are shown in table 8.2 below.

Table 8.2: Comments on how the factors affected operators and service providers

Factor category	**How the factors affected the development and growth of the business**	**Frequency**
A. IBGOs		
Access to capital	Capital for roll out and modification lacking	1
	Budgetary limitations limiting access to the desired technology	1
Access to technology	Unable to access to technologies to support the services in the market	1
Rapid changes in technology	Rapid change in technology leads to high cost of service due to shorter depreciation periods on equipment	1
	Having to modernize and be up-to-date with technological changes in the market	1
Human resources		

Factor category	How the factors affected the development and growth of the business	Frequency
Regulatory and licensing framework	Inadequate allocation of frequency spectrum to enable wider coverage	2
	Frequent changes in licensing scheme	1
	Not allowed to provide VoIP services	1
	Licensing framework does not take into account technology convergence	1
	Distinct, single or stand alone licenses do not make good business cases, leading to a firm having several licenses	1
Policy		
Legal framework		
Interconnection	CCK not being able to enforce interconnection, especially for small operators	2
	Mandatory interconnection with the incumbent has been hindrance and the cost is too high	1
Other factors		
	Total	**14**
B. ISPs		
Access to capital	Access to capital means businesses cannot grow, cannot roll out business strategies, operators under-invest, etc.	13
	Most financial institutions have not adopted ICT funding	1
Access to technology	Access to cheaper technologies in the market competing with established but expensive technologies, reducing barriers to entry	1
Rapid changes in technology	Having to invest to newer technologies, e.g. migrating from copper to fibre to wireless, purchasing new hardware, etc.	10
Human resources	Inadequate qualified and skilled labour	3
	Availability of labour has been an enhancing facility to business growth	1
	High turnover of staff, necessitating high cost of training	1
Regulatory and licensing framework	Biased/unfair regulatory and licensing framework	3
	Licensing framework limits the time frame to venture new markets	1
	Implementation of regulations by CCK is slow for business growth	1
	Licensing costs too expensive, especially for small ISPs	2
	CCK's licensing process is bureaucratic and takes too long	4
	Biased policy in the provision of gateway license	2
	No levelling ground for ISPs	1
	Slow liberalization of the industry	1
	No clear regulatory policy, e.g. to regulate unfair competition practices	3
	Unfair practices by certain firms, e.g. unfair competition between ISPs and IBGOs for Internet access services to corporate customers, PDNOs with licensed ISPs dominating, special rates given to some firms and not others, licensing TKL to compete with ISPs, etc.	6
	Not allowing vertical integration	1
Policy	Lack of policy or clarity in policy causes confusion	4
Legal framework	Lack of appropriate legal framework, e.g. e-commerce, IPR	1
Tariffs	High International bandwidth tariffs	4
	High telephone charges for dial-up	*3*
Telecommunications infrastructure	Inadequate national infrastructure to reach markets, especially PDNO infrastructure	2
	Lack of fibre backbone infrastructure in Kenya	2

Factor category	How the factors affected the development and growth of the business	Frequency
	Low local loop penetration	1
	Unreliable distribution gateway/infrastructure	1
Other factors	TKL and KDN have frequent downtime problems on their links	2
	Mobile operators refusing to interconnect	2
	Low ICT awareness in the industry	1
	Tax on telecommunication equipment is too high	1
	Lack of capacity to cope with change	1
	Not yet terminating calls for TKL due to bureaucracy	1
	Limited amount of local content hinders growth of the industry	1
	Lack of capacity to manage growth	1
	Exchange rate losses	1
	Total	**84**
C. PDNOs		
Access to capital	Access to and expensive capital	2
Access to technology	Outdated unreliable and technology is dumped into the third world market	1
	Modern technology to support services	1
Rapid changes in technology	Rapid changes in technology can make investment is tricky, necessitate heavy investment in a short period, lead to an unstable market, etc.	3
	Having to keep up with changes in technology	1
Human resources	The lack of skilled technicians	1
Regulatory and licensing framework	The playing field needs leveling	1
	Ineffective regulatory and licensing framework, e.g. the regulatory environment needs to be more flexible to allow for changes in technology, licensing framework does not take into account convergence of technology	3
	A single standalone license do not make a good business case, e.g. limits access to capital	1
	Regulation of the tariffs and competition affects the revenue	1
	Regulation & licensing are still restrictive and harsh especially on frequencies; Frequency allocation and continuous calculation does not encourage expansion into rural areas and low density urban centres	2
	Scarce frequency spectrum, slowing growth	3
Policy	Government policies do not favour business interests	1
Legal framework		
Other factors	Mandatory interconnection with TKL limits costs reductions that can be passed to the end user	1
	Total	**22**
D. VSAT Operators		
Access to capital	Banks are sceptical in extending credit to telecommunications sector (deemed to be new)	1
Access to technology	Technology is not locally available	1
Rapid changes in technology	VSAT technology is rapidly changing	1
	Changes are very rapid while technology deployment can take long	1
Human resources	Number of skilled manpower on VSAT technology in Kenya is very low	1
Regulatory and licensing framework	Not having other licenses, e.g. ISP	1
	License processing took over 10 years thus we lost considerable	1

Factor category	How the factors affected the development and growth of the business	Frequency
	business	
Policy		
Legal framework		
Other factors	Having to procure services from Jambonet	1
	Lengthy and bureaucratic capital investment procedure	1
	High duties and taxes	1
	Huge capital investment	1
	Total	**11**

During a roundtable discussion of Internet experts and entrepreneurs, regulatory, policy, licensing, limited penetration of ICTs in business, government and households, and affordability were also identified as some of the factors inhibiting the growth of the Internet. For example, investors found the ISP license confusing and could only fund access networks (infrastructure) rather than the more important content development business. The Internet business leaders admitted that there is limited investment in content development and most of their investments are in infrastructure. The quality of ICT professionals was also identified as a big problem in the Internet business and they had to invest heavily in training without any guarantee of long-term staff retention.

We have therefore added the following other factors that have been identified as affecting growth of the Internet:

d. Limited ICT penetration in Sectors (business, government, and educational institutions)
e. Affordability of Internet services by Kenyans
f. Limited availability of locally relevant content

8.2 Regulatory and Licensing Framework

Operators and service providers identified regulatory and licensing framework to be the most critical factor hindering the development of the Internet market as shown in table 8.1. A closer examination of the comments by licensees as why this is the case in table 8.2, we synthesize the following explanations and their frequencies:

- Regulatory framework is unclear, does not address uneven level playing ground or does not regulate unfair competition practices (e.g. unfair competition between ISPs and IBGOs for Internet access services to corporate customers, PDNOs with licensed ISPs dominating, special rates given to some firms and not others), etc. (10)
- Inadequate allocation of frequency spectrum to enable expansion into rural areas, growth, etc. (7)
- Licensing process is bureaucratic and takes too long and can delay entry into a new market, lead to lost business opportunities, etc. (6)
- Licensing framework is biased and unfair, e.g. licensing TKL to compete with ISPs, (6)
- Not allowing vertical integration and issuing stand-alone licenses – does make a good business case, e.g. limits access to capital (6)
- Licensing and regulatory framework does not take into account technology convergence (4)

- Licensing costs too expensive, especially for small ISPs (2)
- Frequent changes in licensing scheme (1)
- Implementation of regulations by CCK is slow for business growth (1)
- Slow liberalization of the industry (1)
- Regulation of the tariffs and competition affects the revenue (1)

It is clear from the above synthesis that the most critical issue is the regulation of the unfair competition and business practices in the market. The second critical issue is the management of the frequency spectrum to meet the business needs of the licensees. This is closely followed by three other issues: the bureaucracies and delays in licensing, the unfairness and biases of licensing and the issuance of stand-alone licenses as opposed to unified licenses.

In Section 7, we analyzed the effect of the hierarchy of licensed Internet access providers and leased line tariffs on pricing of Internet services and affordability. The Internet business leaders, especially ISPs, perceive the licensing to be biased, slow and expensive. This was confirmed by the analysis of the comments of licensees as synthesized above. We now analyze some of the important regulatory and licensing factors that we believe have affected the growth of the Internet.

8.2.1 Monopoly in the Provision of Internet Bandwidth and Leased Lines

During the period from July 1999 to June 2004, Telkom Kenya was a monopoly provider of Internet bandwidth and also leased lines. During that period, leased line prices remained constant at a high cost of Ksh 14,400 per kb/s (local loop). This in turn affected the profitability of ISPs and increased the cost of Internet access to businesses and organizations (e.g., educational institutions). It also meant that ISPs could not cheaply establish POPs to connect larger groups of customers. In fact, data collected during the study shows that most ISPs still do not build their own network of POPs using leased lines but instead have multiple entry points into the backbone Jambonet network. This is not a good design. Similarly, during the monopoly period, Internet bandwidth remained expensive to the customer. At no time did the regulator invoke price regulation for the monopoly services of leased lines and international Internet bandwidth.

One of the effects of the monopoly provision of leased lines was the limited reach of the Kenstream network. This meant that ISPs could not reach some of their customers even near Nairobi. For example, the leased line capacity to Kenyatta University was only expanded using grant money given to the Kenya Education Network (KENET) in the year 2001. Similarly, Kenstream did not have capacity to JKUAT (35km from Nairobi), Daystar (25km from Nairobi), Africa Nazarene (30km from Nairobi), or Meru town in the year 2003. Digital microwave radios and Kenstream node equipment purchased using USAID grant to KENET were used to expand the backbone Kenstream network. However, this donation did not change the pricing of leased lines (see figure 7.5 in Section 7 for tariffs of leased lines during TKL's monopoly period).

Apart from the limited reach of the leased line network of the monopoly provider, the faults on the leased lines were unacceptably high. In the words of one of the CEOs of an ISP during the roundtable discussion, "it was not possible to sign an SLA with their customers with such

unreliable services". This means that the new PDNOs licensed in 2005 first needed to meet the capacity and quality needs of the exiting customers in Nairobi and Mombasa.

We note that collaboration between a PDNOs and mobile operators for example, could extend the geographical reach of the leased line network very rapidly. However, such arrangements need to be formalized by the regulator. We recommend that, rather than wait for small PDNOs to build parallel networks, CCK should grant the mobile operators the new Data Carrier Network Operator (DCNO) license to leverage on their national GSM networks to provide local leased line capacities to ISPs. There is however a need for CCK to protect ISPs from unfair competition or exploitation by the mobile operators providing Internet access services, especially in revenue sharing for customers and content.

8.2.2 Licensing of the Kenya Internet Exchange Point (KIXP)

Our analysis in Section 7 demonstrated that increasing the peering bandwidth at the KIXP could lower the cost of Internet. This is because it would reduce the demand for expensive international Internet bandwidth for most of the users in Kenya. In fact, the Internet was originally conceived as interconnected set of IXPs. Unfortunately, the need for a KIXP was not well understood by both the regulator and the monopoly provider of Internet bandwidth (Telkom Kenya) at the time it was proposed by ISPs. This delayed the licensing of KIXP up to 2001. However, even after licensing, the high cost of the digital leased lines as well as the limited availability of leased line capacity meant that peering did not grow rapidly. Telkom Kenya did not have a connection to the KIXP and yet it was switching local traffic from ISPs. Switching local traffic was therefore as expensive as switching international Internet traffic, a situation that has persisted up to 2006 when Telkom Kenya was finally connected to the KIXP at the modest bandwidth of 4 Mb/s.

In the future, it will be necessary to scale up the peering bandwidth so that it becomes much higher than the international Internet bandwidth. This is because most of the e-mail traffic is local (similar to SMSs and telephone calls). With competition in the leased line provider market, it is possible that leased line prices will fall to about Ksh 5,000 per 2 Mb/s line. This will be possible only if the large operators (Safaricom and Celtel) with economies of scale are allowed by the regulator to provide leased line capacity to end-users and ISPs.

We note that the current regulatory practice of licensing subsidiaries of small ISPs (as PDNOs) to provide leased lines means that the penetration will not change significantly. Moreover, small ISPs do not always use the expensive carrier class systems and the quality of the link is only good for small number of users.

8.2.3 Hierarchy of Internet Access Providers and Tariffs

In Section 7, we demonstrated that the IBGO, PDNO, IGO licenses simply add the cost of Internet access to the customer without adding much value. The large number of ISPs are also primarily in the business of Internet access or reselling Internet bandwidth rather being application providers as required by their licenses. In this study, it was not possible to unbundle the revenue streams from the different services. This is because of the non-transparent business practices adopted by the ISPs. Such business practices arise because of ineffective enforcement

of license conditions. Since it has been relatively easy for ISPs to simply resell bandwidth and overcharge customers for leased line terminations (traffic switching), there has been no motivation to either develop content or develop new markets.

One of the regulatory interventions that could change the Internet business is to license all the large operators (mobile and fixed) to provide Internet access and switching services. However, they would need to share revenue with the ISPs if customers visit their web sites or access services and content provided by the ISPs. New Internet services regulations will be required to promote fair competition.

8.2.4 Transparency of Internet Access Tariffs

Our study showed that less than 20% of ISPs (17.65) published their tariffs in the year 2005-2006. This is an improvement over the 5.8% in 2001-2002. Similarly 16.7% of the PDNOs publish their tariffs. Only the incumbent leased line provider continues to publish tariffs.

ISPs and IBGOs/IGOs do not distinguish local traffic from International traffic. Since it is much cheaper to switch local traffic at the KIXP or ISP routers (not expensive international bandwidth) this means that there is cross-subsidy of the services or that local traffic is priced at international bandwidth rates. At the IBGO level, it should be possible to separate local from International traffic. We recommend that the regulator requires that IBGOs unbundle their offerings. We also recommend that the regulator makes it a licensing condition for all operators to publish their Internet tariffs. This will ensure fair competition among the service providers and operators and promote transparency.

8.3 Affordability of Internet Services

In our analysis in Section 7, we demonstrated that fixed dial-up Internet services are not affordable by the majority of Kenyans. This is partly because of the local call timing of the fixed operator licensees. This high cost has affected the growth of the Internet market. In comparison, mobile Internet services are relatively cheap, at 8.8% of the GNI per capita. It is priced on usage rather than time spent on a call. It is likely that the availability of the cheaper Internet services by the mobile operators will drive the prices down and extend the reach of the Internet. It is also likely these prices will drop as the number of users continues to increase.

Although the average income of Kenyans is low at US $530 per capita, it has been shown that providing Internet services to schools, colleges and universities increases the number of users by very large numbers. The schools could then also operate as cheap cyber cafés for the local community. Clarke and Wallsten (2004), studied 27 high-income countries and 66 developing countries, and found that a 1-percentage point increase in the number of Internet users boosts total exports by 4.3 percentage points. A strategy of increasing Internet users by using schools and colleges to provide cheap Internet access to local communities will eventually translate to increase in incomes of the local communities.

8.4 Limited Availability of Local Content

During the roundtable organized by the regulator and the consultants as part of this study, Internet Service Providers admitted that they have not been investing in the development of local content. However, they admitted that the Internet traffic increased drastically when the Ministry of Education released the Kenya Certificate of Primary Education results via the Web. Data available at the KIXP also showed that there was a similar increase in local traffic when the Kenya Certificate of Secondary Education (KCSE) results were released via the Web (see Figure 5.10). This is a demonstration that local content increases demand for Internet services and is necessary for sustainable Internet business. Since the Internet Services were introduced in Kenya, the proportion of local content has been very limited and this has therefore affected the growth of the Internet. Most users simply want to use the ISP networks to access foreign content.

The Internet business leaders identified the following factors that have contributed to the slow growth of local content:

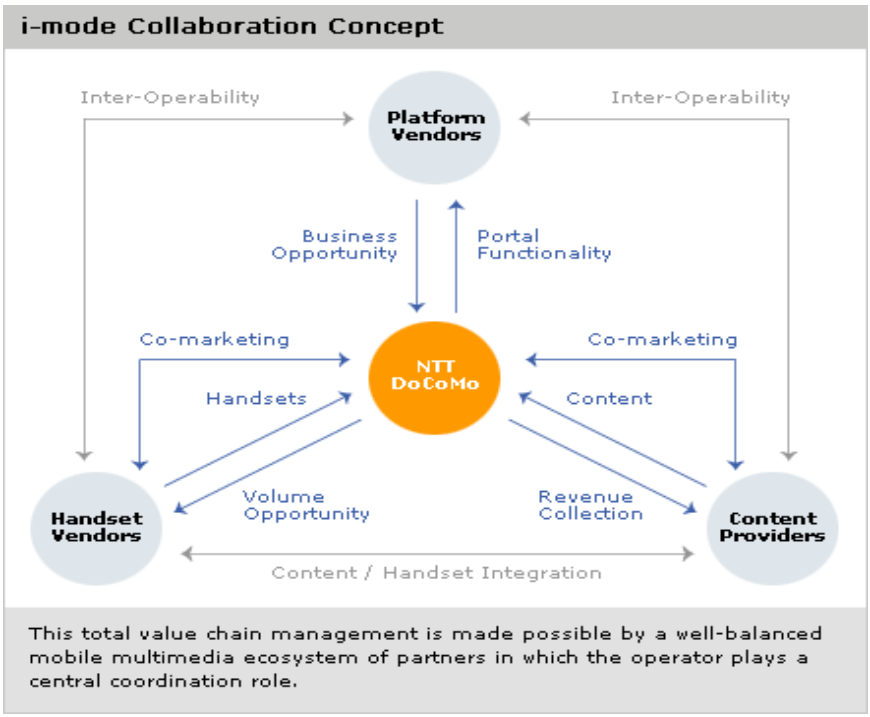
- The lack of E-government services similar to KCPE/KCSE that would increase demand for Internet services. Such services could be in areas of interest to local businesses and Internet users (e.g. Agriculture and Tourism).
- Although the initial ISPs focused on local content (e.g., Africa Online bulletin board and information services in 1995), the business model was not sustainable and the services were discontinued.
- The lack of e-commerce applications in Kenya means limited traffic from the local business community. This could support such critical sectors as agriculture, tourism, finance, trade, and education. For example, the Kenya Power & Lighting Company E-bill application is a partial e-commerce application that would increase local Internet traffic and make the ISP business sustainable.
- Lack of locally relevant educational content or e-learning content that would also increase the local traffic.
- The lack of investments in local content development by the ISPs. This is because ISPs are only able to attract funding for infrastructure and local access networks that are well understood by the investors. Content development and applications are not well understood by investors.

The above factors suggest that development of local content in Kenya will be driven by implementation of the E-government strategy (interactive government on-line), ICT in education strategy, and adoption of E-business applications by businesses in Kenya and E-commerce. We note that even partial e-commerce applications or ICT-facilitated international trade could make the ISP business viable.

The regulator does not need to explicitly support the content development, e-government, or e-commerce strategies of government and businesses. We believe a reduction in the cost of Internet access through increased competition from the large operators will drive ISPs into the local content development business and encourage businesses to develop E-business applications. More users will also use the Internet once the access costs are reduced through the regulatory intervention. The Internet access business is only viable with economies of scale and

heavy infrastructure investments. Internet applications and local content development on the other hand is often done by small business and entrepreneurs (e.g., the I-node service in Japan that is offered by NTT DoCoMo http://www.nttdocomo.com). The business model adopted by NTT DoCoMo is shown in figure 8.1.

Figure 8.1: Collaboration model



Source: www.nttdocomo.com

Although the regulator has no direct role in the model shown in figure 8.1, there is a need for the regulator to protect the ISPs (small businesses or entrepreneurs) from exploitation by the large operators providing Internet access services by developing new Internet and content services regulations. For example, many ICT entrepreneurs are developing SMS applications. However, the mobile operators insist on taking 60% of the revenue yet they do not add value in the business.

8.5 Limited ICT Penetration in Sectors

The study obtained data on sectoral absorption of the Internet in businesses, government, education and health institutions (see Section 6). The results indicated that only a small percentage of educational institutions (< 2%) are connected to ISPs using leased lines. That represents mainly the higher education institutions. Most of the leased lines customers of ISPs are commercial businesses. The government outside Nairobi is also not connected to the Internet. In general, 80% of the Internet business serves customers in Nairobi.

Although a demand-side business survey is necessary for establishing the reasons for low penetration of Internet in businesses and educational institutions, the following are possible reasons for the slow growth of Internet in Kenya:

- The high cost of leased-lines and Internet bandwidth (see Chapter 7 on affordability of Internet services)
- The limited geographical penetration of leased lines and their capacity in Kenya
- The low penetration of PCs and Intranets in local businesses, academic institutions, government, and health institutions (see 2002 E-readiness survey, research ICT Africa survey of ICTs in SMEs, and 2005 E-readiness survey of central government)

The regulator cannot directly influence the ICT penetration in business, government and educational institutions. However, the regulator has the important lever of reducing the cost of leased lines by introducing competition among the large operators with national networks (e.g., Safaricom and Celtel) and adopting cost-based pricing of leased lines. In addition, all IGO and IBGO licensees should be required to sell bandwidth to other operators and not only to their own group of companies or their own customers only.

9. Internet Market Forecasts

9.1 Forecast Internet Users

In our forecast we identify two classes of users:

a. Dial-up internet users (mobile or fixed)
b. Users in organizations or institutions with leased lines or permanent Internet connections

9.1.1 Rationale for Dial-up Internet user forecasts

Dial-up users could be small businesses, households, or individuals. For the purpose of this estimate we assume fixed dial-up users are residential households. Dial-up users include ADSL, fixed wireless and mobile Internet users in our analysis. The average size of a household is five. We assumed that mobile phones and mobile Internet in Kenya are being used as a substitute for fixed lines and fixed dial-up Internet. This has been the trend in other developing countries (ITU 2006). It is therefore possible that a mobile Internet connection serves households when connected to the household PC or other Internet access device including the mobile phone. In addition, a mobile phone will be used for individual access to Internet via the mobile phone. Although the average size of a household in Kenya is *five*, we have assumed an average of *two* Internet users per Mobile Internet connection. A future Internet-user survey could be used to revise this assumption.

Dial-up users are assumed to track the number of fixed or mobile customers. We make the assumption that 100% of the fixed lines will be used for dial-up Internet access including ISDN and ADSL access to households or small businesses. For mobile Internet, we assume only 10% of the mobile customers will sign up for mobile Internet services. The 10% is based on the fact that currently, about 4% of the mobile customers are also Mobile Internet customers after only one year of service. The 10% might therefore be a conservative estimate. The mobile Internet data at the end of the year 2007 could be used to revise this estimate. A demand-side survey would also provide better estimates of the Mobile Internet users.

Forecasted growth in fixed and mobile telephone customers

As explained above, fixed or mobile dial-up Internet are directly proportional to the number of fixed or mobile telephone customers. During the period 2000-2006, the number of cable-based (copper or optical) fixed-telephone customers remained at about 300,000. This is because the expected privatization of Telkom Kenya did not happen. However, there has been some growth of fixed wireless customers as Telkom Kenya and the licensed Local Loop Operators have started to connect customers in the past one year. During the period 2006-2007, Telkom Kenya has connected only 40,000 fixed wireless customers while the local loop operators have a subscriber base of about 6,000 customers. This is an annual growth rate of about 15%. In the next five years, this will translate to a growth of about 100%. That is, the estimated number of fixed lines subscribers will be about 600,000.

Our forecast is therefore based on a modest growth of 100% in the next five years. In addition, we assume that only 50% of the fixed lines will be used by households for Internet access. The

other fixed lines will be in institutions and will be terminated at Private Branch Exchanges (PBX) and used to support voice services. Moreover, users will have other options for broadband Internet access in urban residential areas, for example, using wireless local area network technologies like WiMax. These assumptions will need to be reviewed one year after the SNO is licensed and/or Telkom Kenya is fully privatized. A detailed Internet user survey (demand-side) will also generate a more accurate forecast of the Internet users.

Mobile telephone penetration has experienced dramatic increases in the period 2001-2006. The growth rate does not appear to have reached a peak even with about 8 million customers. However, the mobile operators are starting to focus more on customer retention by offering more value-added services. This includes the relatively cheap mobile Internet services and lower off-peak tariffs. We therefore estimate that the total mobile customers will be about 15 million in the next five years based on the forecasts of the operators. This is a growth of about 100%.

Categories of leased line customers and Internet user

Leased line customers are classified into the following categories:

a. Academic institutions (x1000)
b. Health institutions (x 100)
c. Commercial organizations or businesses (x 100)
d. Government (x 100)
e. Others category that includes civil society, NGOs, and religious organizations (x 100)

We then made the following assumptions in forecasting Internet users' growth:

- All sectors would experience an average growth of 40% in the number of institutions. This approximately mirrors the annual GDP growth of between 6% and 10%.
- All the sectors would double their penetration of leased Internet lines, except the Academic sector which would increase from 1.4% to 7% as explained later in this section.
- We used the international definition of the Partnership for Measuring ICTs for Development of Internet access (UNCTAD 2005). According to that definition, an Internet user is anyone who used the Internet (e-mail or Web) once in 12 months. The computer used could be a mobile phone, PDA or an ordinary PC.

9.1.2 Rationale for institutional users forecast

In the academic sector, we made the following assumptions:

- That a leased line to academic institutions provides Internet access to 1,000 users. For large institutions like universities, this is an underestimate because the leased line provides at least e-mail access to all students at least once in a year. With a university enrollment of 130,000 for the 17 universities, the users should be 130,000. Given the high enrollment rates in both secondary and primary schools, we therefore think the 1,000

figure is reasonable but will be confirmed by a demand side field survey. We recommended that a demand survey should be carried out as soon as possible.

- That 7% of the educational institutions will be connected to the Internet using a leased line. This gives about 2,178 institutional customers. This is not unreasonable given that the Ministry of Education actually plans to provide PCs to all secondary schools (a total of about 4,000) in its five year strategic plan. The 7% represents 50% of all the secondary schools and all universities and tertiary institutions. We ignored the small number of primary schools that will have access to the Internet for students.
- We also assumed that each of the rural secondary schools will be offering Internet services to the neighboring communities at modest cost.

For all other commercial organizations, government, cyber cafés and other institutions, we assumed that an average of 100 users is behind every leased line connection. This is because it the medium and large organizations that will first be connected to the Internet are assumed to have an average size of 100. We note that we could not get accurate data on the average size of businesses in Kenya. We think 100 is an underestimate if we include all the government departments.

Table 9.1 shows the results of the calculations based on the above assumptions. The forecast Internet users of about 8 million in the next five years would more than double the current penetration. This penetration is comparable to the current penetration of middle income countries such as Morocco.

Table 9.1: Forecast number of Internet users

	Leased line					Dial-up		Total
	Academic	**Commercial**	**Health**	**Govt**	**Others**	**Fixed Dial-up**	**Mobile Dial-up**	
No. of institutions/ customers	29,912	29,820	880	2,590	3,009	293,364*	6,484,791*	
Current no. of customers	414	6,978	149	743	591	169,078	236,220	
Current percentage with Internet access (%)	1.38	23.40	16.93	28.69	19.64	57.63	3.64	
Growth in institutions/ customers	40%	40%	40%	40%	40%	100%	100%	
Forecast no. of institutions	31,108	31,013	915	2,694	3,129	586,528	12,969,582	
Forecast percentage with Internet access (%)	7%	47%	34%	58%	40%	50%	10%	
Forecast no. of customers	2,178	14,576	311	1,562	1,252	586,528	1,296,958	
Factor	1,000	100	100	100	100	5	2	
Forecast no. of users	2,177,594	1,457,602	31,117	156,229	125,174	1,466,320	2,593,916	8,007,952

Sources: CCK and Internet Market Study

*Key: * This is the number of fixed and mobile telephone lines by 2006*

9.2 Investment Forecast

9.2.1 Rationale for investment forecasts

The questionnaires had questions on historical Internet investments of all licensees. However, historical data on investments was missing or inaccurate for most of the questionnaires analyzed. For example, in the last five years, all Internet licensees stated that they had only invested just over US$32 million.

Our forecast was therefore not based on the historical data but on the desired Internet infrastructure for supporting 8 million Internet users and the networked applications that will be required based on the Kenya ICT Policy, ICT Master plan, ICT in education strategy and the E-government strategy (i.e., BPO, E-learning, E-government and E-commerce applications). These are the strategic applications that will drive Internet usage in Kenya and have a significant economic impact. Of course, all the institutions will need to upgrade their internal information systems that would allow them to use the national Internet infrastructure. A national optical fiber backbone, an undersea optical connection, an e-learning portal, and full e-government strategy implementations will be achieved in the next five years.

Using the 8 million Internet users and the international bandwidth per user in the middle income countries, we forecast that the total international bandwidth in the next five years will be 10 gigabits per second (10 Gbps), over 10 times higher than the current 0.7 Gbps. This translates to a five (5) time increase in bandwidth per user, which is an indicator that the speed and quality of current Internet services is inadequate. We made the following assumptions for each category of users.

a. Academic sector: This will need access networks consisting of data centers (includes servers and power supply), last mile transmission links, and e-learning platform. This would be operated by KENET.

b. E-government strategic applications: We used data in the e-government strategy to calculate the level of investment that will be required for the different strategic applications like e-procurements, digital villages, automation of the state law office and judiciary among others. Automation of tax authority and Kenya Ports and Airports was not included in the strategic applications.

c. Establishment of an E-commerce platform that would support domestic and international e-commerce by individuals and businesses (i.e., support B2C and B2B e-commerce)

d. Establishment of a national optical fiber backbone and the undersea optical fiber network.

Once assumptions on infrastructure requirements of the above strategic applications were made, a calculation of the investments required was carried using the consultants experience on the estimated costs. We note that Kenya does not yet have a detailed ICT strategic plan that could have been used in the investment calculations. This could be achieved within a National

Information Infrastructure plan that is driven by strategic economic plans of the country. The UN Economic Commission for Africa (ECA) has a National Information and Communication Infrastructure model that could be used to develop an NII. We note that Mauritius, South Korea, and Singapore were driven by their respective NII developed in consultation with Ministry of Finance, private sector and academia.

9.2.2 Investment forecast

Table 9.2 below summarizes the forecasts in investment in the next five years. The table shows the sectors that will need to invest in the infrastructure. The academic sector might require internal resources as well as resources from the private sector and the government. Some other investments like E-commerce platforms and common network services are funded by the private sector or commercial organizations. We emphasize that this is a supply-side forecast (i.e., based on users forecast based on supply side data). The total investment required is forecast at approximately US$700 million. This is over 20 times the Internet investment levels of US$ 32 million invested by of the ISPs and operators in the past 5 years.

Table 9.2: Forecast investment in '000 US$

	Investor			
	Academic	*Commercial*	*Government*	*Total*
National backbone			150,000	
Access networks (DCNO, E-Govt and Education access infrastructure)	132,000	20,000	10,000	
POPs and common network services (IXPs, data centres, KENIC, etc.)	98,000	45,000		
Strategic ICT applications				
E-learning	196,000			
E-commerce platform		5,000		
E-government			25,000	
Total	426,000	70,000	185,000	**681,000**

Sources: Ministry of Education strategic plan, Internet Market Analysis, KENET strategic plan

10. Conclusions and Recommendations

We have grouped all the key conclusions and recommendations from the study under the broad categories identified in the integrated indicator framework presented in Section 3. We do this by outlining the challenges found in the study, identifying the desired outcomes to ameliorate the effects of the challenges and making recommendations for interventions to achieve these outcomes.

10.1 Network Infrastructure

The study established that the international bandwidth has increased tremendously since the end of TKL's exclusivity period, doubling in 2004 and more than doubling in 2005/2006 from the previous year. However, this bandwidth is too skewed towards downlink bandwidth (downlink bandwidth was about seven times the uplink bandwidth). This is an indication of high dependence on off shore hosted content. At the same time, international Internet bandwidth costs have not been falling in any significant way even as the number of IBGO licensees has been increasing. This could be due to the fact that new IBGO's tend to purchase bandwidth in small quantities and there are therefore no bulk-purchase advantages.

The study also established that peering bandwidth has tremendously increased over the last two years. In the last year, it increased over five fold from the previous year level. This bandwidth is nevertheless very small in comparison to international downlink bandwidth (downlink bandwidth is 44 times the peering bandwidth). One reason why ISPs are not buying adequate leased line capacity to KIXP is the relatively high cost of digital leased lines, which have not been falling in any significant way. A low ratio of International bandwidth to KIXP leased line capacity (or peering bandwidth) would reduce the impact of high international bandwidth prices on Kenyan Internet services. This is because leased lines are considerably cheaper than international bandwidth.

In order to grow the peering bandwidth considerably, we recommend that the regulator provides support to KIXP as a common network services resource on a PPP basis. This support could be in form of capacity building as the regulator currently provides to KENIC and KENET and could be done through local universities.

The limited reach, capacity and quality of the domestic leased line network are some of the factors that the study found hindered access to the Internet. A high speed and quality national backbone and broadband connectivity infrastructure to the end users is key to the development and operation of a suitable Internet nationally. We therefore recommend that Kenya implements a national information infrastructure (NII) project as an integral part of the priority socio-economic development plans based on the ECA's NICI framework. In addition, we recommend that the regulator requires that service level agreements (SLAs) be introduced at all levels and monitors and announces the quality of Internet services provided by operators and service providers.

Although the licensees did not give accurate figures on Internet investment levels, the study results show that in the last five years, there has been very little investment in the Internet

market, with all licensees having only invested just over US$32 million. The study also demonstrated that ARPUs for the Internet market are very low, perhaps partly explaining why Internet services have not been attracting significant Foreign Direct Investments. We have forecast a total investment of about US$700 million over the next five years. Most of this investment will largely go into establishing the national information infrastructure, including cable connection to the global Internet; developing access infrastructure and POPs in the Government, Academic and Commercial sectors; and implementing e-learning, e-government and e-commerce strategic applications. The implementation of these strategic applications will drive local content, which is key to the growth of the Internet.

With respect to competition, the study established that there is considerable competition in the provision of International bandwidth by both IBGOs and CVOs. There is however very little competition in the provision of domestic leased lines, with only two PDNOs being dominant on a national scale. The other PDNOs are small and owned by small ISPs. Although there are many ISPs, their competition is only concentrated on the Nairobi and Mombasa markets, with the competition focused on Internet access services only. Only one ISP was found to be dominant by geographical presence. In the dial-up Internet market, the network operators were found to be dominant.

We note that the current regulatory practice of licensing subsidiaries of small ISPs (as PDNOs) to provide leased lines means that the penetration will not change significantly. The net result of the setting up infrastructure by the PDNO subsidiaries of ISPs is a duplication of access networks. This is an additional cost which is passed on to the consumer and further reduces affordability. In order to significantly increase the penetration of leased lines, we recommend that large network operators are granted DCNO licenses. They should then be able to provided leased lines to both end-users and ISPs. However, the operators would need to share revenue with the ISPs if customers visit their web sites or access services and content provided by the ISPs. New Internet services regulations will be required to promote fair competition.

This study has established that leased lines are critical for the growth of the Internet. This is because business, government and other institutions that have a large number of potential Internet users (e.g., academic institutions) use leased lines for Internet access. Thus, leased lines are critical for increasing the number of Internet users. Leased lines are provided by PDNO's under the current license regime. As noted above, ISPs are applying for PDNO licenses using subsidiary or same group of companies. Such PDNO licensees have no intention of selling their leased line capacity to other independent ISPs but simply hope to provide quality services to their customers. This means that there is no competition among such PDNOs. It also seems to be cheaper for an ISP to have exclusive access to the subsidiary company PDNO leased lines rather than lease the lines from other PDNOs. That is, it appears to be cheaper for Access Kenya, for example, to use exclusive leased lines from a sister company rather than continue leasing lines from KDN or Telkom. This situation would also apply to NairobiNet (ISP) and Open Systems (subsidiary PDNO licensee).

It is also obvious that the parent or sister ISP would have a higher priority when it needs a leased line in a particular area than a 'competitor' ISP. That is, the PDNO does not treat all the ISPs in a fair manner. In addition, the leased line price to a sister company is not transparent and other

ISPs therefore cannot compete fairly with the sister ISP when it leases a line from the PDNO. This lack of transparency means that there is no fair competition.

The study also established that Safaricom or Celtel that have been granted IGO licenses do not resell international Internet bandwidth to other ISPs. This is despite the fact that the license requires that the bandwidth be available to other ISPs as a way of increasing competition among IGO licensees. That means, a mobile operator that can purchase International bandwidth at a low price of $625 per Mb/s per month could decline to resell the cheap bandwidth to other competitor ISPs downstream.

The examples above are both against the current Kenya Communications Regulations 2001 (KCR 2001) Clause 5(1) which states:

> ***5.****(1) The Commission shall, in the performance of its duties under the Act and these Regulations, promote, develop and enforce fair competition and equality of treatment among all licensees in any business or service relating to communications.*

The KCR 2001 were specifically developed for communications service providers although they could be extended to include Internet access operators and ISPs. However, we propose that CCK develops Internet specific regulations that ensure fair competition among the Internet providers and operators. The regulations would for example, require that IGO and PDNO licensees treat all ISPs fairly and have common tariffs for all ISPs. The proposed DCNO license will also require similar regulations to ensure that ISPs and end-users are treated fairly, especially by the dominant DCNO licensees. Although the development of the regulations is outside the scope of this project, we note that such regulations would enforce transparency among the different license holders. Regulations would also protect ISPs providing content services and networked application services from the dominant DCNO licensees.

Table 10.1 summarizes the interventions for provision of network infrastructure services.

Table 10.1: Recommended interventions for Network Infrastructure

Key Challenges	Desired Outcomes	Required Interventions	Responsibility
▪ Limited penetration and low capacity of the national backbone ▪ Limited investment in national backbone ▪ Lack of competition and trust in building a national backbone	Widespread and high-capacity national backbone infrastructure	▪ Implement a national information infrastructure (NII) project as an integral part of the priority socio-economic development plans based on the ECA's NICI framework ▪ Develop a legal instrument for implementation of national fibre backbone ▪ Strengthen the competition laws	▪ GoK, DCNOs, Partners ▪ GoK ▪ GoK
▪ Limited penetration of leased line network	Digital line capacity to be available wherever operators have a presence	▪ Make the DCNO license technology neutral, e.g. change clause 4.3 in the DCNO license to read: "Dedicated domestic and International links to licensed network operators, internet service	▪ CCK

Key Challenges	Desired Outcomes	Required Interventions	Responsibility
		providers and corporate entities" by dropping the term "VSAT". ▪ Grant network operators DCNO licenses in order to provide leased line capacity to end-users and ISPs ▪ Develop regulation to promote fair competition (e.g. cost of leased lines is the same for all ISPs irrespective of ownership, appropriate revenue sharing arrangements, etc.)	 ▪ CCK ▪ CCK
▪ Low peering bandwidth in comparison to international bandwidth	Peering bandwidth to be at least comparable to international bandwidth	▪ Provide support to KIXP as a common network services resource on a PPP basis	▪ CCK
▪ Quality of infrastructure is poor, e.g. dropped packets high, many faults, etc.	▪ Less than 10% dropped packets ▪ Less than 10 faults per leased line per year	▪ Require operators to maintain less than 10% dropped packets ▪ Require that SLAs be introduced at all levels ▪ Monitor and announce the quality of Internet services provided by operators and service providers	▪ CCK ▪ CCK ▪ CCK

10.2 Tariffs and Affordability

The study has established that Internet tariffs have not come down in any significant way since the end of the exclusivity period. At the same time, the hierarchical design of the Internet service provision results in high cost to the end-user, with operators and service providers at each tier creating their margins with very little value addition, and most times with quality of service degradation. As an illustration, for every 1 Mb/s purchased from the global Internet, IBGOs/CVOs connect 2 customers using 1 Mb/s links and that for every 1 Mb/s purchased from the IBGOs, the ISPs connect about 6 customers using 1 Mb/s links. Therefore the quality of the links has been degraded by a factor of 12 by the time it gets to the customer.

The minimum purchase cost of international bandwidth was found to be a mere US$625 per Mb/s compared to the average of $2,127 per Mb/s. That means the bulk purchasing capacity and use of long-term contracts with satellite providers can reduce cost of international bandwidth by about 3 times. The study also found that ISPs and IBGOs/IGOs do not distinguish local traffic from International traffic. We recommend that the regulator requires that IBGOs unbundle their offerings. We also recommend that the regulator makes it a licensing condition for all operators to publish their Internet tariffs. This will ensure fair competition among the service providers and operators and promote transparency.

Data presented in this report shows that fixed dial-up Internet is very expensive and not affordable by the majority of Kenyans, at over 200% of GNI per capita. The data also shows that without the timed local telecommunication charges, the figure comes down to less than 40% of GNI per capita. This demonstrates that local telecommunication charges constitute the largest

component of a fixed dial-up service. Mobile Internet and SMS are much more affordable (at less than 9% of GNI per capita) than fixed dial-up Internet even without the telecommunication charges. This partly explains the growth of mobile Internet customers, which have exceeded fixed dial-up customers.

In order to partly address the high cost of dial-up Internet charges, we recommend a flat rate telecommunication charges or volume-based pricing. We believe that this will reduce the cost of an Internet dial-up in the immediate to medium term before there more competition is introduced in both the fixed and mobile markets. For example, research has shown that one of the key reasons why some countries have achieved high Internet penetration levels is because they provide unlimited internet access plans and no local telephone usage charges.

The recommended interventions for dispersion are shown on table 10.2 below.

Table 10.2: Recommended interventions for Tariffs and Affordability

Key Challenges	Desired Outcomes	Required Interventions	Responsibility
▪ International Internet tariffs to the ISP and to the customer and are high ▪ Leased line tariffs are high ▪ High cost of the deep vertical hierarchy	▪ Internet tariff to the customer is cost plus margins ▪ Low leased line tariffs to support local broadband services	▪ Require all tariffs to be published on licensee websites ▪ Require IBGOs to unbundle their offerings ▪ Educate customers on Internet services	▪ CCK ▪ CCK ▪ CCK
▪ Fixed dial up Internet is not affordable by the majority of Kenyans (at over 200% of GNI per capita)	Fixed line dial up Internet to be less than 5% of GNI per capita	▪ Require flat rate telecommunication charges or volume-based pricing for fixed or mobile dial-up Internet services ▪ Increase competition in the fixed network	▪ CCK ▪ CCK
▪ Mobile Internet (at about 8% of GNI per capita) is still high	Mobile Internet to be less than 5% of GNI per capita	▪ Increase competition in the mobile market	▪ CCK

10.3 Dispersion

The study established that Internet penetration in Kenya is comparable to the comparator countries in level A (low income, low average IOI) but very low in comparison to the comparator countries in level B, which is where Kenya should initially aim to be. One of the key reasons for this is that Kenya has never had an Internet strategy. Comparator countries in middle and high income bracket that had achieved high Internet penetration levels had deliberate and focused strategies to grow the Internet market as part of their national socio-economic development plans. The Morocco government, for example, invested heavily in ICTs since 2004 as an agent for enabling the business process outsourcing (BPO) industry which had been identified as one of the key sectors to be supported. We therefore recommend that Kenya develops and implements an Internet strategy that is clearly linked to the priority national socio-economic development plans.

We have forecast that, with the right strategy, the number of Internet users can grow from the current estimate of 2.7 million to about 8 million, which is more than double the current penetration level and comparable to the current penetration of middle income countries such as Morocco. This is a forecast based on supply-side data. A better estimate would be obtained with additional data from the demand side. To this end, we recommend that the regulator funds a national demand baseline survey using the Partnership for Measuring ICT for Development Framework. This study should be repeated every year.

It was interesting to note that mobile Internet customers have overtaken fixed line dial-up clients. The high penetration of mobile represents a major opportunity for the growth of the Internet. It is therefore recommended an Internet strategy is part of the NII project recommended in section 10.1 above.

The study found that Internet POPs are in only 50% of the Kenyan districts. At the same time, Nairobi province has the lion's share (over 80%) of the Internet customers. The Coast province is a distant second with about 9% of the customers. Indeed, Nairobi and the Coast province account for about 90% of all Internet customers. Eastern, Western and North Eastern provinces have the lowest number of Internet customers in respective decreasing order, with the last two having a negligible percentage. In order to address these disparities, we recommend a review and an implementation of the UA/US strategy.

Further, the study established that overall, sectoral absorption of Internet is very low (12-13% of all institutions). The Commercial sector has the highest number of both leased and dial up lines (about 80% of the total in both cases and a penetration level of over 20%) while the Academic sector has the least penetration (just over 1% of all the institutions in the sector for both leased and dial-up lines). We recommend provision of incentives from UA/US funds to Internet access providers to provide broadband Internet services to at least 50% of all secondary schools in every district and all Teacher Training Colleges (TTCs) and Technical Training Institutes (TTIs).

Finally, the study found that inadequate locally relevant content to be one of the key factors limiting the growth of the Internet. The role of locally relevant content to the demand for Internet was demonstrated by the dramatic increase in Internet traffic when the Ministry of Education released the Kenya Certificate of Primary Education results via the Web. We believe that the growth of Internet will be driven by the implementation of specific strategic applications that create locally relevant content. To this end, we recommend that the regulator provides incentives from Universal Access/Service funds to content providers to develop public educational content, that the government and stakeholders create the necessary legal framework for e-commerce transactions and that the government intensifies the implementation of the e-government strategy. At the same time, we recommend the design and implementation of targeted consumer awareness campaigns on the role of the Internet and the benefits of the various Internet applications, e.g. e-commerce.

The recommended interventions for dispersion are shown on table 10.3 below.

Table 10.3: Recommended interventions for Dispersion

Key Challenges	Desired Outcomes	Required Interventions	Responsibility
▪ Limited Internet penetration ▪ Internet POPs are in only 50% of the districts (ISPs in less than 30% of districts)	At least double Internet penetration	▪ Fund an annual national demand baseline survey using the Partnership for Measuring ICT for Development Framework, starting 2007 ▪ Develop and implement an Internet strategy clearly linked to the priority socio-economic development plans ▪ Design and implement consumer awareness campaigns for the role of Internet	▪ CCK ▪ GoK, Partners ▪ CCK, GoK
▪ Huge disparities in regional distribution of Internet customers	More equitable uptake of Internet in the regions	▪ Review and implement the UA/US strategy	▪ CCK
▪ Limited absorption of Internet in all sectors, especially in Education sector	Increased absorption into the education (at least 50% of all secondary schools are connected)	▪ Provide incentives from UA/US funds to Internet access providers to provide broadband Internet services to at least 50% of secondary schools in every district and all TTCs and TTIs	▪ CCK, MoE
▪ Very limited locally relevant content	At least 50% of the Internet content is locally relevant	▪ Provide incentives from UA/US funds to content providers to develop public educational content ▪ Intensify the implementation of e-government services ▪ Create the necessary legal framework to support e-commerce transactions ▪ Create consumer awareness of the benefits of Internet applications, e.g. e-commerce	▪ CCK ▪ GoK ▪ GoK, Stakeholders ▪ CCK

10.4 Other factors

The study established that the licensees perceive that the most critical factor hindering development of the Internet is the regulatory and licensing framework. A closure examination revealed that the specific factors that hindered the growth of the Internet market are the inability to regulate the unfair competition and business practices in the market, the poor management of the frequency spectrum, the bureaucracies and delays in licensing, the unfairness and biases of licensing, and the issuance of stand-alone licenses as opposed to unified licenses. The regulator can address these issues by increasing the fairness, transparency, efficiency and effectiveness of the licensing and regulatory processes, procedures and decisions.

It is necessary for CCK to choose the most critical data that needs to be collected on a regular basis and amend the database to only contain the pertinent data sets. This will need to be complimented by awareness creation among the licensees on the importance of keeping accurate records and increasing the level of disclosure to the regulator. The regulator will then need to obligate operators and service providers to provide the required data sets on a regular basis. In

addition, given the gaps in the current database, it will be necessary to collect data for the past two years each time the annual surveys are carried out in order to increase the credibility of the database. The regulator also needs to have certain aggregate data sets of the database accessible via the Internet and to publicize the database so that CCK becomes the reference point for data on this market.

The Kenya Bureau of Statistics carries out a number of household and business surveys every year. The bureau is increasingly collecting data on ICT. We recommend that the regulator establishes mechanisms of collaborating with the bureau in either collecting the required data or exchanging data. Similarly, we recommend that CCK explores mechanisms of collaborating and exchanging data with the Kenya Revenue Authority, which is also a custodian of relevant data (e.g. ICT equipment imported into the country).

The recommended interventions for "others" are shown on table 10.4 below.

Table 10.4: Recommended interventions for "Others"

Key Challenges	Desired Outcomes	Required Interventions	Responsibility
		▪ Ensure that licensing and regulatory processes, procedures and decisions are fair, transparent, efficient and effective	▪ CCK
		▪ Ensure that the database is updated every year from annual returns by licensees and from both supply- and demand-side surveys	▪ CCK
		▪ Publicize the database so that CCK becomes the reference point for data	▪ CCK
		▪ Establish collaboration and data exchange mechanisms with KRA and CBS	▪ CCK

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Annexes

Annex 1: Questionnaire for the Internet Market Analysis Study

General

1. Date: _____ Interviewer:_____

2. Interviewee:_____ Position:_____

3. Name of institution: _____

4. Type of institution (Please tick ☑):

IBGO ☐	ISP ☐	PDNO ☐	VSAT Operator ☐	LLO ☐	Mob. Operator ☐	IXP ☐

Specify Other ……..

5. Address:

P.O. Box	
Code	
Location	
Town	
District	
Province	
Telephone	
E-mail	
Fax	
Web site	

6. What is the ownership structure of your internet business? Please tick.

100% Locally	60-80% Locally	40-60% Locally	20-40% Locally	< 20% Locally	100% Foreign owned	Other specify

7. What was the total number of Internet customer accounts in the last five years?

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

8. What was the Internet investment levels in the past five years in Ksh?

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

9. Please indicate the proportions of this investment in the following categories.

	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006
Computer hardware					
Networking hardware					
Software					
Communication infrastructure, e.g. local loop					
Business development, including R&D					
Power					
Human resources					
Physical infrastructure, e.g. buildings, masts, etc.					
Security					

10. What were your Internet services revenues in Ksh in the last five years?

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

11. What were your Internet services total operating expenses in Ksh in the last five years?

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

12. Does your institution have an Internet business strategic plan, whether separate or an integral part of the corporate plan? (Yes/No)

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

Voice services

13. What was the total number of post-paid fixed telephone customers connected to your network?

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

14. Who in your view constitutes a pre-paid customers? Please tick.

Active for at least 12 months in a year	Active for at least 6 months in a year	Active for at least 3 months in a year	Possession of a line (active or not)	Other (specify)

15. What was the total number of pre-paid fixed telephone customers connected to your network? (Active for at least 3 months in one year)

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

16. How many post-paid mobile telephone customers did you have in the past 5 years?

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

17. What was the total number of pre-paid mobile telephone customers do you have? (i.e., customers who sent or received a call at least once every 3 consecutive months of the year)

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

18. What was the total number of VoIP telephone customers?

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

19. What were the call-minutes recorded for your VoIP telephone services in the last five years?

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

20. What were the call-minutes recorded for your international telephone services in the last five years?

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

Internet services

21. Do you publish detailed Internet services tariff on your web site or in the media? Yes/No

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

22. Please provide the tariff structure for your dial-up Internet services in the last five years.

	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006
Analog					
Digital					

23. Please provide the tariff structure for your ADSL services in the last five years.

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

24. Please provide the tariff structure for your Internet leased line services to your customers (provide published documents, if available).

	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006
16Kbps					
32Kbps					
64Kbps					
128Kbps					
192Kbps					
256Kbps					
320Kbps					
512Kbps					
640Kbps					
768Kbps					
960Kbps					
1024Kbps					
1536Kbps					
1728Kbps					
2Mbps					
3Mbps					
4Mbps					
5Mbps					
6Mbps					
7Mbps					
8Mbps					

	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006
9Mbps					
10Mbps					

25. Please provide the tariff structure for your Internet bandwidth services (provide published documents, if available).

	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006
16Kbps					
32Kbps					
64Kbps					
128Kbps					
192Kbps					
256Kbps					
320Kbps					
512Kbps					
640Kbps					
768Kbps					
960Kbps					
1024Kbps					
1536Kbps					
1728Kbps					
2Mbps					
3Mbps					
4Mbps					
5Mbps					
6Mbps					
7Mbps					
8Mbps					
9Mbps					
10Mbps					

26. List all the Internet services that you have provided in the past five years, including VoIP and SMS services (please tick the service against the year). Indicate the number of customers, call minutes for VoIP, or total SMSes for each year.

Internet Service	2001-2002	Accounts/ Call minutes/ SMSes	2002-2003	Accounts/ Call minutes/ SMSes	2003-2004	Accounts/ Call minutes/ SMSes	2004-2005	Accounts/ Call minutes/ SMSes	2005-2006	Accounts/ Call minutes/ SMSes
Dial-up										

Internet Service	2001-2002	Accounts/ Call minutes/ SMSes	2002-2003	Accounts/ Call minutes/ SMSes	2003-2004	Accounts/ Call minutes/ SMSes	2004-2005	Accounts/ Call minutes/ SMSes	2005-2006	Accounts/ Call minutes/ SMSes
Internet										
Leased line Internet										
E-mail										
VoIP Accounts										
VoIP Call minutes										
Web hosting										
E-commerce										
SMS										
Mobile Internet										
Others										

Network speed and quality

27. What is the total bandwidth and annual cost purchased from your **upstream providers** for the last 5 years?

	2001-2002		2002-2003		2003-2004		2004-2005		2005-2006	
	b/width	Cost	b/width	cost	b/width	Cost	b/width	Cost	b/width	Cost
Provider 1										
Provider 2										
Provider 3										

28. What is the total capacity of the digital leased line (in kb/s) connecting your POPs to your customers?

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

29. What factors influence the pricing of your connectivity to users? Please rank the factors in terms of their importance (where 1 is the most important).

Factor	Rank	Factor	Rank
Cost of the leased lines		Taxes	
Cost of bandwidth from upstream providers		Competition	
Operational costs		Human resources	
Interconnection costs		Other (specify)	
License fees			

30. What was the capacity of the digital leased line (in kb/s) connecting your POPs to the any of the Kenyan Internet Exchange Points?

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

31. What was the capacity of the digital leased line (in kb/s) connecting your POPs to other POPs in your network?

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

32. What was the capacity of the digital leased line (in kb/s) connecting your POPs to other providers POPs in Kenya?

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

33. What was the capacity of uplink Internet bandwidth (in kb/s) you purchased from your upstream bandwidth provider (e.g., Telkom Kenya or Jamii)?

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

34. What was the capacity of satellite DVB Internet bandwidth (in kb/s) you purchased from your upstream bandwidth provider (e.g., Telkom Kenya or Jamii)?

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

35. Provide the bandwidth for different transmission media used to connect your POPs to your upstream Internet bandwidth provider.

	2001-2002		2002-2003		2003-2004		2004-2005		2005-2006	
Media	Tick media	B/width	Tick media	B/width	Tick media	B/width	Tick media	B/width	Tick media	B/width
Copper (dial up, ADSL, ISDN)										
Fiber										
VSAT										
Wireless										
Microwave										
Other (specify)										

36. Provide the bandwidth for different transmission media used to connect your customers (local access network).

	2001-2002		2002-2003		2003-2004		2004-2005		2005-2006	
Media	Tick media	B/width	Tick media	B/width	Tick media	B/width	Tick media	B/width	Tick media	B/width
Copper (dial up, ADSL, ISDN)										
Fiber										
VSAT										
Wireless										
Microwave										
Other (specify)										

37. On average, how many digital leased line faults per month (your customers or your own) occurred in the last five years?

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

38. Does your organization monitor the packet loss for Internet traffic? Yes/No

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

39. Have you installed any Internet bandwidth management software in your POPs? Yes/No

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

Service and support

40. How many employees provide helpdesk or customer care services?

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

41. How many system or network administrators do you have?

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

42. How long does it take to install a leased line for your customers in weeks (from application of leased line to installation)?

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

43. How long on average does it take to clear a digital leased line fault reported by your customer or your own? (in days)?

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

44. Do you provide Internet-based support to your customers? Yes/No

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

Locally relevant content

45. How many non-Kenyan domain names (.com, .org, .info) have you registered for your customers in the 5 years?

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

46. How many public IP addresses have you applied for your customers in the last five years?

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

47. How many Web sites have you hosted for your customers in the last five years?

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

48. How many e-commerce Web sites have you hosted for your customers in the in the last 5 years?

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

49. Do you count the number of visitors to your Web sites or the Web sites you host for your customers?

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

50. What is the number of International visitors (outside Kenya) to your Web site?

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

51. What is the number of local visitors (in Kenya) to your Web site?

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

52. What is the number of International visitors (outside Kenya) to the Web sites you host at your site?

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

53. What is the number of local visitors (from other IP addresses in Kenya) to the Web sites you host at your site?

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

54. Do you mirror your Web site outside Kenya? Yes/No

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

55. If yes, indicate the region where you mirror your site (North America, Europe, Africa, Others)?

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

56. Have you advertised your Web site in other media (e.g., radio, TV, print etc.) Yes/No

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

ICT power supply and air-conditioning

57. Does each of your POPs have access to commercial power supply from the electrical utility company (i.e. KPLC)? Yes/No

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

58. Do you have a backup diesel generator for all ICT equipment for some of your POPs? Yes/No

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

59. If yes, what is the annual cost of maintaining the diesel generator (in Ksh)?

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

60. What is the inventory cost of the generator plant in Ksh?

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

61. Do you have UPS equipment for your server equipment? Yes/No

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

62. What is the total UPS inventory in Ksh?

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

63. Do you have air-conditioning equipment for your server room? Yes/No

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

Security for ICT equipment and software

64. Are all networked computers protected using a licensed anti-virus software? Yes/No

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

65. Do you protect your customer e-mail against Spam mail, Internet spy ware and computer viruses? Yes/No

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

66. What kind of security do you have for your POPs (Please tick)?

	2001-2002		2002-2003		2003-2004		2004-2005		2005-2006	
	Tick	Cost	Tick	Cost	Tick	Cost	Tick	Cost	Tick	Cost
Physical security										
Security guards										
Radio alarm										
Off-site back-up										
Disaster recovery centre										
Other (specify)										

67. Have you had a security breach into your network in the last 5 years? Yes/No

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

68. How often do you back-up data on the servers? _____

Internet Employment opportunities

69. What is the total number of employees in your Internet business?

	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006
Male					
Female					

70. How many ICT professionals (ICT managers, programmers, network engineers web developers, system and web administrators, analysts, technicians etc.) are employed in your organization?

	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006
Male					
Female					

71. How many ICT professionals were hired in last 5 years by your organization?

	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006
Male					
Female					

72. How many expatriates are employed in your ICT departments of the Internet business?

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

73. How long does it take in months to fill a senior ICT professional position (e.g., analyst, network engineers, IT managers etc.)?

2001-2002	2002-2003	2003-2004	2004-2005	2005-2006

Geographical Dispersion

74. In which districts do you have Internet POPs?

DISTRICT	☑	**DISTRICT**	☑	**DISTRICT**	☑	**DISTRICT**	☑
NAIROBI		**EASTERN**		**NYANZA**		**R/VALLEY**	
Nairobi		Embu		Bondo		Baringo	
CENTRAL		Isiolo		Gucha		Bomet	
Kiambu		Kitui		Homa Bay		Buret	

DISTRICT	☑	DISTRICT	☑	DISTRICT	☑	DISTRICT	☑
Kirinyaga		Machakos		Kisii		Kajiado	
Maragua		Makueni		Kisumu		Keiyo	
Murang'a		Marsabit		Kuria		Kericho	
Nyandarua		Mbeere		Migori		Koibatek	
Nyeri		Meru Central		N.Kisii		Laikipia	
Thika		Meru North		Nyando		Marakwet	
WESTERN		Moyale		Rachuonyo		Nakuru	
Bungoma		Mwingi		Siaya		Nandi	
Busia		Nithi - Meru S.		Suba		Narok	
Butere/Mumias		Tharaka		**COAST**		Samburu	
Kakamega				Kilifi		Trans Mara	
Lugari				Kwale		Trans Nzoia	
Mt. Elgon				Lamu		Turkana	
Teso				Malindi		Uasin Gishu	
Vihiga				Taita Taveta		West Pokot	

75. How many Internet customers are there in each district?

DISTRICT	USERS	DISTRICT	USERS	DISTRICT	USERS	DISTRICT	USERS
NAIROBI		**EASTERN**		**NYANZA**		**R/VALLEY**	
Nairobi		Embu		Bondo		Baringo	
CENTRAL		Isiolo		Gucha		Bomet	
Kiambu		Kitui		Homa Bay		Buret	
Kirinyaga		Machakos		Kisii		Kajiado	
Maragua		Makueni		Kisumu		Keiyo	
Murang'a		Marsabit		Kuria		Kericho	
Nyandarua		Mbeere		Migori		Koibatek	
Nyeri		Meru Central		N.Kisii		Laikipia	
Thika		Meru North		Nyando		Marakwet	
WESTERN		Moyale		Rachuonyo		Nakuru	
Bungoma		Mwingi		Siaya		Nandi	
Busia		Nithi – Meru S.		Suba		Narok	
Butere/Mumias		Tharaka		**COAST**		Samburu	
Kakamega				Kilifi		Trans Mara	
Lugari				Kwale		Trans Nzoia	
Mt. Elgon				Lamu		Turkana	
Teso				Malindi		Uasin Gishu	
Vihiga				Taita Taveta		West Pokot	

76. Rank in terms of importance (where 1 is the most important) the key factors you considered in opening the POPs outside Nairobi?

	Eco-nomic	Public obligation	Education	Telecoms infra-structure	Power infra-structure	Other infra-structures, e.g. roads	Physical geography	Others (specify)
Rift Valley								
Western								
Nyanza								
North Eastern								
Coast								
Eastern								
Central								

Sectoral Absorption

77. What is the number of institutions and amount of bandwidth for the following **academic institutions** with Internet connectivity of the following types?

Internet Connectivity		**Primary Schools**	**Secondary Schools**	**Colleges**	**Universities**
Analog leased line	No. of institutions				
	Total bandwidth				
Digital leased line (ADSL, ISDN)	No. of institutions				
	Total bandwidth				
Wireless leased line	No. of institutions				
	Total bandwidth				
Dial up	No. of institutions				
	Total bandwidth				
VSAT	No. of institutions				
	Total bandwidth				
Mobile Internet	No. of institutions				
	Total bandwidth				
Other (specify)	No. of institutions				
	Total bandwidth				

78. What is the number and amount of bandwidth for the following **commercial businesses** with Internet connectivity of the following types?

Internet Connectivity		**Distribution**	**Finance**	**Manufacturing**	**Retail**	**Services**
Analog leased line	No. of institutions					
	Total bandwidth					
Digital leased line (ADSL, ISDN)	No. of institutions					
	Total bandwidth					
Wireless leased line	No. of institutions					
	Total bandwidth					
Dial up	No. of institutions					
	Total bandwidth					
VSAT	No. of institutions					
	Total bandwidth					
Mobile Internet	No. of institutions					
	Total bandwidth					
Other (specify)	No. of institutions					
	Total bandwidth					

79. What is the number and amount of bandwidth for the following categories of **commercial businesses** with Internet connectivity of the following types?

Internet Connectivity		**Large corporates** (> 100 employees)	**Medium corporates** (50-100 employees)	**Small enterprises** (10-50 employees)	**Micro enterprises** (< 10 employees)
Analog leased line (analog)	No. of institutions				
	Total bandwidth				
Digital leased line (ADSL, ISDN)	No. of institutions				
	Total bandwidth				
Wireless leased line	No. of institutions				
	Total bandwidth				

Internet Connectivity		**Large corporates** (> 100 employees)	**Medium corporates** (50-100 employees)	**Small enterprises** (10-50 employees)	**Micro enterprises** (< 10 employees)
Dial up	No. of institutions				
	Total bandwidth				
VSAT	No. of institutions				
	Total bandwidth				
Mobile Internet	No. of institutions				
	Total bandwidth				
Other (specify)	No. of institutions				
	Total bandwidth				

80. What is the number and amount of bandwidth for the following categories of **commercial businesses** with Internet connectivity of the following types?

Internet Connectivity		**Export-based businesses**	**Import-based businesses**
Analog leased line (analog)	No. of institutions		
	Total bandwidth		
Digital leased line (ADSL, ISDN)	No. of institutions		
	Total bandwidth		
Wireless leased line	No. of institutions		
	Total bandwidth		
Dial up	No. of institutions		
	Total bandwidth		
VSAT	No. of institutions		
	Total bandwidth		
Mobile Internet	No. of institutions		
	Total bandwidth		
Other (specify)	No. of institutions		
	Total bandwidth		

81. What is the number and amount of bandwidth for the following **health institutions** with Internet connectivity of the following types?

Internet Connectivity		**Hospitals**	**Clinics**	**Medical Research Centers**	**Physicians/ Practitioners**
Analog leased line (analog)	No. of institutions				
	Total bandwidth				
Digital leased line (ADSL, ISDN)	No. of institutions				
	Total bandwidth				
Wireless leased line	No. of institutions				
	Total bandwidth				
Dial up	No. of institutions				
	Total bandwidth				
VSAT	No. of institutions				
	Total bandwidth				
Mobile Internet	No. of institutions				
	Total bandwidth				
Other (specify)	No. of institutions				
	Total bandwidth				

82. What is the number and amount of bandwidth for the following **government institutions** with Internet connectivity of the following types?

Internet Connectivity		**Central Government**	**Local Authorities**	**Other Government Organizations (.go.ke)**
Analog leased line (analog)	No. of institutions			
	Total bandwidth			
Digital leased line (ADSL, ISDN)	No. of institutions			
	Total bandwidth			
Wireless leased line	No. of institutions			
	Total bandwidth			

Internet Connectivity		Central Government	Local Authorities	Other Government Organizations (.go.ke)
Dial up	No. of institutions			
	Total bandwidth			
VSAT	No. of institutions			
	Total bandwidth			
Mobile Internet	No. of institutions			
	Total bandwidth			
Other (specify)	No. of institutions			
	Total bandwidth			

83. What is the number and amount of bandwidth for the following **institutions** with Internet connectivity of the following types?

Internet Connectivity		International NGOs	Local NGOs	Religious organizations	Other community-based organizations
Analog leased line (analog)	No. of institutions				
	Total bandwidth				
Digital leased line (ADSL, ISDN)	No. of institutions				
	Total bandwidth				
Wireless leased line	No. of institutions				
	Total bandwidth				
Dial up	No. of institutions				
	Total bandwidth				
VSAT	No. of institutions				
	Total bandwidth				
Mobile Internet	No. of institutions				
	Total bandwidth				
Other (specify)	No. of institutions				
	Total bandwidth				

Other influences on the Internet business

84. Rank in terms of effect (with 1 as the greatest effect) the duties and taxes that have most affected the development, spread and growth of your firm's Internet business?

Import duty	VAT	Corporate tax	Excise duty	Training levy	Corruption	Others (specify)

85. Please explain in what ways these duties and taxes have positively or negatively affected the provision of your Internet services.

_____

_____

86. Which categories of professional ICT staff does your firm have adequate/inadequate numbers available in Kenya? Please tick.

	Telecoms Engineers	Hardware Engineers	Software Engineers	Technicians	Business Analysts	Others (specify)
Adequate						
Inadequate						

87. Please explain how the unavailability of adequate skilled labour in Kenya affected the development and growth of your Internet services outside Nairobi?

_____

_____

88. What strategies have you often employed to address the unavailability of adequate skilled labour in specific areas of your business operations? Please tick.

Hire expatriates	On-the-job training	Targeted training	Hire consultants	Poach from other firms	Others (specify)

89. Indicate the sources of your Internet capital budget in the last five years from the following options (please tick).

	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006
Owners equity					

	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006
Internal / profits					
Bank loans					
Others (specify)					

90. To what extent have these sources been adequate to cover your firm's business plans? Please tick.

<20%	20%-40%	40%-60%	60%-80%	80%-100%

91. Rank the key factors that have affected the development and growth of your firm's Internet business (with 1 representing the factor with greatest effect).

Access to capital	Access to technology	Rapid changes in technology	Human resources	Regulatory and licensing framework	Policy	Legal framework	Others (specify)

92. Please explain how the top four factors have affected the development and growth of your firm's Internet business.

1._____

2._____

3._____

4._____