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By Hon Aden Duale
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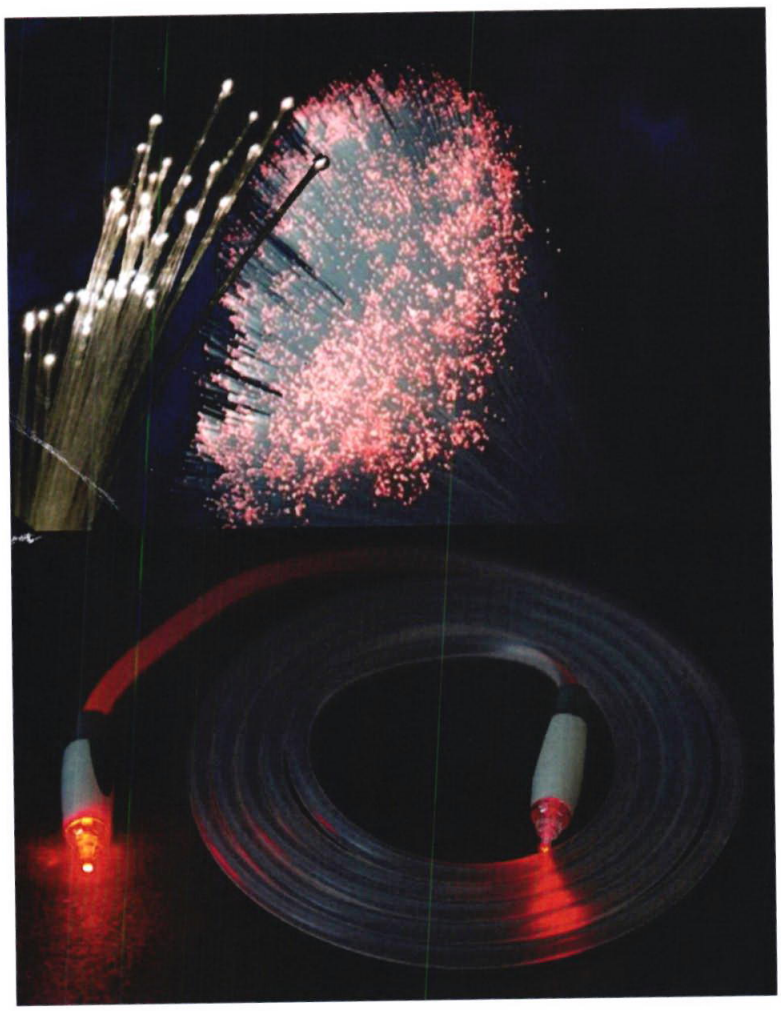
Office of the Auditor-General



Performance Audit Report of the Auditor-General

Implementation of National Optic Fibre Backbone Infrastructure Project (NOFBI)

Ministry of Information Communication and Technology

December 2014

v.7

Foreword by the Auditor-General

I am pleased to publish and publicize this audit report that examines the implementation of the National Optic Fiber Backbone Infrastructure Project (NOFBI) by the Ministry of Information Communication and Technology. My Office carried out the audit under the mandate conferred to me by the Public Audit Act, 2003. Section 29(1) of the Act mandates me to assess the economy, efficiency and effectiveness with which the Government, a state corporation or local authority uses its resources.

Performance audits together with financial and continuous audits form the three-pillar audit assurance framework that I have established to give focus to the varied and wide scope of audit work done by my Office. The framework provides high-level of assurance to stakeholders that public resources are not only disbursed, recorded and accounted for in the correct manner, but also that their use results in beneficial change in the lives of Kenyans. The main goal of our performance audits is to promote effective use of public resources and delivery to Kenyans of public services of outstanding quality.

I have submitted the original copy of the report to the Speaker of the National Assembly to table in Parliament in accordance with Article 229(7) of the Constitution. In addition, I have remitted copies of the report to the Cabinet Secretary for Information Communication and Technology, the Principal Secretary at the National Treasury, and to the Director-General, Communication Authority of Kenya.

EDWARD R.O. OUKO, CBS

AUDITOR-GENERAL

December 2014

LIST OF ABBREVIATIONS

AFROSAI-E	-	Africa Organization of the Supreme Audit Institutions
AG	-	Auditor-General
BCS	-	Bandwidth and Cloud services
BPO	-	Business Process Outsourcing
CCK	-	Communication Commission of Kenya
E1	-	E- is a European digital transmission format
EASSy	-	Eastern Africa Submarine Cable System
GDC	-	Government Data Centre
GCCN	-	Government Common Core Network
GoK	-	Government of Kenya
ICT	-	Information and Communication Technology
ICTA	-	ICT Authority
INTOSAI	-	International Organization of the Supreme Audit Institutions
ISSAIs	-	International Standard for Supreme Audit Institutions
IP	-	Internet Protocol
KENAO	-	Kenya National Audit Office
KENHA	-	Kenya National Highways Authority
KURA	-	Kenya Urban Roads Authority
LION	-	Lower Indian Ocean Network submarine cable
MDG	-	Millennium Development Goals
MOIC	-	Ministry of Information and Communication
MOT	-	Ministry of Transport
NOFBI	-	National Optic Fibre Backbone Infrastructure
OAG	-	Office of the Auditor General
OFC	-	Optical Fibre Cable
POP's	-	Points of Presence
SEACOM	-	African Cable Systems
STM-1	-	Synchronous Transfer Module
TEAMS	-	The East African Marine Cable Systems
TKL	-	TELKOM Kenya
VPN	-	Virtual Private Network
CCITT	-	Consultative Committee for International Telephony and Telegraphy
ITU-T	-	International Telecommunications Union, Telecoms Standardization
VFM	-	Value for Money
WDM	-	Wavelength Division Multiplexing

LIST OF DEFINITIONS

Bandwidth - The highest frequency that can be transmitted by an analog system and is commonly used to represent highest frequency and information-carrying capacity of a medium.

Broadband - High-capacity transmission technique using a wide range of frequencies, which enables a large number of messages to be communicated simultaneously and commonly refers to Internet access via a variety of high-speed networks, including cable, DSL, Wi-Fi, WiMAX, 3G, 4G and satellite.

Business process outsourcing (BPO) - a subset of outsourcing that involves the contracting of the operations and responsibilities of specific business functions (or processes) to a third-party service provider. BPO that is contracted outside a company's country is called offshore outsourcing. BPO that is contracted to a company's neighboring (or nearby) country is called near shore outsourcing.

Concessional loan - These are loans that are extended on terms substantially more generous than market loans. The concessionality is achieved either through interest rates below those available on the market or by grace periods, or a combination of these. Concessional loans typically have long grace periods.

Core - The central part of an optical fiber that provides the transmission region for an optical signal. The core is manufactured of an optically pure glass of a high refractive index surrounded by a lower refractive index cladding.

Dark Fiber - Typically, optical fibers that are unused within an installed cable assembly or operational network scheme. For lease fibers to support another operator for their network capability.

Digital subscriber line (DSL) - a family of technologies that provide internet access by transmitting digital data using a local telephone network. DSL service is delivered simultaneously with wired telephone service on the same telephone line.

Dongle - is a small USB device that allows you to access the internet

Ethernet/LAN - consist of either one or more network terminals (NTs) tied together with a centrally located network switch over either twisted pair, wired cable or optical networking over a pair of multimode optical fibers.

E1 - A link that operates over two separate sets of wires, usually unshielded twisted pair (balanced cable) or using coaxial (unbalanced cable). A nominal 3 volt peak signal is encoded with pulses using a method avoiding long periods without polarity changes. The line data rate is 2.048 Mbit/s (full duplex, i.e. 2.048 Mbit/s downstream and 2.048 Mbit/s upstream).

Fibre optic Cable - A cable provides organization and separation for one or more wires or optical fibers. Depending upon the installation, common commercial cable's outer jacket consists of either a UV-resistant or low-smoke, zero-halogen polymer.

Fiber Optic Link - A basic fiber optic link consists of a transmitter, fiber optic cable assembly and a receiver/detector

ISP (Internet Service Provider) - A company or organization, usually associated with either a telecommunication or cable TV provider, which provides internet access and physical connections to the general public and industry.

Lit Fiber - Optical fiber with active equipment on both ends i.e. connecting a transmitter and receiver together.

Network - The definition of an interconnected system of cabling and communications devices between data servers, centers, storage and users.

Node - The common definition is a terminal or terminals, of which, are connected to a network or a point of demarcation

Optical Fiber - An optical transmission medium developed in the late 1970s manufactured from either optically pure glass or plastic preforms, in long length spans for the sole purpose of transmitting digital light pulses.

Satellite - is a self-contained communications system with the ability to receive signals from Earth and to retransmit those signals back with the use of a transponder—an integrated receiver and transmitter of radio signals.

Splicing - A method of mounting two optical fiber end faces together, either temporarily (testing), semi-permanently (mechanical splicing) or permanently (fusion splicing).

STM-1 - Synchronous Transfer Module level 1, a fibre optic transmission Standard equivalent to 155.52Mb/s.

Termination - The common term used for the preparation of the end of an optical fiber for either a splice, connector installation or the installation into an electro-optical device

The Ministry – Ministry of Information, Communication and Technology.

Wavelength Division Multiplexing (WDM) - The multiplexing (and de-multiplexing) of different wavelengths (channels) within a specific wavelength or wavelength windows, for the purpose of carrying many different signals over a single optical fiber.

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EXECUTIVE SUMMARY

Background to the Audit

1. By 2007 over 80% of Kenya's population had no access to basic telecommunication services, due to the rural urban network coverage imbalances as well as the high costs of the services that were unaffordable to most Kenyans. The Government's opinion was that an optic fiber cable was the best economical solution to achieve the required national bandwidth to expedite the deployment and development of rural telecommunication services in Kenya. The National Optic Fiber Backbone Infrastructure (NOFBI) project was then proposed to establish a national public broad band network with access points in every county in order to attract and stimulate private sector participation in the provision of rural telecommunications services.

2. The NOFBI project is implemented by the Ministry of Information Communications and Technology (MoICT) who has the mandate of general oversight of the communications sector in Kenya .The operations of the NOFBI project were entirely financed by the National Government with additional funding from two concessional loans from China totaling US$ 109.5 million; US$ 37 million in 2007 for phase I, and US$ 72.5 million in October 2012 for phase II. NOFBI phase I was implemented between 2007 and 2009. Phase I involved the establishment of a national telecommunication back bone network using fiber optics cable traversing 5000 Kms within road reserves along major roads/highways in Central, Western, Coast and Northern Eastern regions of Kenya. At the end of the audit, NOFBI phase II was still ongoing. Phase II entailed adding 2100 km fiber to further improve the backbone's coverage, reliability, provide wider bandwidth and expand e–Government.

Why the successful implementation of the NOFBI project is important

3. The Auditor-General authorized the audit of the NOFBI project after having considered that successful implementation of the NOFBI project has the potential to increase the Kenya's GDP by up to 10%. Other benefits of national broadband include increased worker productivity, job creation, efficiencies in the distribution of goods, services and information, and reduction in the challenges of low population density and physical remoteness from cities. In addition, by 2014, the Government had allocated the MoICT over US$ 135 million for the NOFBI project yet expected benefits had not trickled down to Kenyans. Cost of internet in Kenya was still high, only a few Kenyans could afford access to good quality broadband network and most Kenyans still lacked access to basic telecommunication services.

Objective and Scope of the Audit

4. The purpose of the audit was to establish whether the NOFBI project had provided broadband connectivity so as to enhance provision of communication services in the country. In particular, the audit aimed to establish whether the implementation of the NOFBI project by the MoICT had; improved universal access to information, communication and telecommunication services in Kenya, lowered internet charges, made ICT services more reliable, been fully utilized to the full capacity provided and has been economically implemented.

5. The audit focused on the implementation of the NOFBI project in eight counties namely; Kisumu, Busia, Eldoret, Embu, Malindi, Mombasa, Machakos and Kajiado by the MoICT, between 2007 to 2014. The counties sampled were where the implementation of the NOFBI phase I had been completed and phase II surveying had started. Most of internet data available are national thus in some instance we were not able to assign causes directly attributable to the NOFBI project alone.

Audit Findings

6. Connection of major towns through the NOFBI project was among the Ministry's major achievement. By 2009, the Ministry had laid 4415Kms of NOFBI covering major towns within selected regions (1342 Kms in the Western Region, 1961Kms in Coast and North Eastern Region and 112Kms in Central Region). This was over 88% of the 5000Kms of NOFBI that the Ministry had set out to achieve in their strategic plan by 2012. Kenya's internet penetration level also rose from about 10% in 2009 to over 47% by 2013. In addition, internet penetration level by 2013 was already in line with the United Nation's Broadband Commission advocacy target of 40 people for every 100 targeted. The target had been achieved through the NOFBI project and other backbone infrastructures in the country. However, in spite of the said successes the audit revealed that:

a) There was still inadequate access to ICT services in Kenya through the NOFBI project;
b) NOFBI services were unreliable;
c) The cost of internet services was still high;
d) NOFBI services were not utilized to the full capacity provided; and
e) The NOFBI project was not effectively monitored nor implemented within projected costs resulting to variations and delays in executing NOFBI phase II.

There was inadequate access to ICT services through the NOFBI project

7. The Government's desire was to improve universal access to ICT services to all regions in Kenya through the NOFBI project. Preliminary activities of the NOFBI project which included route surveys were undertaken by the Ministry in liaison with technical staff from Telkom Kenya Ltd. However, as acknowledged by the Communications Authority of Kenya, despite the growth in the total

broadband subscriptions per person, the penetration was still low compared to the average African penetration rate of 7.4%. By 2014, the presence and availability of the NOFBI project had not yet covered a large part of Kenya especially in the rural areas:

a) The audit found that the NOFBI had inadequate coverage within the four (Central, Western, Coast and Northern Eastern) contract regions where NOFBI phase I had been constructed;

b) There were numerous cuts on the network making some links extremely disjointed and unusable leading to lack of connectivity and accessibility;

c) NOFBI phase I project was not designed to enhance access in all regions as infrastructure was purely a backbone link with no last mile connectivity to end users; and

d) The NOFBI infrastructure was found not to have any protection circuit to leverage on incase of disruption of services in the main circuit so as to ensure uninterrupted access.

NOFBI services were unreliable

8. As stated in the Ministry's strategic plans and NOFBI project documents, NOFBI was expected to bring reliable power of high speed, high bandwidth connectivity to Kenya. However, the audit found that the activities and operations of the NOFBI made the services unreliable:

a) Telkom Kenya Ltd. took long to restore destroyed NOFBI links sites. According to interviews conducted with NOFBI clients, at time NOFBI links outages last up to 24 hour;

b) The NOFBI links experienced frequent down times due to sabotage, normal faults, damage by road contractors, force majeure and theft of NOFBI cables making it unreliable. The NOFBI links often has an average downtime of approximatly 1.45 hours per day;

c) NOFBI phase I design was linear instead of ring making the links lack redundancy. In addition, the main and protection are on the same cable so that when there is a cut, both protection and main are down. Further as shared by NOFBI Operations and Maintenance teams, NOFBI had poor quality termination; and

d) NOFBI did not have guaranteed continuous quality of services since its links were damaged due to frequent soil erosions and floods that left the NOFBI cables exposed and unavailable, vandalism, damage by road contractors, NOFBI equipment malfunction due to high temperatures and damage to optic cables from burrowing animals (rodents). The unreliability has forced some ISP's that use the NOFBI to invest heavily on back up links due to the sensitivity of services and type of clients they provide connectivity. The backs up costs are eventually pushed back to the end users.

Cost of internet services was still high in Kenya

9. One of the expected benefits of a NOFBI was to lower cost of communication that can attract investment particularly in rural areas. The audit however found that despite the implementation of the NOFBI project, Kenyans were still paying more for internet than the UN target for developing countries. Also, though NOFBI charge prices were heavily subsidized, internet costs to end users is still very costly and Government District Treasury Offices at the counties were still using modems.

NOFBI was not being utilized to its full capacity

10. The Government's intention from the onset was that the NOFBI project was to be fully utilized to the available capacity. The Government was to use the NOFBI within its offices and lease out any remaining capacity. Contrary to this, the audit found that the utilization level of NOFBI links was low ranging from 0% to 58% across different regions where it traversed. There had also been a low effort to commercialize the NOFBI infrastructure. Licensed ISP's increased to 169 in 2013 up from 52 in 2009. Of these, over the four years running from 2009 to 2013, only five ISP's leverage on the NOFBI directly as of June 2014, representing a mere 3% of the total number of ISP's. As a result the project continues to place a heavy financial burden to Kenyans since it is not self-sustaining:

a) NOFBI's monthly operation and maintenance fee was Kshs.20,261,966.00 giving an annual figure of Kshs.252,771,496.00(inclusive of 9,627,928.00 collocation charges for January to February 2010) for the period March 2010 to February 2011 and Kshs.243,143,568.00 for the period March 2011 to 28 February 2012, giving a total of Kshs.495,915,064.00. However, during these period, NOFBI generated only Kshs.143,787,337.00; and

b) In addition, despite the fact that NOFBI project is not generating sufficient revenue to maintain its own operating costs, taxpayers are also being subjected to repaying the concessional loans received from China to finance the NOFBI project totaling over US$ 110 million (US$37 m for phase I and US$72.5m for phase II plus additional loan management and commitment fees). By August 2014, the government had already paid only Kshs.1,264.3 million towards the NOFBI phase II loan.

Low commercialization of the NOFBI

11. Overtime the NOFBI project was expected to be self-reliant. However the audit found that NOFBI has not been commercialized as intended thus reducing project revenue. In all the regions visited, the audit found that the level of NOFBI awareness was still low. The low awareness was because the Ministry had not campaigned or created awareness about the existence and benefits of the NOFBI project. This led to the infrastructure's extra capacity not being leased out to generate the much needed revenue. Thus taxpayers continued to being subjected to heavy financial burden.

There was inadequate management and monitoring of the NOFBI project by the Ministry

12. The audit found that the NOFBI project was not managed as effectively as expected since:

a) The NOFBI phase I network in some regions had not been commissioned five years later. Phase I of the NOFBI was completed by 2010. However by 2014, the audit found that the Athi - River to Namanga NOFBI link in the Central and North Eastern Regions, had many cable cuts which had not been repaired since 2007 which led to lack of internet connectivity and access in Kajiado County. This site was done by M/S Huawei but was never accepted by Telkom Kenya Ltd during handover of the project for management.

b) NOFBI Phase I was not designed properly. The installation of NOFBI cables in some regions was not to the correct depth and was frequently destroyed by soil erosions and floods that left the cables exposed and unavailable, vandalism, damage by road contractors, high temperatures and burrowing animals (rodents). In addition the backbone infrastructure design was linear instead of ring which had the following effects:

- The linear network did not have redundancy and had no alternative route in case of damages. The main and protection are on the same cable so that when there is a cut, both protection and main are down; and
- As such the Government has to incur more taxpayers funds in phase II to close the loops in phase I's infrastructure and integrate equipment to allow the backbone be extended to all the 47 county headquarters in Kenya.

c) Phase II of the NOFBI Project was not implemented as planned. Contract for the implementation of NOFBI phase II was awarded to M/S Huawei on 7July 2010. The contract had since had two amendments, the first one on 17 October 2011, and a second one on 23 May 2014. In March 2013, Huawei, the contractor, was paid advance payments of US$ 14.5 Million (20% of the contract sum of US$ 72.5 Million) to start preparing for phase II project delivery. However project works were again suspended for over two years, as the Ministry requested for project changes, in compliance with new requirements due to reorganization and restructuring of the Government following Kenya's 2010 Constitution. By October 2014, the Ministry was still in the initial plans of implementation NOFBI phase II and had not yet put in place a dedicated office to provide supervisory services and ensure effective implementation of the NOFBI project.

d) The NOFBI Cable was experiencing numerous cuts, which were costly to repair. The cuts were due to vandalism, damage during road constructions, rodents and floods. For instance, the 164Km NOFBI link between Athi River and Namanga which was seriously damaged during road construction, needed to be redone at the cost of a new installation estimated to cost taxpayers over US$ 419,962.92.

e) The NOFBI project had not been implemented within projected costs. Major alterations of phase II included removal of some items e.g. Digital Hospital solution which was to cost US$ 4,115,426.00, Telepresence solution which was to cost US$ 6107,960.00 and other accessories although the total cost of project has not changed. Thus additional funds amounting to US$10,223,386 (14% of the initial contract price) will be required to implement these elements by line Ministries like the Ministry of Health. In addition, these additional costs do not take care of expected monetary changes due to inflationary pressures in the economy over time.

f) Taxpayers continued to incur heavy financial burden for the delayed implementation of NOFBI phase II. NOFBI phase II's final approved loan agreement was signed in October 2012 for US$ 72,500,000. The loan has a maturity period of two hundred and forty months from the date the loan agreement became effective (with a grace period of eighty four months and a repayment period of one hundred and fifty six months). Thus despite phase II of the NOFBI project not yet started, Kenyan taxpayers had by October 2014, borne the burden of over 1 US$ 7,995,000 on the project for advance fees to contractor US$ 13,500,000 (being 20% of contract price), interest rate of US$ 2,900,000 (being 2% of US$ 72,500,000 for two years), mmanagement fees of US$725,000 (1% of loan amount) and commitment fees of US$ 870,000 (being 72,500,000-13,500,000)*0.75% for two years). Taxpayers also paid for NOFBI operations and maintenance to Telkom Kenya Ltd of Kshs. 20,261,964.00 per month from 2010 - 2012. Following the privatisation of Telkom Kenya Ltd, the Ministry entered into a 50% - 50% profit sharing contract on NOFBI's net profit received from dark fibre revenue from 2011 to date. Telkom has however maintained the fixed O & M charges at Kshs. 20,261,964 to date.

Conclusions

13. The Ministry has not been able to improve universal access to information, communication and telecommunication services in Kenya as expected. The NOFBI project has provided reasonable dark and lit Fiber charges to ISPs but the benefits are yet to be transferred to end users. ICT services have not been made as reliable as expected due to frequent downtimes creating unavailability of connectivity to users. The current O & M provider has not done its work satisfactorily as evidenced by ISP who lease dark fiber and are all (except KENET) yet to sign the current SLA provided based on poor terms. The NOFBI infrastructure has not been utilized to the full capacity available as shown by the low uptake by ISP's and government institutions. Phase II of NOFBI project has delayed in implementation and major ISPs who are anticipated to lease the last mile have already laid their own fiber and might not lease the fiber as projected by the Ministry. This will extend the period the project will repay itself.

Recommendations

14. In view of the findings of the audit, the Auditor-General has made several recommendations that the Accounting Officer in the MoICT could take to ensure that the next phases of the NOFBI project is implemented in an economic, efficient and effective manner. The recommendations call for more assertive actions and a dedicated office to manage the operational activities of NOFBI.

Chapter 1

Background to the Audit

Introduction

1.01 This report examines the implementation of the National Optic Fiber Backbone Infrastructure (NOFBI) project. The Office of the Auditor-General conducted the audit as provided for under Section 29 of the Public Audit Act, 2003 and has prepared the report for tabling in Parliament in accordance under Article 229(7) of the Constitution. The National Optic Fiber Backbone Infrastructure (NOFBI) is implemented by the Ministry of Information and Communications who has the mandate of general oversight of the communications sector in Kenya.

Background of the National Optic Fiber Backbone Infrastructure project

1.02 As stated in the Government Cabinet Memo on the establishment of the NOFBI project "Over 80% of Kenya's population had no access to basic telecommunication services by 2007, due to the rural urban network coverage imbalances as well as the high costs of the services that were unaffordable to most Kenyans. An optic fiber cable was considered the best economical solution to achieve the required national bandwidth. The NOFBI project was to establish a national public broad band network with access points in every county in order to attract and stimulate private sector participation in the provision of rural telecommunications services. The NOFBI project was also to supplement existing telecommunication and other forms of infrastructures such as roads, railways and power lines in national development." The operations of the NOFBI project were entirely financed by the National Government with additional funding from two concessional loans from China totaling US$ 109.5 million; US$ 37 million in 2007 for phase I, and US$ 72.5 million in October 2012 for phase II.

1.03 NOFBI phase I was implemented between 2007 and 2009 and involved the establishment of a national telecommunication back bone network using fiber optics cable traversing 5000 Kms within road reserves along major roads/highways in Central, Western, Coast and Northern Eastern regions of Kenya. At the time of audit (in 2014), NOFBI phase II was still ongoing and entailed adding 2100 Kms fiber to further improve the backbone's coverage ,reliability, provide wider bandwidth and expand e - government .

Motivation for the Audit

1.04 The Auditor General authorized the audit after having considered that:

- The benefits of broadband include increased worker productivity, job creation, efficiencies in the distribution of goods, services and information, and reduction in the challenges of low population density and physical remoteness from cities.
- Successful implementation of the NOFBI project has the potential to increase the Kenya's GDP by up to 10%.
- By 2014 the Government had allocated the Ministry over 135 million US$ for the NOFBI project yet expected benefits had not trickled down to the ordinary Kenyans. Cost of internet in Kenya was still high, only a few Kenyans could afford access to good quality broadband network and most Kenyans still lacked access to basic telecommunication services.

1.05 An audit on the implementation of the NOFBI project would provide valuable information to Parliament, the Executive, its managers and stakeholders and offer recommendations to improve its management so that its objectives may be attained and taxpayers receive the right value for the money invested in the project.

Chapter 2

Design Of The Audit

Objective of the Audit

2.01 The objective of the audit was to assess whether the Ministry of Information, Communication and Technology (MoICT) had implemented the National Optic Fiber Backbone Infrastructure (NOFBI) project with due care so as to enhance provision of communication services in the country and ensure that:

i. Universal access to ICT services in Kenya was improved;
ii. Internet charges were lowered;
iii. ICT services were made more reliable;
iv. The national backbone infrastructure was fully utilized to the full capacity provided; and
v. The project was implemented within projected costs and monitored as intended.

Audit questions

2.02 The audit sought to answer the following questions in order to achieve the above audit objective:

i. Has the Ministry of Information and Communication (MoICT) improved universal access to information and communication services through the NOFBI project?
ii. Has the NOFBI project lowered the cost of deploying and operating broadband networks?
iii. Has the MoICT provided reliable ICT services through implementation of NOFBI project?
iv. Was the NOFBI infrastructure utilized to the full capacity provided?
v. Was the NOFBI project implemented within projected costs?
vi. Has the MoICT effectively monitored the operations of the NOFBI project?

Scope of the Audit

2.03 The audit focused on the implementation of the NOFBI project by the MoICT, between 2007 and 2014.The audit examined the implementation of the NOFBI projects in eight counties (Kisumu, Busia, Eldoret, Embu, Malindi, Mombasa, Machakos and Kajiado) where NOFBI phase 1 had been completed and phase 2 when surveying started. Most of internet data available are national thus in some instance we were not able to assign causes attributable to NOFBI project alone.

Audit Criteria

2.04 We expected the MoICT to have implemented the NOFBI project as outlined in their strategic planning and contract documents. Therefore, the performance of the MoICT was assessed in relation to how:

i. Universal access to ICT services in Kenya was improved relative to the number of counties and government institutions with NOFBI internet connectivity;
ii. Internet charges were lowered as compared to the UN Broadband Commission benchmark on entry level broadband;
iii. ICT services were made more reliable in relation to the extent of down times, speed and consistency of internet connections through the NOFBI infrastructure;
iv. The capacity provided in the NOFBI infrastructure was utilized against the Kilometers of dark and lit NOFBI cables; and
v. The NOFBI project was implemented as contrasted to project implementation periods and costs and monitoring terms outlined by the MoICT.

Detailed assessment criteria applied in the audit are highlighted in the findings under Chapter 4.

Methods Used To Gather Audit Evidence

2.05 We conducted the study in accordance with International Standards of Supreme Audit Institutions (ISSAI's) and audit policies and procedures established by the Office of the Auditor General (OAG). To understand the structure, laws and regulations of National Optic Fiber backbone infrastructure (NOFBI) project, we reviewed MoICT strategic plan 2008 - 2012, cabinet paper on establishment of the NOFBI project, the Kenyan Constitution of 2010, Kenya's ICT Policy 2006, Kenya National 2017 Master ICT Plan, the Draft National Broadband Strategy for Kenya 2013, NOFBI phase II concept note and master plan and metro optical fiber cable analyses, Kenya's Vision 2030 and Kenya's ICT Act, 2009 and the UN broad band Commission. To gain a deeper understanding of operations, activities and challenges of the NOFBI project the audit team visited sampled regions and physically observed held various discussions and interviews with staff in the MoICT, ICT Authority, Telkom and Internet Service Providers and reviewed NOFBI network performance and management reports. The findings were reported after comparing observations and analysis made against the audit criteria agreed with the auditee.

Chapter 3

Description Of The Audit Area

Legal Framework for the NOFBI project

3.01 In addition to Kenya's Constitution of 2010, other legislations and regulations, the Government has put in place National ICT Policies and 2009 legal framework to support the ICT sector. The National Optic Fiber backbone infrastructure (NOFBI) project is in line with Kenya's 2013 National ICT Policy's recommended solutions of expanding the fibre optic network to cover hospitals, schools, and police stations, progressively roll out free WI-FI in major towns within five years from 2013 and create incubation hubs for ICT start-ups in each county. However, as stated in Kenya's 2013 National Broad Band Strategy, "Broadband is not yet adequately addressed within Kenya's current national policy, legal and regulatory framework. ICT policies with respect to energy and roads are not yet harmonized. In addition, there is also no clear legislative provision on public sector participation in relation to broadband infrastructure or services. This has inhibited the effective and efficient deployment and utilization of services delivered and assessed through broadband as required by the Kenya's Constitution of 2010."

Roles and Responsibilities of key players in the NOFBI project

3.02 The NOFBI project is implemented under the Ministry of Information and Communications (MOICT). The mandate of the MoICT as derived from Presidential Circular No. 1/2007 of January 2007 and the ICT Act, 2009 includes formulating and implementing public policy in ICT sector including information, broadcasting, communications and film development policies. One of the key functions of the MoICT as derived from Executive Order No. 2/2013 of May 2013 is fibre optics infrastructure development and management. The MoICT is also responsible for the dissemination of public information, development of national communication capacity and provision of public relation services.

3.03 The MoICT has given the following roles and responsibilities to key players in the NOFBI project:

a) **Telkom Kenya Ltd (TKL) :** In 2008, TKL was contracted to provide project management services during implementation of NOFBI phase I. TKL's terms of reference as NOFBI's project management team was to provide technical, administrative and legal services of the projects during implementation and commissioning, monitor and manage the execution of the contract to ensure compliance to plan of works as provided for in the contracts, ensure that the contract rights and obligations of parties are met as well as manage disputes arising out of the NOFBI contract, supervise the implementation of the construction contracts and oversee the smooth handing over of the project as appropriate. In March 2010 after completion, of NOFBI phase I, TKL was further appointed as NOFBI's commercialization, operation and maintenance (O&M) provider.

b) **ICT Authority:** Liaison of project management activities for NOFBI phase II activities are done by the ICT Authority, a semi-autonomous government agency under the MoICT. The ICT Authority was established in May 2013, through a Legal Notice under the State Corporations Act, Cap 446 to; develop and position Kenya as the preferred ICT destination in Africa, develop and promote competitive ICT industries in Kenya, develop world class Kenyan ICT institutions, increase access and utilization for ICT, promote the e-government services and roll out digital government initiative.

c) **Communications Authority of Kenya:** The functions of the authority as regards to the NOFBI project is to ensure optimal management of frequency spectrum and numbering and addressing resources, the achievement of universal access to ICT services, the development and formulation of adequate standards for the ICT sector in the country, protect the rights of users of ICT services, promote development of ICT systems and services in accordance with recognized international standards, practices and public demands, further the advancement of technology relating to the ICT sector and contribute to overall Government objectives towards human, social and economic development through facilitating universal access and use of ICT.

Objectives of the NOFBI project

3.04 NOFBI's main objective is to provide broadband connectivity to enhance provision of communication services to spur the growth of Information Communication and Technology (ICT) and Business Process Outsourcing (BPO) and improve universal access to ICT throughout the country. The NOFBI project is also supposed to supplement existing telecommunication and other forms of infrastructures such as roads, railways and power lines in national development. The project's specific objectives are to develop a robust ICT backbone infrastructure that:

i. Connects all districts and major towns in Kenya with a bandwidth;
ii. Provides bandwidth to learning and social institutions;
iii. Opens up rural areas by providing alternative investment opportunities through the use of information and communication technology; and
iv. Facilitates the establishment of county data and information centers.

The NOFBI Project Implementation Process

3.05 The NOFBI project is being implemented in two phases :

a) **Implementation of NOFBI Phase I:** involved the establishment of a national telecommunication back bone network using fiber optics cable traversing 5000 Kms within road reserves along major roads/highways in Central, Western, Coast and Northern Eastern regions of Kenya. In January 2007 the Government awarded construction of NOFBI phase I to three contractors: M/S Huawei Technologies for eighteen sites in Central region, M/S Sagem for nineteen sites in Coast and North

Eastern regions and M/S ZTE for nineteen sites in Western region as depicted in **Appendix 1 to 4**. The contractors were to deliver the cables and pipes, do civil works to prepare the way to lay down the pipes, splice and connect the optical fiber cables, deliver the transmission equipment, install, commission and test the equipment including for the network plus cables end to end and the network management technical teams to handle the project maintenance and operation where required. NOFBI Phase I was to be completed by 2009.

b) **Implementation of NOFBI Phase II:** involved extending the NOFBI project with 2100 km fiber and further improving the national backbone's coverage and reliability. Construction of NOFBI phase II was initially to begin in January 2010 and be completed by December 2010. Construction of Phase II was awarded to M/S Huawei on 7 July 2010. After completion of NOFBI phase II, Kenya was to have a more reliable, stable and efficient national backbone network that is used by the Government at the National and County levels and also be available for use by private operators for the delivery of connectivity services. Initial NOFBI phase II contract signed in July 2010 was for :

i. **Expansion of Government Common Core Network (GCCN):** By January 2010 the Government Common Core Network (GCCN) covered government headquarters of twenty nine of the then forty two Ministries in Nairobi. Through the expansion, all government agents were to be connected to realize paperless offices. Expansion of the GCCN was to include the construction of core routing & switching in the counties

ii. **Core Routing & Switching:** Core Routing & Switching were to be done at the defunct eight provincial headquarters in Embu, Garissa, Kakamega, Kisumu, Mombasa, Nairobi, Nakuru, Nyeri to form the core sites for the Government information network

iii. **35 Points of Presence (PoPs) in counties**: The following thirty five counties were to function as point of presences in counties; Busia, Kericho, Kisii, Kisumu, Machakos, Malindi, Meru, Turkana, Uasin Gishu, Kiambu, Kirinyaga, Muranga, Nyandarua, Kilifi, Kwale, Lamu, Taita, Tana River, Isiolo, Kitui, Marsabit, Mandera, Wajir, Siaya, South Nyanza, Baringo, Marakwet, Kajiado, Laikipia, Nandi, Narok, Samburu, Trans Nzoia, West Pokot and Bungoma.

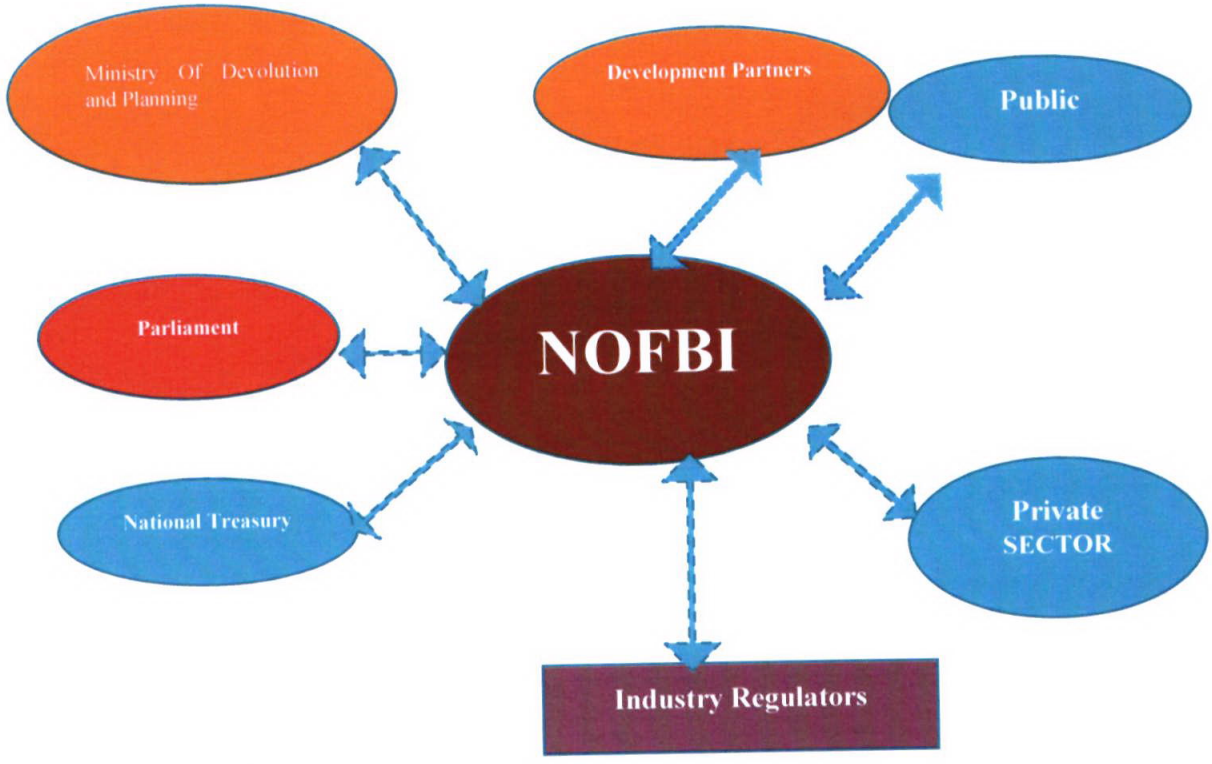
iv. **Completion of the National Optical Fiber Infrastructure:** Phase II's scheduled expansion was to add NOFBI links to the current transmission network to constitute ring-protection for telecommunication services and establish connections to main counties. Some of the counties not connected were to be covered during this phase.

v. **Consolidation and migration of Current Government Applications to the Government Data Centre (GDC)**: The applications to be immigrated included the Integrated Financial Management Information System (IFMIS), Integrated Personnel and Payroll Database (IPPD) to either a new system or the existing one.

3.06 NOFBI phase II project works were suspended since the MoICT requested for project changes due to reorganization and restructuring of the Government following the enactment of the Kenya's Constitution. To avoid variations in the original total contract amount, the alterations resulted to variations to some of the above original NOFBI project works. Construction of NOFBI phase II had not yet commenced at the time of the audit in November 2014.

NOFBI Stakeholders

3.07 The NOFBI project is an important Investment with multi-sectorial stakeholders as shown below:



Source: MOIC strategic plan

Budget and funding of the NOFBI project activities

3.08 NOFBI project operations were financed by the National Government as follows:

a) **NOFBI Phase One funding:** Initial feasibility studies and project survey for the NOFBI project cost the taxpayers Kshs.6,550,000.00 and Kshs.199.854,806.70 respectively. In addition a project management fee of Kshs.150 million was paid to Telekom Kenya Ltd during implementation. The financing of NOFBI phase I contracts were in three components. The first two components entailing Huawei and ZTE contractors were funded through a concessional loan of US$ 37 million from China and the third component, Sagem Contractor was complimented with GOK input of US$ 26.3 million giving a total of US$ 63.3 million as tabulated below:

Table 1: Supplier Contract, Implementation Schedule and Related Costs

	Contract	Region	Scope of work	Currency	Contract sum	Contract sum (kshs)	Schedule
1	ZTE CONTRACT	Western Region,	1342 Kms with 19 sites	US$	18,757,788. 54	1,500,623,083.20	April 7, 2008 until 22 April 2009
2	HW CONTRACT	Central Region,	1112 Kms with 18 sites	US$	17,746,933.00	1,419,754,640.00	January 29, 2008 until 11February 2009
3	SAGEM CONTRACT	Coast & North Eastern Region	1750 Kms with 19 sites	Euros	14,853,569.96	1,515,064,135.92	January 2008 until April 2009
				Kshs	442,789,359.99	442,789,359.99	
Total amount paid to Contractors (kshs)						4,878,231,219.11	

Source: Ministry of Information and Communications Records
(Exchange Rate Kshs 80=1 US$ and Kshs 102=1 Euro)

b) **NOFBI Phase Two funding:** The Government entered into another concessional loan agreement with the Export – Import Bank of China on 8 October 2012 to fund NOFBI phase II for US$ 72.5 million. The loan had a maturity period of 240 months from the date the loan agreement became effective, a grace period of 84 months and a repayment period of 156 months. In addition to the loan repayment, the loan cost Kenyan taxpayers an interest at a rate of 2% per annum, management fees of 1% of the loan and a commitment fee of 0.75% per annum payable semiannually on undrawn and uncanceled loan balance which accrued on a daily balance.

Chapter 4

Findings of the Audit

Advantages of the NOFBI project

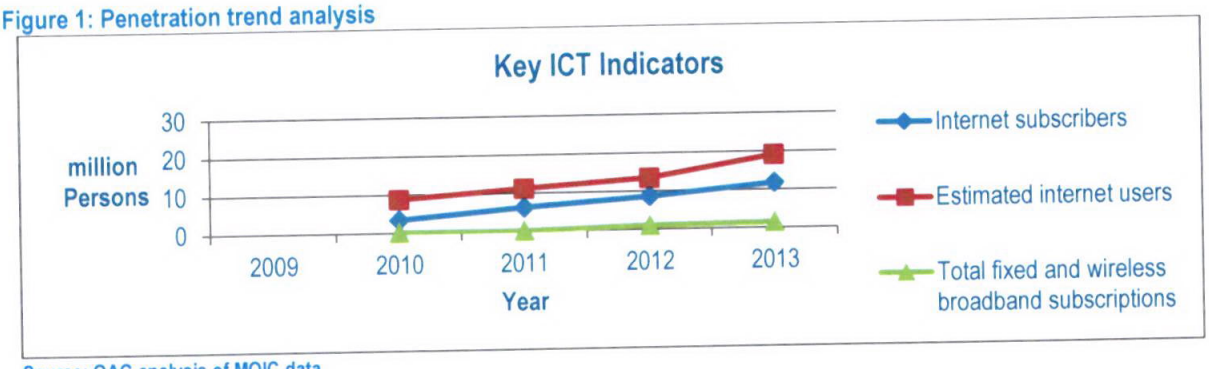
4.01 The NOFBI project provides a ready platform for broadcasting information to Kenyans and ultimately promotes national, political, economic and cultural cohesion. Its interoperable broadband network also has potential to support security agencies to respond faster to emergencies and natural disasters to protect the public within Kenya and the region. The lower cost of communication through a national broadband further attracts investments and solutions to the constraints of healthcare delivery systems in rural and marginalized areas through e--health applications in addition to promoting business processes outsourcing, investment competitiveness, distance learning opportunities and lower cost quality education as well as inclusion in society for people living with disabilities over the internet.

NOFBI project achievements

4.02 Connection of major towns through the NOFBI is among Kenya's remarkable achievements in ICT. By 2009, the MoICT had laid 4415 Kms of NOFBI infrastructure covering major towns within selected regions (1342 Kms in the Western Region, 1961 Kms in Coast & North Eastern Region and 1112 Kms in Central Region) as shown in Appendices 1 - 4. This was over 88% of the 5000 Kms of NOFBI infrastructure strategized that the MoICT had set out to achieve in their strategic plan by 2012.

4.03 Kenya's internet penetration level also rose from about 10% in 2009 to over 47% by 2013. Kenya's internet penetration level by 2013 was in line with the United Nation's Broadband Commission advocacy target of 40 people for every 100 target. The target had been achieved through the NOFBI project and other backbone infrastructures in the country. Kenya's broadband penetration for wireless internet access also increased from 2.4 % in 2012 to 3.3 % in 2013. In addition, the country's total broadband (fixed and wireless) in line with Kenya 2013 national broad band's overall objective of providing quality broadband services to all citizens, further rose from 2.5% in 2012 to 3.4% by 2013 as depicted in figure 3 below.

Figure 1: Penetration trend analysis



Source: OAG analysis of MOIC data

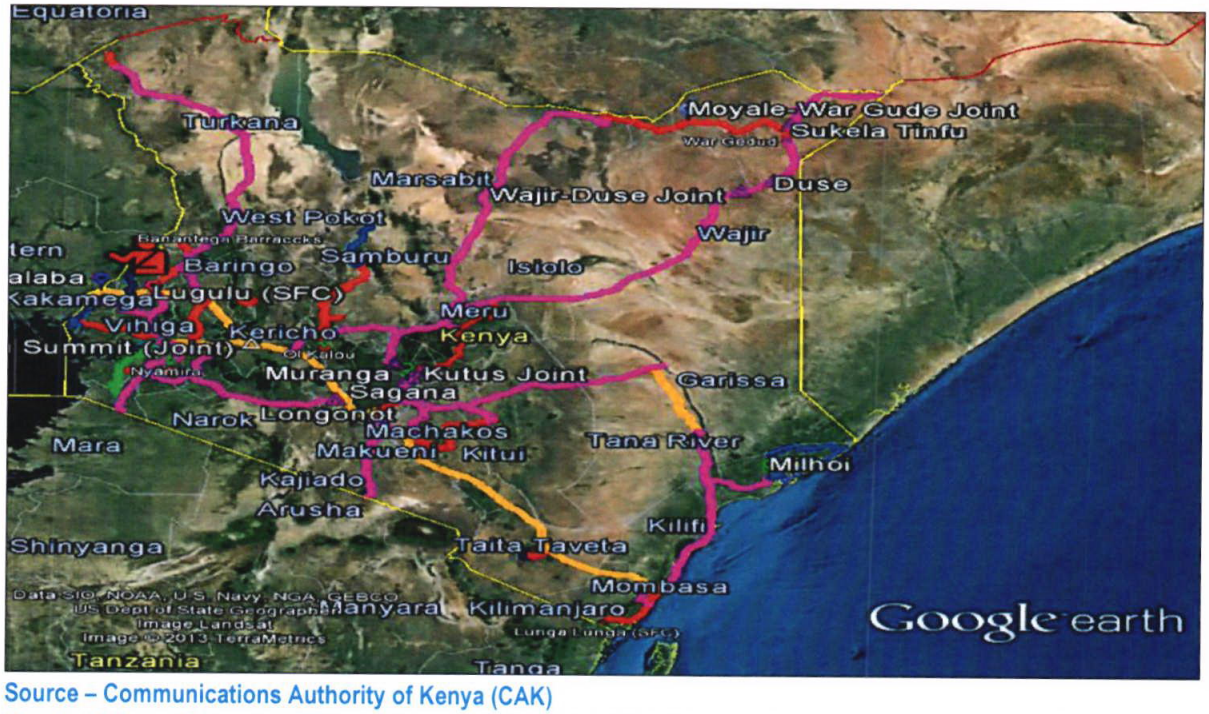
4.04 In spite of the above achievements, the audit found that the NOFBI project's aim of providing broadband connectivity to enhance provision of communication services in the country, was inhibited since:

a) There was still inadequate access to ICT services in Kenya through the NOFBI project;
b) NOFBI services were unreliable;
c) The cost of internet services was still high;
d) NOFBI services were not utilized to the full capacity provided;
e) The NOFBI project was not effectively monitored resulting to variations and delays; and
f) The NOFBI project was not implemented within projected costs.

Inadequate access to ICT services through the NOFBI project

4.05 The MoICT desire was to improve universal access to ICT services to all regions in Kenya through the NOFBI project. Preliminary activities of the NOFBI project such as tender preparation, evaluation, route surveys and negotiations were undertaken by the MoICT in liaison with technical staff from Telkom Kenya (TKL). However, as acknowledged by the Communications Authority of Kenya, the penetration level was still low compared to the average African penetration rate of 7.4 per cent (CCK) despite the growth in the total broadband subscriptions per person. The presence and availability of the NOFBI project had not yet covered a large part of Kenya as depicted in figure 2 below:

Figure 2: Access of NOFBI in Kenya



Source – Communications Authority of Kenya (CAK)

Key: Red lines reflect optic fiber cable - OFC (New) of NOFBI Phase 2 while pink lines indicate OFC (Existing) of NOFBI Phase 1.

4.06 Audit inspections, documentary review of NOFBI projects and various interviews conducted with Telkom Kenya Ltd. regional managers, technical officers of the NOFBI projects, district accountants, ICT university heads and internet service providers (ISP) engineers in the regions revealed that the NOFBI project's bandwidth, presence and availability access was still inadequate as detailed below:

a) **The extent of the NOFBI project coverage within the regions was inadequate.** The audit found that the NOFBI coverage even within the four (Central, Western, Coast and Northern Eastern) contrasted regions in Kenya where NOFBI phase I had been constructed still had inadequate coverage. For instance, within Central and North Eastern Region the extent of coverage of the NOFBI project was only 2396 km yet the land region is almost 279,506 sq. km covering sixteen counties. In the Western region the NOFBI project coverage was 1342 km yet the land region is close to 131,582 sq.km. In the Coastal region NOFBI's last mile connectivity did not exist and many government offices were not connected to the NOFBI infrastructure. There was also no NOFBI infrastructure between major towns like Mazeras, Voi and Mombasa. NOFBI connectivity between Milhoi – Lamu is via a microwave link which supports only Synchronous Transfer Module level 1 (STM-1) as a maximum. STM-1 is a fibre optic transmission standard equivalent to 155.52Mb/s thus other internet service providers cannot lease NOFBI fiber in this section. NOFBI fiber nodes available within the Coastal region were not universal since their fiber terminated only in the towns and were not anywhere within the regions it traversed.

b) **Lack of NOFBI internet connectivity within some regions following privatization of Telkom Kenya.** At the time of the audit inspection in June 2014, the audit found that there was no NOFBI infrastructure between Voi, Mazeras and Mombasa. The region was connected to internet services provided by the Telkom Fiber, owned by Telkom Kenya Ltd as a private entity. Other Internet service providers (ISPs) cannot lease fiber in the section because the existing link is owned by Telkom Kenya following its privatization. The audit also found that the NOFBI link connecting the Western region to the rest of the country (between Webuye – Eldoret – Nakuru – Longonot - Nairobi) and the Kitale – Lokichar link were purely on the Telkom Orange link, which limited NOFBI uptake in the region. ISP's interviewed stated that they were uncomfortable leveraging their traffic back to Nairobi purely on the private Telkom Orange link since it was expensive.

c) **The NOFBI infrastructure in some regions was purely a backbone link.** The audit found that the NOFBI project had no inroads, in the Western, Central and North Eastern regions, to link internet accessibility to councils and towns from their points of presence.

d) **The NOFBI infrastructure was found not to have any protection circuit (redundant link).** There was no protection circuit to leverage on incase of disruption of the services in the main circuit to ensure uninterrupted access. A redundant link is a backup used to reroute internet traffic when the main link fails or is damaged. This was because the structural design in NOFBI phase I was linear rather than ring network which limited NOFBI internet accessibility and redundancy c the regions.

NOFBI services were unreliable

4.07 As stated in the MoICT's strategic plans and the NOFBI project documents, NOFBI was expected to bring reliable power of high speed, high bandwidth connectivity to Kenya. The audit assessed reliability of NOFBI services provided against recommendations set by ITU Telecommunication Standardization sector (ITU-T) - a division of International Telecommunication Union (ITU) and a specialized agency of the United Nations whose primary function is to ensure efficient and timely production of standards covering all fields of Telecommunication on a worldwide basis, as well as defining tariffs and accounting principles for international telecommunication services. These standards are referred to as recommendations. The audit noted that the MoICT did not put ITU recommendations in place during the implementation and operations of the NOFBI project :

- ITU-T Recommendation M.15 sets general maintenance considerations for new systems to ensure that they are implemented so as to permit compatible international operation and maintenance in the most effective manner, to reduce total (lifetime) costs and to improve the efficiency of maintenance.
- ITU-T Recommendation M.3341 and M. 3342 define the basic requirements for quality of services or service level agreements (QoS/SLA) management. Service Level Agreements (SLAs) are considered an effective way of solving the problems of QoS guarantee between Service Customers and Service Providers and these recommendations provide instructional explanations about service level, quality of service, priorities and duties in the SLA content. The goal of the SLA is to create a healthy relationship between the Service Provider and the Service Customer, and to protect the legal rights of both the Service Provider and the Service Customer.

4.08 The management contract between the MoICT and Telkom Kenya Ltd states that "Telkom shall perform the services in accordance with generally accepted professional techniques and practices ". However the audit found that the activities and operations of the NOFBI project at times did not meet the above ITU-T recommendations which resulted to NOFBI services being unreliable :

a) **Telkom Kenya Ltd took long to restore destroyed NOFBI links.** As stated by ITU-T Recommendation T.3342, SLAs are an effective way of solving the problems of QoS guarantee between service customers and service providers to ensure telecommunications are managed effectively. However the audit found that even though Telkom Kenya Ltd. As the MoICT's appointed operation and maintenance managers of the NOFBI project had achieved the SLA's they had with the NOFBI clients, they took a long time to reach the destroyed sites which extended the overall resolution time which made NOFBI services unreliable. NOFBI customers, who include the Government of Kenya (GOK), Safaricom, KENET and Orange among others, use the NOFBI infrastructure as a critical component in their nature of business. According to NOFBI customers interviewed, they experienced extended downtimes owing to the long response times taken by Telkom Kenya Ltd. to restore NOFBI links in the event of a cable cut or damage.

- Telkom Kenya Ltd. (TKL)'s SLA with NOFBI customers was to ensure they repair destroyed NOFBI links within eight hours upon arrival on site. Audit review of NOFBI operation and maintenance performance reports between 2012 and 2014 revealed that on average Telkom Kenya Ltd. took almost seven hours to repair the link once on site, this was within the agreed service level time. However the audit noted that, due to the long geographical distances, on average TKL took approximately nine hours to mobilize staff to destroyed NOFBI infrastructure sites. Thus NOFBI clients had to wait an average of sixteen hours for Telkom Kenya Ltd to repair a destroyed NOFBI link. Time taken to site (TTS) was found to be almost 56% of the total time taken to repair a fault on the NOFBI link (outage time) as tabulated below:

Table 2: Fault resolution times

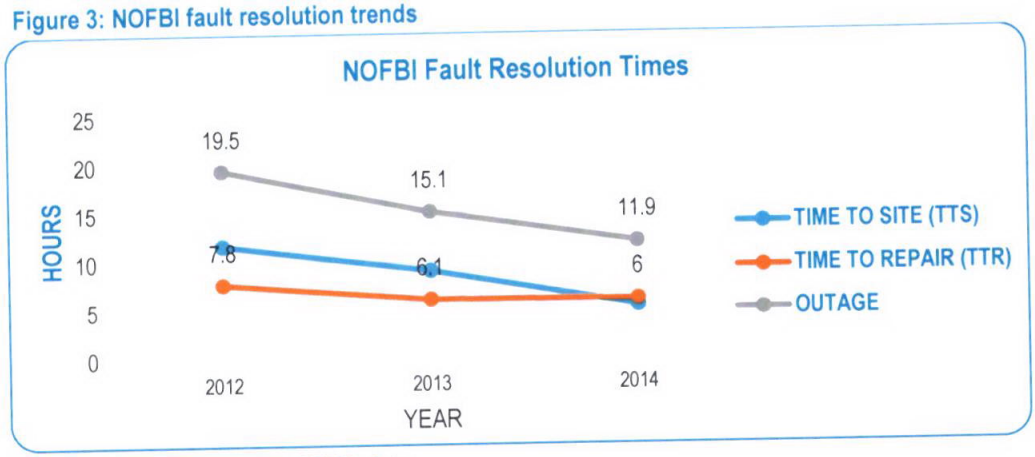
Year	Time To Site (TTS)	Time To Repair (TTR)	Outage
2012	11.7	7.8	19.5
2013	9	6.1	15.1
2014	5.3	6	11.9
Average	8.67	6.63	15.5

Source: NOFBI network performance reports

- According to interviews conducted with ISPs at times NOFBI links outages last up to 24 hours. The audit reviewed an ISP's documentation on links leveraging on NOFBI from July 2013 to June 2014 and noted an average of 95.42% service availability per month against ISP's service level agreement with their customers which is up to 99.5%.

- NOFBI clients therefore lease backup links at additional costs which are eventually pushed back to consumers. The audit noted that Telkom continued to deploy more repair teams across the country thus time taken to site improved over time and the overall outage was gradually being reduced :

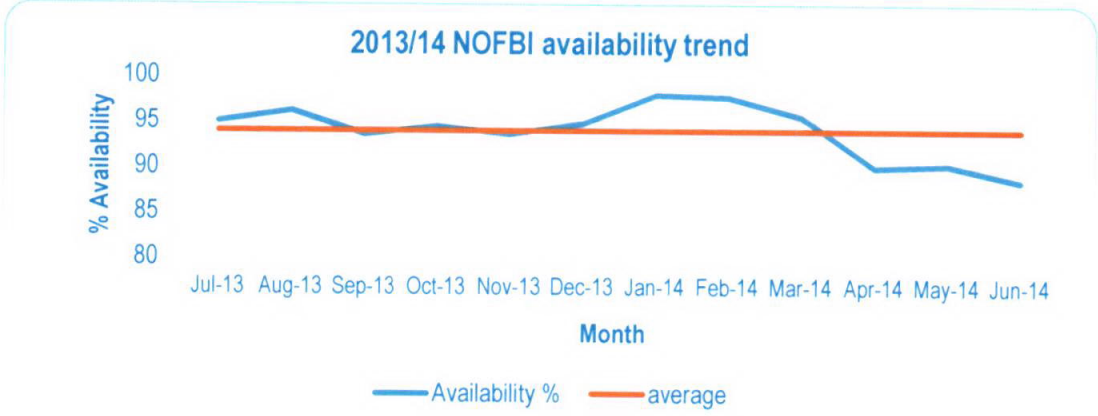
Figure 3: NOFBI fault resolution trends



Source: OAG-K analysis of TKL data

b) **NOFBI experienced frequent down times.** ITU-T Recommendation 3441 states that ISP, who has the primary contract with the service customer, has the responsibility to observe end to end quality of service of the entire network. Thus according to interviews conducted with NOFBI's clients who are also in turn ISP revealed that any disruption of services to their customers was unacceptable. Any downtime experienced was especially critical to them as network operators. However, NOFBI progress reports between July 2013 and June 2014 revealed that the NOFBI links often had an average downtime of approximately 1.45 hours per day as depicted below which made their internet service delivery unreliable.

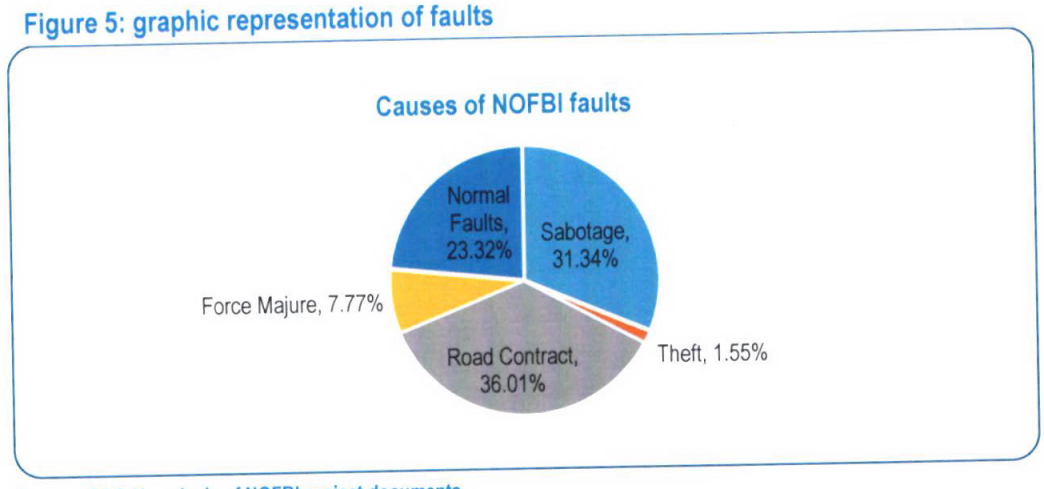
Figure 4: NOFBI availability trends in 2013/2014 fiscal year



Source: OAG-K analysis of NOFBI project data

- The causes of NOFBI faults between 2013 and 2014 as reported by Telkom Kenya Ltd. were due to sabotage, normal faults, damage by road contractors, force majeure and theft of NOFBI cables. As depicted below, faults by saboteurs (31%) and road contractors (36%) account for 67% of all NOFBI infrastructure faults over the period in consideration. No proper education of the locals was carried out in NOFBI sites to educate the public about the importance of the NOFBI infrastructure in order to instil a social sense of responsibility. Also, there were no controls put in place to ensure that Kenya National Highway Authority (KeNHA) provided accurate data to NOFBI contractors on the road or for road contractors on their side to take due responsibility. The motive behind saboteurs was mainly attributed to disenfranchised employees (sacked former labourers) and economic saboteurs due to imperfect market competition/business rivals.

Figure 5: graphic representation of faults



Source: OAG-K analysis of NOFBI project documents

c) **NOFBI experienced frequent splicing which degraded the quality of services offered.** As initially designed, the optical cables had a clearance of about 6 Kms without any splices. Over the years the NOFBI cables have been cut several times during constructions, repairs and maintenance. The NOFBI cable cuts degrade the quality of services offered and the fibre transmissions link in addition to loss of internet traffic. Repairing and restoring the cable cuts involve mounting of two optical fiber end faces together (Splicing). Transmission Engineers of NOFBI clients interviewed complained heavily of degradation in links that are restored following cuts. At times, teams sent by Telkom Kenya Ltd to restore damaged cable cuts, do poor splicing ending in distortion of signals that require high end error correcting equipment that are costly. As pointed out by NOFBI's Technical Managers too many splices within the NOFBI infrastructure reduce the overall lifetime of optical fibre cable, which is estimated to be about 20yrs, and eventually leads to the link optic cable having to be replaced. This definitely places a heavy burden to the tax payer since it is very expensive to replace the optical fibre cable and repair the links. The audit found that NOFBI services had been degraded in all the regions visited during the audit due to the numerous cuts:

- As stated by the Telkom Kenya Ltd. engineers, every NOFBI cable cut leads to two joints requiring between 50 to 100 meters of replacement cable. It is however not recommended to make two joints of 1 metre apart as this creates reflections that burn the card and affect services. NOFBI connection between Mombasa and Malindi has been cut many times which has led to too many cable joints (even up to every 10 metres) and many cable losses. At the time of audit there were up to 20 joints/cuts in the same length which heavily degraded the NOFBI services offered in the Coastal region.
- There was no redundancy link on the Nairobi – Machakos – Kangundo – Thika – Nairobi NOFBI network. The Machakos - Kangundo route which would act as a backup link could not support traffic due to too many splices.
- ICT officers in sampled learning institutions which leverage on NOFBI through KENET such as Machakos University, Technical University of Mombasa and Pwani University explained that

reliable internet services are key for the institutions since core services which have been rolled out to online platform are always compromised, due to NOFBI cuts and down times. This hinders service delivery by the universities who are then forced to spend resources on paper communication. The downtimes also affect learning and research activities for their students and cause trouble with the administration. At some point, some students issued a strike notice due to a persistent internet outage.

d) **NOFBI equipment suffered link loses due to poor termination:** As reported by NOFBI operations and maintenance teams, NOFBI had poor quality termination. Some connection standards used in the NOFBI Optical Distribution Frame (ODF) left the system susceptible to losses. NOFBI's current optical distribution framework utilizes the screw type of Ferrule Connectors, which cause a lot of reflections due to misalignment of screw joints within the optical cable. In practice, Ferrule Connectors suffers more losses as compared to Standard Connectors. The Ferrule Connectors type of Optical Distribution Frame contributed to almost 30% of NOFBI link causing weak unreliable internet signals.

e) **Frequent unavailability of NOFBI services made it unreliable:** As stated in ITUT-T Recommendation 3341, in an e-commerce environment, customers require guarantees of continuous quality of services offered since emphasis on real time is deliberate. Kenya's 2013 National Broadband Strategy defines quality broadband services as connectivity that is always on and that delivers a minimum of 5 Mbps to homes and businesses for high speed access. However audit inspections and interviews conducted with Telkom Kenya Ltd. Technical Managers, Deputy County Commissioners, ISP Engineers, District Accountants, University Heads of ICT revealed that the network was at times unavailable making the quality of services offered unreliable due to the down times. The unreliability has forced some ISP's that use the NOFBI to invest heavily on back up links due to the sensitivity of services and type of clients they provide connectivity. NOFBI unavailability was due to:

- **Frequent soil erosions and floods that left the NOFBI cables exposed and unavailable.** Frequent floods were found especially in West Pokot and Turkana, Nairobi – Narok link, along Wajir – Elwak link, Isiolo - eldera link, and Rhamu – Mandera links, where flash floods erode the sub surfaces and the Kitale – Lokichar route along Nakabothan area which experiences frequent mudslides.
- **Vandalism.** This was prevalent in West Pokot and Turkana areas while the residents are scouting for water from the fibre optic infrastructure, in the Machakos - Kangundo route, as residents look for copper wires. This has led to disruption in network supply hence affecting provision of services by affected organizations.
- **Damage by road contractors.** Found in the western region: along Kitale – Lokichar, Kisumu – Kakamega link, Kisii – Kisumu, Kisii – Migori and Kakamega – Webuye. The situation was

worse especially along Kisumu – Kakamega link. In the Central and North Eastern Region along Isiolo – Moyale route and within Garissa town.

- **NOFBI Equipment malfunction due to high temperatures.** This had affected the Kisii – Migori link.
- **Damage to optic cables from burrowing animals (rodents).** Most prevalent where there are sugar plantations for instance along Kakamega – Webuye link (Western region), Nyahururu – Nanyuki link (Central region).

4.09 According to the ISP's interviewed due to the unreliable services, only a few of NOFBI customers have leased its fibre or have conducted surveys and intend to lease from the NOFBI project. Two out of five sampled ISPs are yet to sign NOFBI's service level agreements (SLA) and contract. The ISP's are waiting until they discuss and resolve on how to improve the SLA from the current agreed levels. The dissatisfaction on SLA terms by ISPs leasing NOFBI dark fiber on the current SLA with current operations and management (O&M) was as tabulated below:

Table 3:SLA and contracts signed

Customer	SOF (Service Order Form)	SLA Signed	Contract Signed
Safaricom	Yes	Have been discussing on how to improve the SLA from the current agreed levels.	TKL signed the contract but is yet to be signed by Safaricom
JTL	Yes	No	No
KENET	Yes	Yes	Yes
BCS/Iquip	Yes	Yes	Yes (NB. Ceased the service this year from June after failing to get customers on the link)
TKL	No	Yes	Yes

Source: Analysis of interviews conducted with NOFBI's internet service providers customers

Cost of internet services in Kenya was still high

4.10 One of the expected benefits of NOFBI was lower cost of communication that can attract investment particularly in rural areas. The audit however found that despite the implementation of the NOFBI project, Kenyans were still paying more for internet than the UN target for developing countries. Also though NOFBI prices are heavily subsidized, internet costs to end users is still very high and the Government Treasury Offices at the Counties were still using modems instead of NOFBI as initially intended:

a) **Kenyans were spending more to access internet than the recommended UN target.** Implementation of the NOFBI project was a key performance indicator in the MoICT's 2008 to 2012 strategic plan's goal 2, of providing Kenyans with affordable information and communication services. The MoICT documents are however silent on how to measure affordability of internet. Thus the audit agreed with the MoICT's officials to use the common United Nations (UN)

broadband commission entry level broadband target which is five percent of the average monthly income. Five percent of Kenya's average gross domestic product (GDP) per capita, from 2009 to 2014 of $443.80 is $22.19 per year or $1.85 per month. According to the 2010 ICT survey by the Communications Authority of Kenya, many spent an average of $8.57 per month or 23% of the per capita for internet services in 2009/2010.The UN broadband Commission report as at September 2013 for developing countries has an average of 30.1% of monthly income being spent on internet services. This indicates that Kenya's internet costs are way higher than the international UN benchmarks.

Table 4: GDP Per Capita

Description	Unit	2009	2010	2011	2012	2013
GDP Per Capita (constant)	Kshs	36,962	38,345.5	38,956.0	39,620.5	40,345.2

Source: Kenya National Bureau of Statistics Economic Survey 2014 at exchange rate as at 30/6/2014: 1$ = kshs. 87.53

b) **Cost of internet to the end user was still very high.** The audit analysed NOFBI charges for both dark and lit fibre to assess the cost of its internet services. The audit found that NOFBI prices are heavily subsidized especially for the commercial internet service providers (ISP) operators. Review of Telkom Kenya Ltd. and MoICT documents revealed the rates charged for the lease of dark NOFBI fibre to commercial internet service providers were:

- US $ 22.5 per Km for KENET (which is a non-profit organisation that provides internet services to learning institutions)
- US $ 23.44 per Km for Telkom Kenya Ltd. and Safaricom (NOFBI's largest clients) and
- US $ 50 per Km for others
- NOFBI lit fibre is leased at a rate of US $ 433 per E1 link and US $ 9,000 per Synchronous Transfer Module level 4, (STM 4 link - a fibre optic transmission equivalent to 622 Mbps)

4.11 The audit experienced a limitation in obtaining data on prices charged by some internet service providers (ISP's) to end users leveraging on NOFBI. This is because the ISP's are private business enterprises. Of the ISP's interviewed, only KENET felt the price as being prohibitive and would prefer a subsidy on unit price of lease of NOFBI fibre pair per Kilo meter for services provided to the research and education sector in order to reduce the cost of internet access by the education and research community to promote research and innovation. As stated earlier NOFBI charges US $ 22.5 per Km to KENET, who in turn charge learning institutions as follows:

- **Coastal Region:** According to the ICT officer of Technical University of Mombasa, they lease a dedicated 40mbps connection from KENET whose prices are at almost half the prices offered by other commercial ISP providers. The University however was still of the opinion that the internet lease price per 1mb is US $480per quarter is expensive for the institution and limits their capacity to increase bandwidth to sufficient required levels. Pwani University is supplied internet services

by KENET at 20 Mbps bandwidth. Pwani University is paying US $750 per MB per quarter for the NOFBI lease and also has a backup link from Safaricom at about the same rate US $856.14 per MB per quarter. The university was also of the opinion that the cost of internet is still high and should be revised downwards

- **Central and North Eastern Region:** According to the ICT officer of Machakos University, the institution's current internet requirement is 30 Mbps depending on the needs which is still low. The university pays US $900 per quarter to KENET for the 1 Mbps link to leverage on NOFBI through KENET. In total the university pays internet costs of Kshs 20,000.00 per megabit per month which sums up to Kshs. 232,000 per year inclusive of value added tax (VAT). However they consider the amount spent on internet, still to be too expensive for the institution and limit their capacity to increase bandwidth to sufficient levels. Meru University of Science and Technology pays quarterly payments of US $ 18,000 to KENET. The university ICT officials pointed that though this is cheaper than what other commercial internet service providers (ISP's) offer, it is still expensive for the institution and limits their capacity to increase bandwidth to required levels.

- **Western Region:** Masinde Muliro University of Science and Technology pays US $ 200 per MB per month which sums up to US $ 96,000 per year inclusive of VAT to leverage on the NOFBI link. According to the ICT officer, though cheaper than what other commercial ISP's offer, it is still expensive for the institution and limits their capacity to increase bandwidth to sufficient level. The current requirement is 30 mbps depending on university needs which is still low. The university pays $24000 per quarter to KENET for the 40mbps link.

c) **Treasury offices in the counties were using modems:** The audit found that Government District Treasury Offices were still using modems (dongles) funded by the National Treasury and are not connected to NOFBI. The modems were given to treasury as a stop-gap measure since Counties do not have last mile connectivity of NOFBI phase I which was only a backbone infrastructure:

   - **Central and North Eastern Region:** Kajiado and Embu, District Accountants explained that The District Treasury of Kajiado Central is not connected to NOFBI and they transmit their reports to the National Treasury in Nairobi by accessing internet services from the cyber cafes. The cost is met from budgetary allocation by the National Treasury. The quarterly allocation is US $ 66.19 for internet connections. This was insufficient according to the District Treasury Officers.

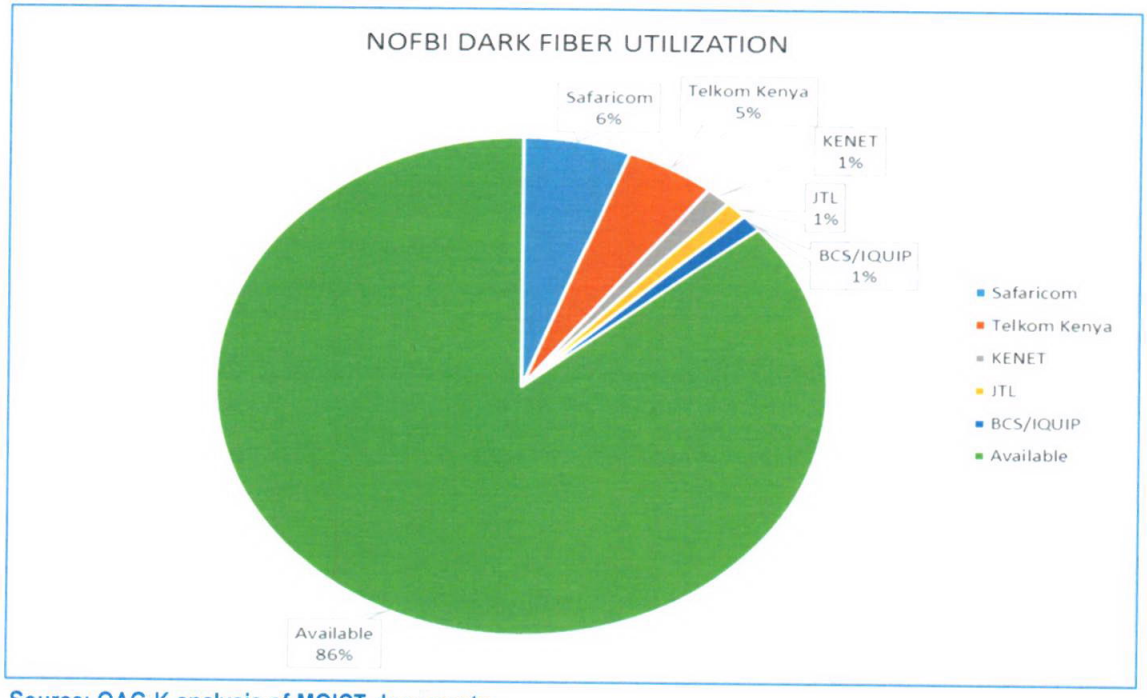
   - **Western Region:** In Busia and Kisumu the District Accountants explained that the District Treasuries are not connected to NOFBI and they transmit their reports to Nairobi by accessing internet services from modems. The cost is met from budgetary allocation by the National Treasury. The quarterly allocation is US $ 68.55 per officer for internet connections. This according to the District Treasury Officers is insufficient and expensive.

NOFBI was not being utilized to its full capacity

4.12 The Government's intention from the onset was that the NOFBI project was to be fully utilized to the available capacity. The Government was to use the NOFBI within its offices and lease out the remaining capacity. Contrary to this, the audit found that the utilization level of NOFBI links was low ranging from 0% to 58.33% across different regions where it traverses :

a) **Low utilization of the NOFBI capacity.** Phase I of the NOFBI was constructed using 24 core cable (2 core cable forms one channel, totaling 12 channels). NOFBI's volume capacity therefore available for use is 12 X 4415 Kms, amounting to a total volume of 52,980 Kms. of this, 52,980 Kms the volume in use by June 2014, for leased dark fiber was only 7502.8 Kms, which is 14% of the network volume available, leaving unutilized capacity of 86% still available. As graphically shown below Safaricom who are NOFBI's leading ISP in terms of leased dark fiber, utilized a total of 6% of the infrastructure countrywide followed by Telkom Kenya Ltd. at 5%.

Figure 6: graphical representation of NOFBI dark fiber



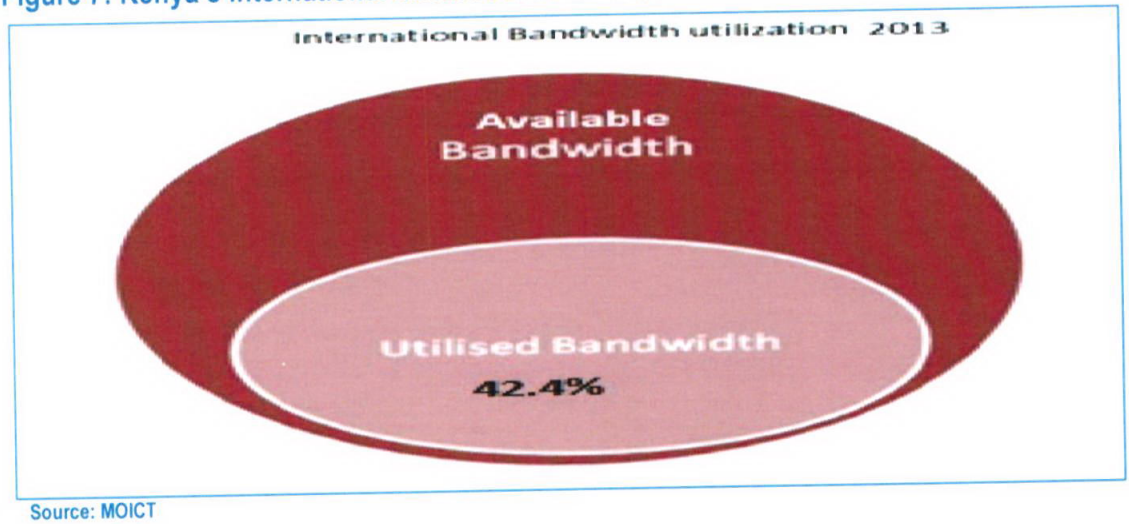
Source: OAG-K analysis of MOICT documents

- Only two internet service providers (ISP's) have leased the lit NOFBI capacity for a total of thirty nine E1s (E1 is a link that operates over two separate sets of wires, usually Unshielded twisted pair (balanced cable) or using coaxial (unbalanced cable) and two Synchronous Transfer Module 4 (STM4's) links countrywide. An E1 link has a capacity of 2.048 Mbps and an STM 4 link has a capacity of 622mbps.

b) **Only 3% of internet service providers in Kenya leverage on the NOFBI bandwidth.** Licensed Internet Service Providers (ISP's) in Kenya increased from fifty two in 2009 to one hundred and sixty nine in 2013, of which only five ISP's had leveraged on NOFBI directly by 2014. The five ISP's leveraging on the NOFBI represents a mere 3% of the total number of 169 ISP's in the country.

c) **Effect of NOFBI's underutilization on Kenya's international bandwidth.** The NOFBI project, as stated in the 2006 Cabinet Memorandum detailing its formation, along with other communications network infrastructures already constructed in Kenya, were to ensure optimum usage of the country's international bandwidth capacity available. Kenya's available internet bandwidth capacity increased by over fifty per cent in 2013 compared to a thirty two per cent increase in 2012. This increase was attributable to increased undersea communications capacity, which rose to 862,210 Megabits per second (Mbps) in 2013 up from 574,054 Mbps in 2012. The country's satellite capacity however declined to 264 Mbps because it was used mainly as a backup for the country's fiber network. By 2013, only forty two percent of the country's total international bandwidth capacity available was utilized as depicted below. The low utilization of the bandwidth was attributed to slow adoption of technologies such as NOFBI by organizations in Kenya.

Figure 7: Kenya's international bandwidth utilization



Source: MOICT

d) **Low utilization of the NOFBI projects in counties.** The NOFBI projects core utilization charts and physical verification documents also pointed to under-utilization. The trend of low utilization of the NOFBI project was evident in the carrier houses (physical sites where data communications media converge and are interconnected) visited by the audit teams in the counties. In all the regions visited during the audit, the Telkom Kenya Ltd. technical managers felt that the level of awareness of the NOFBI project was low since the MoICT had not conducted campaigns to enhance the county governments' awareness on the existence and benefits of the NOFBI backbone.

e) **ISP's may not be able to reduce internet costs due to low utilization of the NOFBI project.** NOFBI has a 24 core capacity terminating in every node, of these, some are lit and others are dark. Users of NOFBI dark fibers were found to be Safaricom, KENET and Telkom Kenya Ltd. while NOFBI lit capacity was often used by e–Government. Fibre has a very high capacity and a single pair lit even at 2.5 GBps can support an unlimited number of customers. Audit inspections of NOFBI in addition to interviews with the Telkom Regional Heads and the users of NOFBI dark fibre revealed that due to the low utilization of the NOFBI project the few internet service providers (ISP's) that have leased NOFBI may not bring down internet charges as market forces would dictate:

- **Coast Region:** The current connectivity for the lit NOFBI links within the Coastal regions are: Mombasa to Malindi - STM 16, Malindi – Garsen – Milhoi - STM 4 and Mombasa – Kwale – Diani - STM 4.The core utilization of these carrier houses, had an average of 17% for the lit capacity, 24.7% for dark and leased capacity, and 58.3% of dark and spare capacity which is an indicative of the unused capacity.

- **Central and North Eastern Region:** Though the link for lit capacity was available in these regions, NOFBI terminated only in the carrier houses and had no last mile connectivity. Therefore there are no customers for lit NOFBI fibre in most terminals. The audit noted that the core utilization of the carrier houses (physical sites where NOFBI data communications media converge and are interconnected.) was highly unutilized. The carrier houses in these regions had 78% of dark and spare capacity with an average of only 3.33% for lit capacity, and 18.33% for dark and leased capacity. NOFBI links in the carrier houses in these regions were found in Athi-river - Machakos, Machakos – Kitui and Athi-river - Namanga. The utilization levels by ISPs within these regions were also found to still be very low. Utilization levels ranged from 8.33% in the Garissa – Hola link to 50 %, being the highest, in Nyeri – Nanyuki, Nyeri – Murang'a and Meru - Isiolo links.

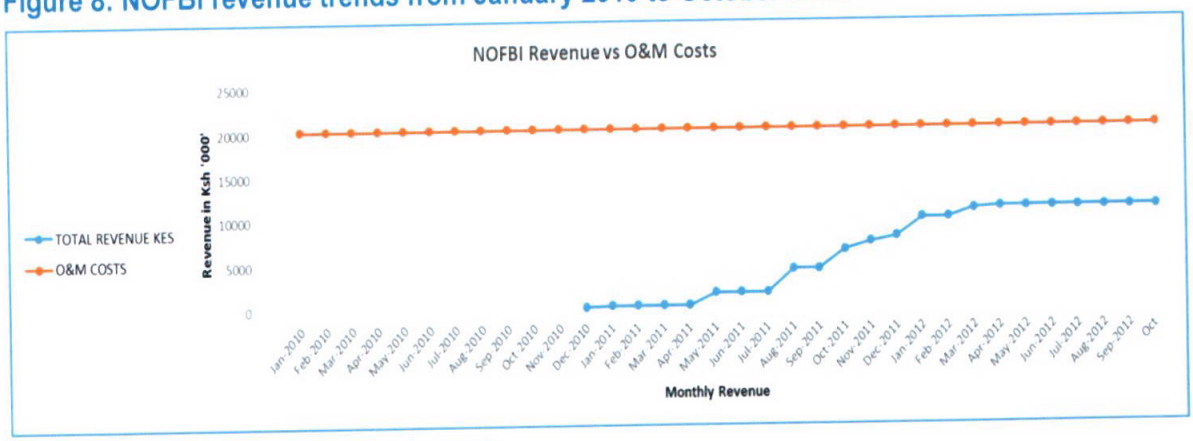
- **Western Region:** At the time of audit only three ISPs were leveraging on the NOFBI structure (Safaricom, Telkom Orange, and Jamii Telkom). These three ISP's had only leased dark fibre that totals only 187km, yet NOFBI Phase I covered a total of 623 km in the region. The utilization levels in the western region carrier houses comprising Kisii, Kakamega, Kisumu, Mumias, Webuye, Busia, Migori, Isibania and Kericho gave a very low trend of unutilized portion of 68% of dark fiber not leased and only 32% either lit or dark that is leased. The highest utilization by ISPs was found in the Kisumu – Kisii link at 58.3 % with the lowest with 0% utilization rate in the Kisii – Isibania link.

Low commercialization of the NOFBI

4.13 It was expected that over time, the proceeds received from the NOFBI project, being an income generating project, would be used in paying for operating and maintenance costs and the project will be self-reliant. However the audit found that NOFBI has not been commercialized as intended. In all the regions visited, the Telkom Technical Managers felt that the level of awareness of this noble Government initiative was still low since the MoICT had not campaigned or created awareness to the County Governments and internet service providers about the existence and benefits of the NOFBI project. Low commercialization of the NOFBI project has led to the infrastructure's extra capacity not being leased out to generate the much needed revenue. Thus taxpayers were being subjected to heavy financial burdens as detailed in paragraphs below:

a) NOFBI's monthly operation and maintenance fee was Kshs. 20,261,966.00 giving an annual figure of Kshs. 243,143,568.00 effective from March 2010. NOFBI project records reflected that by March 2012, management of the NOFBI project had cost the tax payers approximately Kshs 496 million, yet NOFBI's total cumulative revenues from both dark and lit fibre was only Kshs. 143,787,337.00 for the same period and taxpayers have to pay the difference of Kshs 352,127,727.00.

Figure 8: NOFBI revenue trends from January 2010 to October 2012



Source: OAG-K analysis of NOFBI project documents

b) In June 2011, the Government signed another contract for the NOFBI project with Telkom Kenya Ltd. to share the net profits received from Telkom's provision of the "NOFBI dark fiber services" at 50% in consideration of its management services from March 2012, for five years till June 2016. The net profits was to be calculated after taking into account revenues generated by "NOFBI dark fiber services" minus all direct or indirect costs supported by Telkom Kenya Ltd. for generating the revenues. However, revenue for NOFBI Lit or Telecom services was to be remitted to the Government. Based on the information availed at the time of audit, Telkom Kenya Ltd. generated only US $ 239,540.75 from November 2012 up to June 2014 and maintained O&M charges of Kshs. 20,261,964 per month for the same period

Table 5:Dark fiber charges and revenue for June 2014

NO	ISP	NO of KM LEASED	CHARGE RATE PER KM.	AMOUNT (USD)
1	Safaricom	3024.5	23.44	70,894.28
2	Orange	2526.3	23.44	59,216.47
3	Kenet	724	22.5	16,290
4	BCS	529	50	26,450
5	Jamii Telkom	635.8	50	31,790
TOTALS				**204,640.75**

Source: Telkom Kenya

Table 6: Lit fiber charges and revenue for June 2014

NO.	ISP	TYPE OF LINK	NO. of LINKS	CHARGE RATE PER LINK (USD)	AMOUNT (USD)
1	Safaricom	E1 link	26	433.33	11,267
2	Orange	E1 Link	13	433.33	5,633
		STM4 Link	2	9000	18,000
TOTALS					**34,900**

Source: Telkom Kenya

c) Further analysis revealed that the NOFBI project was losing an opportunity to generate 1.8% to 4% of the revenue for lease of dark fibre services monthly from the damaged 164 Kms link in the Athi River - Namanga route which was never repaired. The link has an opportunity cost of US $ 3,844 per month for ISP's charged at USD 23.44 per Km or US $ 8,200 per month for ISP's charged at US $ 50 per Km.

d) In addition, despite the fact that NOFBI project is not generating sufficient revenue to maintain its own operating costs, taxpayers are also being subjected to repaying the concessional loans received from Exim China to finance the NOFBI project totaling over US$ 110 million (US $ 37 million for phase I and US $ 72.5 million for phase II plus additional loan management and commitment fees). By August 2014 the government had already paid Kshs. 1,264.3 million towards the NOFBI phase II loan

e) The project evaluation of NOFBI reported positive values for Net Present Value (NPV), Internal Rate of Return (IRR) and payback period but the project has not generated revenues sufficient to break even and therefore the commercial aspect of the project has achieved minimal results. In addition, the overall productive lifetime of optic fibre cables is estimated to be about 20 years, but at a utilization level of 14% five years into the life of the project, 25% of the lifetime of the network is depleted.

Ineffective monitoring and implementation of the NOFBI project

4.14 The audit found that the NOFBI project has not been effectively managed since :

a) **The NOFBI phase I network in some regions had not been commissioned.** NOFBI phase I was implemented in 2007. However, the audit found that five years later, the Athi - River to Namanga NOFBI phase I link, in the Central and North Eastern Regions, had many cable cuts which had not been repaired since 2007. This led to lack of internet connectivity and access in Kajiado County. This site was done by M/S Huawei but was never commisined by MoICT or accepted by Telkom Kenya Ltd. during handover.

Picture 1: Athi River -Namanga damaged NOFBI phase I section that was not commissioned
Source: OAG

b) **NOFBI Phase I was not designed properly:** The preliminary activities of the NOFBI project included tender preparation, evaluation, route surveys and negotiations were undertaken by the Ministry of Information and Communication in liaison with technical staff from Telkom Kenya (TKL). The installation of cables in some regions was not to the correct depth and was frequently destroyed by soil erosions and floods that left the cables exposed and unavailable, vandalism, damage by road contractors, high temperatures and burrowing animals (rodents). In addition, the backbone infrastructure design was linear instead of ring which had the following effects:

- The linear network did not have redundancy and had no alternative route in case of damages. The main network and protection are on the same cable so that when there is a cut, both protection and main network are down.
- As such the Government has to incur more taxpayers funds in phase II to close the loops in phase I's infrastructure and integrate equipment to allow the backbone be extended to all the 47 county headquarters in Kenya.

c) **Phase II of the NOFBI Project was not implemented as planned.** Contract for the implementation of NOFBI phase II was awarded to M/S Huawei on July 7th 2010. The contract has since had two amendments, the first in one in 17 October 2011, and a second one in 23 May 2014. In March 2013, M/S Huawei, the contractor, was paid advance payments of US $ 14.5 Million (20% of the contract sum of US $ 72.5 million) to start preparing for phase II project delivery. However, project works were again suspended, for over two years, as the MoICT requested for project changes, in compliance with new requirements due to reorganization and restructuring of the Government following Kenya's 2010 Constitution. By October 2014, the MoICT was still in the initial plans of implementing NOFBI phase II and had not yet put in place a dedicated office to provide supervisory services and ensure effective implementation of the NOFBI project.

d) **The NOFBI Cable was experiencing numerous cuts, which were costly to repair. The** cuts were either due to vandalism, damage during road constructions, rodents and floods

e) **NOFBI Project has not been implemented within projected costs.** Major alterations of phase II included removal of some items e.g. Digital Hospital solution which was to cost US $ 4,115,426.00, Telepresence solution which was to cost US $ 6,107,960.00 and other accessories although the total cost of project has not changed. This would mean additional funds amounting to US $ 10,223,386 which is 14% of the initial contract price and will be required to implement these elements by line Ministries like the Ministry of Health. In addition, these additional costs do not take care of expected monetary changes due to inflationary pressures in the economy over time.

f) **Taxpayers continue to pay a heavy financial burden for the delayed implementation of NOFBI phase II.** NOFBI phase II's final approved loan agreement was signed in October 2012 for US $ 72,500,000.00. The loan has a maturity period of 240 months from the date the loan agreement became effective (with a grace period of 84 months and a repayment period of 156 months). Thus despite phase II of the NOFBI project not yet started, Kenyan taxpayers had by October 2014, borne the burden of over US $ 17,995,000 on the project for aadvance fees to contractor US $ 13,500,000 (being 20% of contract price), interest rate of US $ 2,900,000 (being 2% of US$ 72,500,000.00 for two years), management fees of US $ 725,000 (1% of loan amount) and commitment fees of US $ 870,000 (being 72,500,000- 13,500,000)*0.75% for a period of two years).

g) Taxpayers also paid for NOFBI operations and maintenance to Telkom Kenya Ltd. of Kshs. 20,261,964.00 per month from 2010 - 2012. Following the privatisation of Telkom Kenya Ltd, the MoICT entered into a 50 - 50% profit sharing contract on NOFBI's net profit received from dark fibre revenue from 2011 to date. Telkom Kenya Ltd. has however maintained the fixed O & M charges at Kshs 20,261,964.00 to date.

Chapter 5
Conclusions

5.01 The MoICT has achieved significant strides with the implementation of the NOFBI phase I project. NOFBI has provided reasonable dark and lit fibre charges to ISPs but the benefits are yet to be transferred to end users. The MoICT has however not been able to improve universal access to information, communication and telecommunication services in Kenya as expected. ICT services have also not been made as reliable as expected due to frequent downtimes creating unavailability of services to users. The current O&M provider has not done its work satisfactorily as evidenced by ISPs who lease dark fibre and are all (except KENET) are yet to sign the current SLA provided based on poor terms. The NOFBI infrastructure has not been utilized to the full capacity available as shown by the low uptake of ISP's and government institutions. The NOFBI project was not been implemented according to the initial projected costs leaving Kenyan taxpayers with huge financial burdens.

5.02 Phase II of NOFBI project has delayed in implementation and major ISPs who are anticipated to lease the last mile have already laid their own fibre and might not lease the fibre as projected by the ministry. This will extend the period the project will repay itself. The NOFBI project has two aspects, developmental and economic. Though not making profits, socio economic benefits for public and private entities leveraged on the NOFBI such as financial institutions, government departments may not be easily quantified. NOFBI's project evaluation reported positive returns and payback values over time, despite the project not generating sufficient revenues to break even. Therefore the commercial aspect of the project has achieved minimal results. In addition, the overall productive lifetime of the optic fibre cables is estimated to be about 20yrs, and at a utilization level of 14% five years into the life of the project only 25% of the network's lifetime had been depleted by 2014.

Chapter 6

Recommendations

6.01 In view of the findings and conclusions of the audit, the Auditor-General, has proposed the following recommendations for implementation by the Accounting Officer, of the Ministry of Information Communication and Technology:

1. **To enhance universal access to ICT services in Kenya through the NOFBI project the Ministry should:**

   i. Expedite the implementation of NOFBI phase II so as to expand the bandwidth, coverage, presence and availability of the fiber optic network to all the forty seven counties in Kenya

   ii. Ensure NOFBI fiber nodes are adequately available within the regions it traversed and not terminated in the towns

   iii. Finalise the repairing and commisioning of the Athi - River to Namanga NOFBI link to avail NOFBI services in the Central and North Eastern Regions

   iv. Reduce prices and close the access gap for under - served populations to make ICT services affordable

   v. Look for methods to ensure that NOFBI operators, build the last mile access networks in more regions in order to get the ICT services to consumers

   vi. Enhance the structural design of NOFBI phase II to ensure NOFBI internet accessibility and redundancy within the regions it traverses

   vii. Foster Infrastructure sharing among ICT service providers to enhance ease of penetration and enable universal access.

2. **To improve the reliability of NOFBI services the Ministry should:**

   i. Harmonize ICT policies with respect to energy and roads to reduce damages to NOFBI cables during constructions

   ii. Review NOFBI's operations and maintenance contracts in order to enhance its services and decrease down times and outages experienced within the infrastructure

iii. Create sufficient awareness of the importance of NOFBI in rural areas where fiber cuts and vandalism is rampant.

iv. Procure competitively an Operations and Management service provider since the current service provider is no longer a government entity

v. Take a more robust approach in investigating alleged sabotage incidences and take punitive measures to deter such cases as capacitated by the ICT Act 2009, on general prohibition on anti-competitive conduct

vi. Enhance inter-agency collaboration especially with Ministry of Transport and Infrastructure, to adopt an integrated infrastructure development approach that will see ducts incorporated in road designs thus avoid repeated fiber cuts during constructions

vii. Examine connector equipment's used in NOFBI's optical distribution framework to reduce 30% of the losses being experienced currently due to poor termination

viii. Enhance ways to reduce damage to the NOFBI cables and also ensure that damaged cables are repaired as quickly as possible to avoid frequent downtimes

ix. Consider various ways to ensure that Telecom Operators and ISPs who provide ICT services through the NOFBI project have equipment's that give optimal capacity, bandwidth and speed to end users.

3. **To bring down internet costs in the country the Ministry should:**

i. Put in place mechanisms to increase ISP's leveraging on NOFBI to fully commercialize the Fiber Network to improve on its utilization and let market forces favor low costs of connectivity

ii. Ensure that the subsidized NOIFBI internet costs trickle down to end users to enable Kenyans get internet in line with the common United Nations (UN) broadband commission entry level broadband target which is five percent of the average monthly income

iii. Look for ways for subsidies or incentives to reduce the cost of internet access by the education and research community to promote research and innovation in the country

iv. Liaise with other Government agencies to enhance the provision of NOFBI services within Government institutions at a subsidized rate

4. **To increase the utilized capacity of the NOFBI project the Ministry should:**

i. Provide a clear legislative provision on public sector participation in relation to broadband infrastructure and services to enhance the effective and efficient deployment and utilization of services delivered and assessed through broadband as required by Kenya's constitution

ii. Put more effort in public awareness of the opportunities that the NOFBI network presents, especially to content providers and also to actively involve Government in utilizing the cable as it rolls out public services countrywide such as Huduma centres for greater stakeholder engagement

iii. Get a more robust way to commercialize and encourage the utilization and adoption of the NOFBI by organizations in Kenya so as to lease the current 86% unutilized capacity of still available the NOFBI dark fiber

iv. Look for aggressive ways to encourage internet service providers to leverage on the NOFBI services offered

5. **To implement the second phase of the NOFBI project more economically the MOIC should :**

i. Put in place measures to complete NOFBI phase II expansion project within the current contract terms without further amendment to the contract.

ii. Enhance inter-agency collaboration especially with Ministry of Transport and Infrastructure, county lands, housing and urban planning departments and county roads public works and transport departments, in identifying and mapping out any underlying infrastructure to enable issue of proper way leaves hence minimizing chances of disruptions whenever new infrastructure contracts are being undertaken.

iii. Put in place mechanisms to ensure there is a dedicated office within the Ministry that monitors and supervises the NOFBI project and operations and maintenance provider to ensure contract terms are adhered to and service level agreements are achieved. This will enhance the effective monitoring of the project both in implementation and management.

6.02 The Ministry has accepted the above suggestions and recommendations and have actively begun implementing them. Key highlights that according to the Ministry have been started after receipt of the draft report were:

i. The operationalization of the Universal Services Fund to facilitate expanding the penetration of broadband infrastructure to all counties.

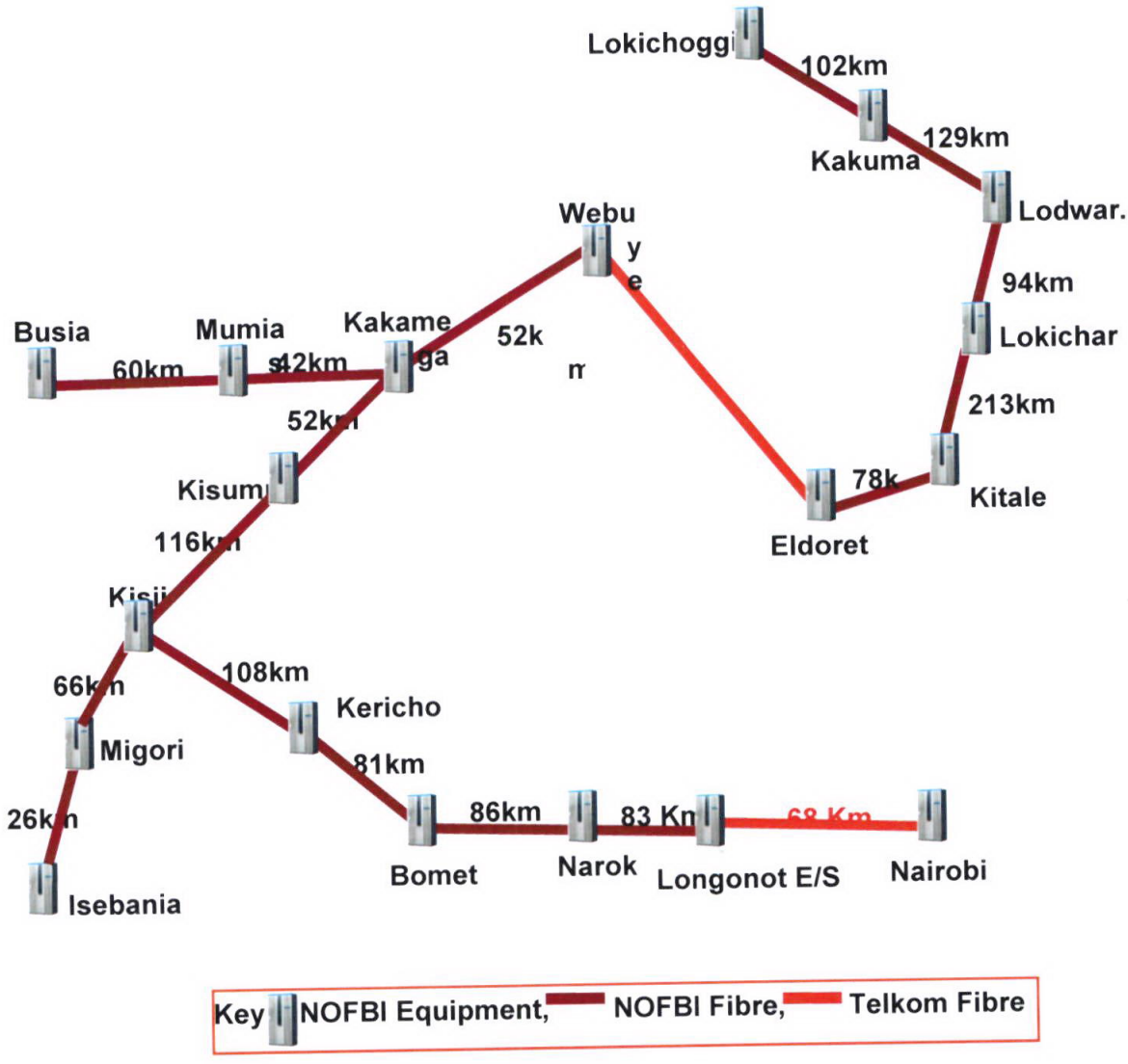
ii. Roll out of NOFBI Phase II to address the inherent issues that are in Phase I infrastructure

iii. Review of the current Operations and Maintenance Contract with Telkom Kenya a view to making it more robust, or terminating it and seeking new cable managers

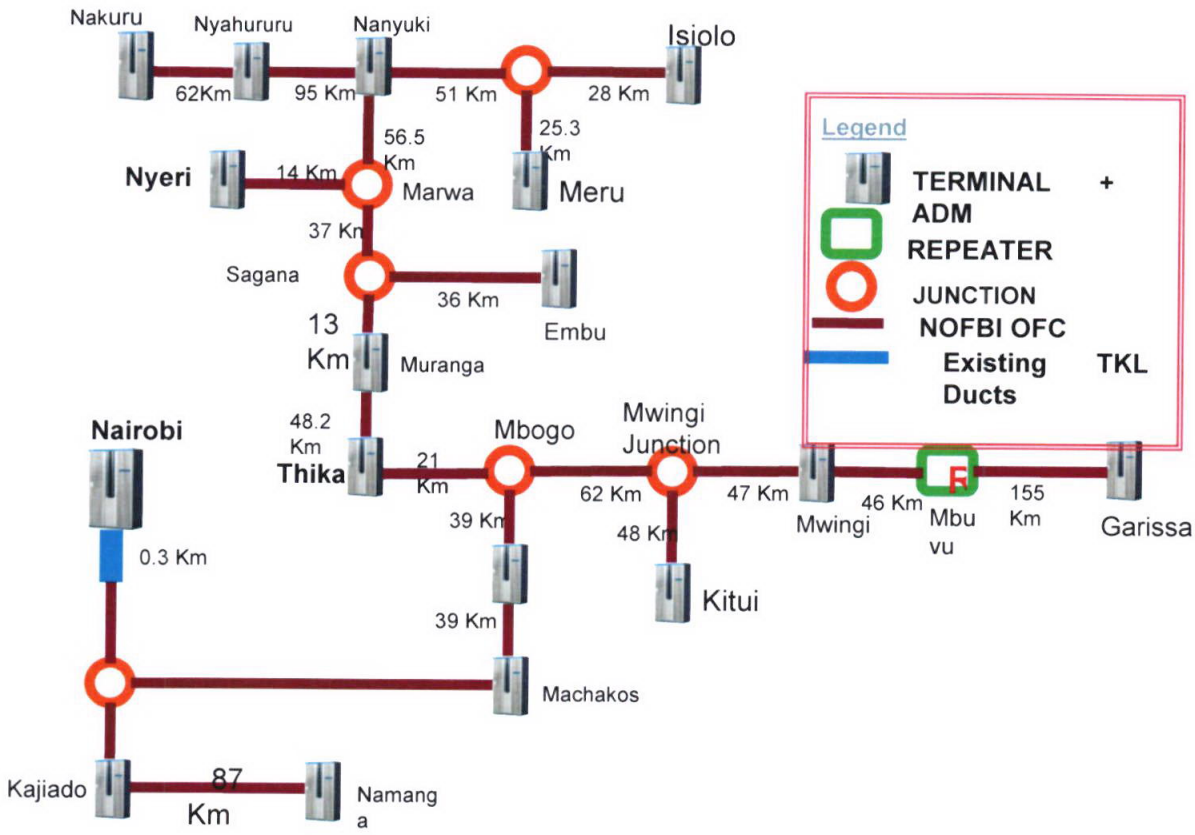
iv. Increased uptake of the Terrestrial network by attracting transit traffic from neighboring countries, and also interconnecting the National Backbones with other Backbones in the region under the Northern Corridor Arrangement. Detailed response of the Ministry to the report is at appendix six of this report.

Appendices

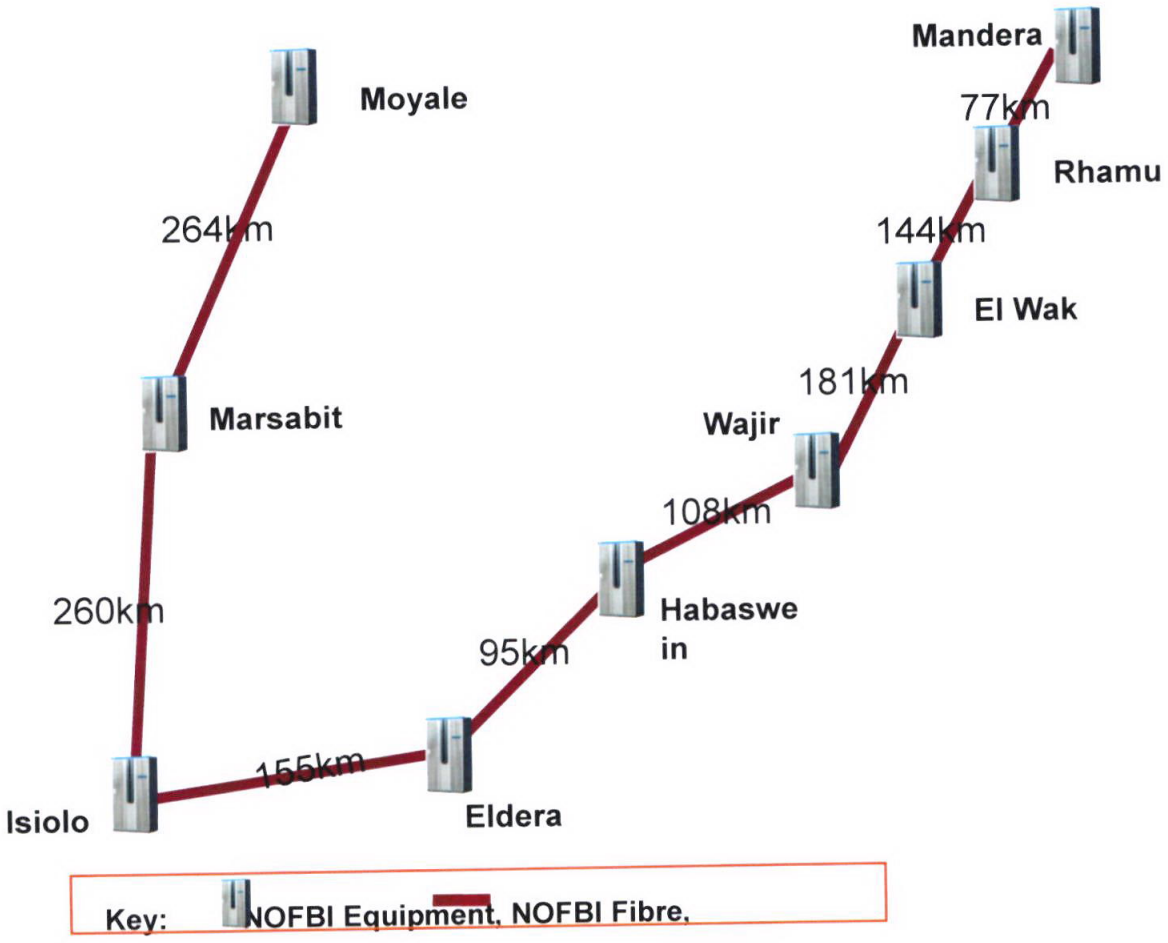
Appendix 1: NOFBI Phase 1 Contractors and their Routes ZTE Region (Western Region 1342 Km)



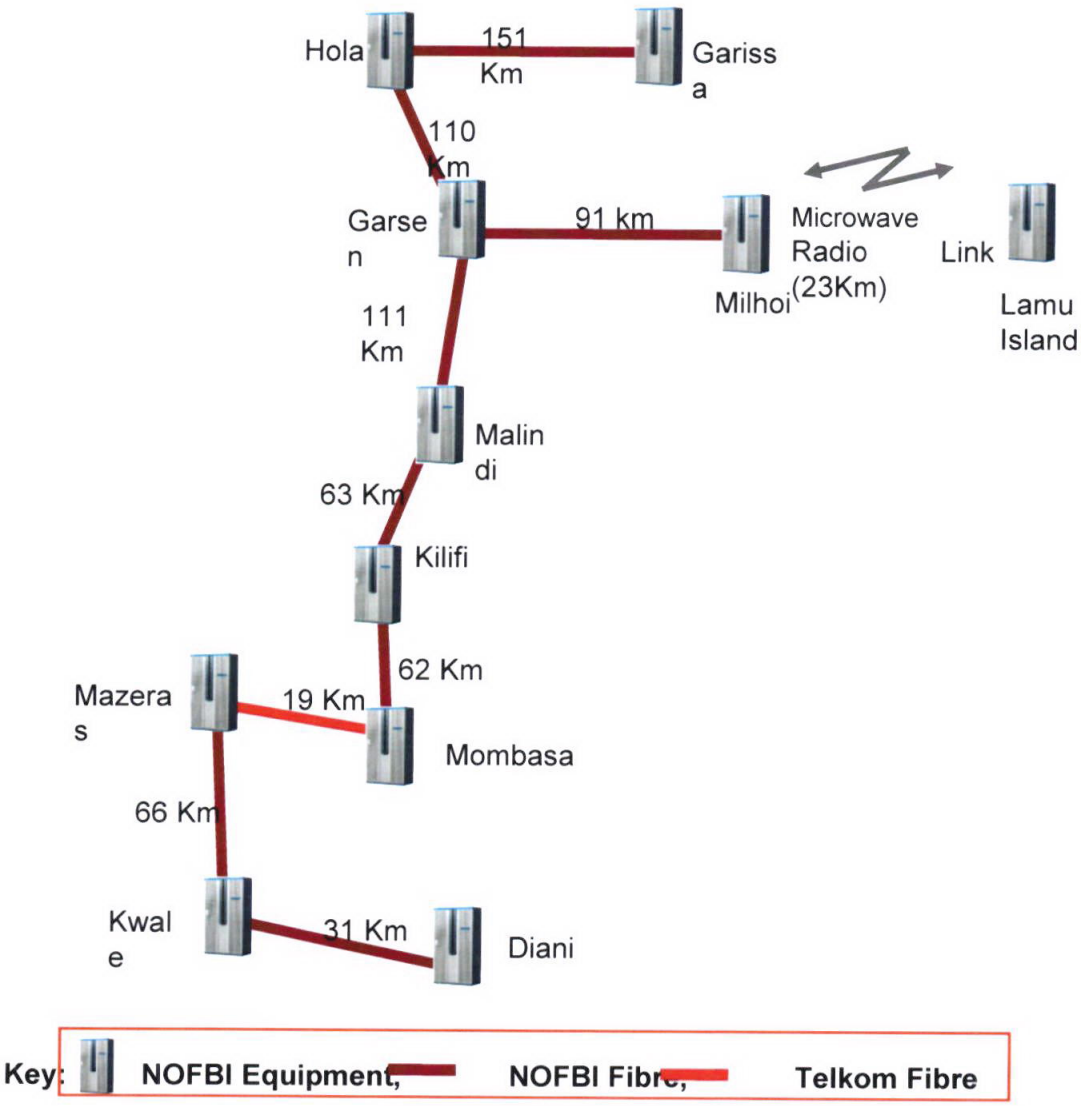
Appendix 2 : NOFBI Phase 1 Contractor and their Routes HUAWEI CONTRACT (Central Region 1112Km)



Appendix 3: NOFBI Phase 1 Contractors and their Routes SAGEM CONTRACT (North Eastern Region 1284KM)



Appendix 4: NOFBI Phase 1 Contractors and their Routes SAGEM CONTRACT (Coast Region 677KM)



Appendix 5: Supporting Tables to the Audit Report

Kenya's Internet penetration levels

Indicator	2009	2010	2011	2012	2013
Internet subscribers		3,296,975	6,152,664	8,506,748	11,671,337
Estimated internet users		8,884,850	11,305,592	13,537,658	19,162,055
Internet penetration (%)	9.7	22.1	28.7	35.5	47.1
Total fixed and wireless broadband subscriptions		99,994	131,829	1,002,701	1,435,267
Broadband subscriptions per 100 inhabitants		0.3	0.3	2.5	3.4

Source: Communications Authority of Kenya (MOIC 2013 – 2017 strategic plan)

NOFBI dark fiber leased

No.	Internet Service Providers (ISP)	No. of NOFBI Kms leased	Total NOFBI network volume (Kms)	% of used dark fiber out of the total NOFBI network volume
1	Safaricom	3024.5	53628	6
2	Telkom Kenya	2526.3	53628	5
3	Kenet	724	53628	1
4	Jamii Telecom	635.8	53628	1
5	Bcs/Liquid Comm	592	53628	1
Total		7502.6	53628	14

Source: Telkom Kenya Ltd.

Kenya's ISP's and international bandwidth

Performance Indicator		2009	2010	2011	2012	2013
Licensed Internet Service Providers		52	57	90	165	169
Capacity in mbps : total undersea Bandwidth capacity:			202,506	434,870	574,056	862,210
Satellite bandwidth capacity:			214	650	650	264
Total available Bandwidth Capacity			202,720	435,520	574,704	862,474
Utilized Bandwidth:	international undersea bandwidth:		20,000	32,152	264,426	365,330
	international satellite bandwidth		210	119	158	83
Total international bandwidth utilized			20,210	32,271	264,584	365,413

Source: Communication Authority of Kenya

Appendix 6: Ministry of Information, Communication and Technology's response on audit finding

Audit Finding	Ministry of Information, Communication and Technology's response on audit finding
1. There was still inadequate access to ICT services in Kenya through the NOFBI Project.	The cited inadequacy with respect to coverage is currently being addressed in the expansion of the infrastructure in the ongoing NOFBI Phase II. Regarding the numerous cuts on the network making some links extremely disjointed and unusable leading to lack of connectivity and accessibility, it is indeed true that due to cases of vandalism, road works and others, some sections of the network have been affected. Since NOFBI Phase I was a linear network, the Phase II implementation is providing diversity and redundancy through ring network configuration to enhance accessibility and availability in case of disruption of services in the main circuit so as to ensure uninterrupted access.
2. NOFBI services were unreliable	The Ministry concurs with the comment that the NOFBI was expected to bring reliable power of high speed high bandwidth connectivity to Kenya. It is noteworthy that the NOFBI provides a dark fiber pair to the service providers which are virtually unlimited capacity bandwidth. The capacity, bandwidth and speed limitation is solely dependent on the equipment that the service providers (Telecom Operators and ISPs) who rent the dark fiber cables decide to deploy. Regarding the frequent outages and long lead times for repair, the Ministry entered into an Operations and Maintenance and Commercialization Contract with Telkom Kenya in 2012, to enhance the services in NOFBI. This arrangement is currently being reviewed in order to provide a more robust regime for the operations and maintenance of the cable as well as commercialization of services. NOFBI cable customers have Service Level Agreements with Telkom Kenya the Operations and Maintenance managers of the NOFBI, which spell out the mean times to repair outages as well as applicable fees.
3. The cost of internet services was still high in Kenya	The telecoms market in Kenya is fully liberalized and market forces of supply and demand in a competitive environment are at play. The annual reports by the industry regulator Communications Authority, in its published Annual Report for the Financial Year 2012-2013 notes that total number of Internet services licensees (Application Services providers) in 2008/2009 were 58 while in 2012/13 were 1,558. The report also notes that the number of Internet users increased by 40.1 per cent, to stand at 19,654,925 in the Financial Year 2012/13. This growth can be attributed to the increased usage of the internet for basic services such as banking, healthcare and education, availability of a wide array of affordable internet access devices such as smart phones and tablets, as well as the innovative promotions and special offers and affordable bundled internet services provided by operators.
4. NOFBI services were not utilized to the full capacity provided	In order to address the challenges, the Ministry through the Communications Authority has operationalized the Universal Services Fund -USF. The USF is expected to play a crucial role in expanding the penetration of broadband infrastructure to all counties. Regarding the project not generating sufficient revenue to maintain its own operating costs, the Ministry has noted the observation, and has initiated remedial action with Telkom Kenya the O&M Managers. It should nonetheless be noted that the uptake of NOFBI cable is not spontaneous, and a maturity path (5-7years) has to be followed before most of the capacity is used. The initial period of uptake (0-5years) will have to be supported before it breaks even, and eventually becomes self-sustaining. With respect to NOFBI awareness, the target users and clients for NOFBI are primarily Telecommunications Services Operators and Research and Education sectors, who are fully appraised of NOFBI and are active users of the same. However, for greater stakeholder engagement, the Ministry will put more effort in public awareness of the opportunities that the Network presents, especially to content providers. The Government is also actively involved in utilizing the cable as it rolls out Huduma centres countrywide.
5. The NOFBI project was not effectively monitored nor implemented	The section from Athi River to Namanga was damaged by road construction and the Ministry brought this matter to the roads supervising Ministry. The matter is still being pursued. Destruction of cable due to soil erosion, floods is constantly being addressed through the Operations and Maintenance agreement. The Ministry has in place a project steering committee and a technical implementation committee and teams in place. Under direction and on behalf of the Ministry, the ICT Authority provides the day to day project technical supervision, to ensure effective implementation. NOFBI Phase I was monitored and logistics managed by Telkom Kenya Limited as the appointed project managers. The company carried out the assignments stipulated in the project management agreement. As the Ministry implements NOFBI Phase II, all the lessons learnt in phase I have been incorporated to improve service delivery.
6. Conclusion and recommendations offered	The Ministry thanks the office of the Auditor General for the work done by the team and wishes to state that the suggestions and recommendations have been taken in and are actively being implemented. Key highlights include; ▪ The operationalization of the Universal Services Fund to facilitate expanding the penetration of broadband infrastructure to all counties. ▪ Roll out of NOFBI Phase II to address the inherent issues that are in Phase I infrastructure ▪ Review of the current Operations and Maintenance Contract with Telkom Kenya a view to making it more robust, or terminating it and seeking new cable managers ▪ Increased uptake of the Terrestrial network by attracting transit traffic from neighboring countries, and also interconnecting the National Backbones with other Backbones in the region under the Northern Corridor Arrangement.