

Ministry of Information, Communications and Technology  
**DRAFT NATIONAL ICT INFRASTRUCTURE MASTER PLAN**  
**2019 - 2029**



August 2019

Transforming Lives Through Smart ICT Infrastructure

## Table of Contents

Executive Summary .....	10
1.0 Introduction .....	10
1.1 ICT as a key driver of the Big Four Agenda.....	11
1.1.1 Manufacturing.....	11
1.1.2 Affordable Housing.....	12
1.1.3 Universal Health Care.....	12
1.1.4 Food & Nutrition Security .....	13
2.0 Vision of the Master Plan .....	14
2.1 Objectives .....	14
2.2 Pillars and Guiding Principles .....	15
2.3 Governance .....	15
2.4 E-Government Infrastructure .....	16
2.5 Implementation Framework.....	16
2.6 Social and Environmental safeguards .....	16
2.7 Monitoring and evaluation .....	16
2.8 Conclusions .....	17
Chapter 1.0.....	18
1.0 Introduction .....	18
1.1 Vision Statement.....	19
1.2 Background .....	19
1.3 Rationale.....	20
1.4 Objectives .....	21
1.5 Pillars.....	21
1.6 Guiding Principles.....	22
Chapter 2.0.....	23
2.0 Governance .....	23
2.1 Partnership and Stakeholder Management.....	23
2.1.1 Roles of Stakeholders .....	24
2.2 Policy and Legal Framework .....	24
2.2.1 Legal Documents .....	25
2.2.2 Required Policies .....	25
2.3 Risk Analysis and Management.....	26
Chapter 3.0.....	28

- 3.0 E-Government Infrastructure ..... 28
- 3.1 Connectivity Infrastructure..... 28
  - 3.1.1 Objectives, Strategies and Desired Outcomes ..... 29
    - 3.1.1.1 Objectives..... 29
    - 3.1.1.2 Desired Outcomes By 2029..... 29
    - 3.1.1.3 Strategies ..... 30
  - 3.1.2 Submarine Cables..... 30
    - 3.1.2.1 Situation Analysis ..... 30
    - 3.1.2.2 Programmes / Projects..... 31
  - 3.1.3 Backbone ..... 32
    - 3.1.3.1 Situation Analysis ..... 32
    - 3.1.3.2 Programmes / Projects..... 35
    - 3.1.3.3 Project Activities..... 35
  - 3.1.4 Metro ..... 36
    - 3.1.4.1 Situation Analysis ..... 36
    - 3.1.4.2 Programmes / Projects..... 37
    - 3.1.4.3 Project Activities..... 37
  - 3.1.5 Last Mile ..... 38
    - 3.1.5.1 Situation Analysis ..... 38
    - 3.1.5.2 Programmes/Projects ..... 38
    - 3.1.5.3 Project Activities..... 39
- 3.2 Data Center and Cloud Infrastructure ..... 39
  - 3.2.1 Objectives, Strategies and Desired Outcomes. .... 40
    - 3.2.1.1 Objectives..... 40
    - 3.2.1.2 Desired Outcomes By 2029..... 41
    - 3.2.1.3 Strategies ..... 41
    - 3.2.1.4 Programmes/Projects ..... 41
    - 3.2.1.5 Project Activities..... 42
- 3.3 Infrastructure Security ..... 43
  - 3.3.1 Situation Analysis..... 43
  - 3.3.2 Objectives, Strategies and Desired Outcome..... 44
    - 3.3.2.1 Objectives..... 44
    - 3.3.2.2 Desired Outcomes By 2029..... 45
    - 3.3.2.3 Strategies ..... 45
    - 3.3.2.4 Programmes / Projects..... 45

3.3.2.5 Project Activities.....	46
3.4 Human Capital .....	49
3.4.1 Objectives, Strategies and Desired Outcome.....	49
3.4.1.1 Objectives.....	49
3.4.1.2 Strategies .....	50
3.4.1.3 Desired Outcomes.....	50
3.4.1.4 Programmes/Projects .....	50
3.4.1.5 Project Activities.....	51
CHAPTER 4.0 .....	52
4.0 Implementation Framework.....	52
4.1 Resource Mobilization .....	52
4.2 Sustainability .....	53
4.3 Social and Environmental Safeguards.....	53
4.3.1 E-Waste .....	66
CHAPTER 5.0 .....	67
5.0 Monitoring and Evaluation.....	67
5.1 Monitoring and Evaluation Framework.....	67
5.2 Research and Development .....	68
5.2.1 Objectives .....	68
5.2.2 Strategies .....	68
5.2.4 Projects.....	69
ANNEXES .....	70
Annex 1: Backbone (NOFBI Expansion) Implementation Matrix.....	70
Annex 2: Last Mile Implementation Matrix .....	71
Annex 3: Implementation Estimates .....	72

### List of Acronyms

	Acronym	Meaning
1.	CAK	The Communication Authority of Kenya
2.	CBD	Central Business District
3.	CCP	County Connectivity Program
4.	CCTV	Closed Circuit Television
5.	CDN	Content Delivery Network
6.	CIB	Critical Infrastructure Bill
7.	CIH	Constituency Innovation Hub
8.	CoE	Centers of Excellence
9.	COMESA	Common Markets for Eastern and Southern Africa
10.	CRA	Commission of Revenue Allocation
11.	CUE	Commission of University Education
12.	DAAM	Digital Authentication and Access Management
13.	DC	Data Centre
14.	DR	Disaster Recovery
15.	EAC	East African Community
16.	EMCA	Environmental Management and Co-ordination Act
17.	ePZ	Export Processing Zones
18.	FDI	Foreign Direct Investments
19.	GCCN	Government Common Core Network
20.	GDC	Government Data Centre
21.	GDP	Gross Domestic Product
22.	CNI	Critical National Infrastructure
23.	GOK	Government of Kenya
24.	GPS	Global Positioning System
25.	ICANN	Internet Corporation for Assigned Names and Numbers
26.	ICT	Information Communication Technology
27.	IFMIS	Integrated Financial Management Information Systems
28.	IOT	Internet of Things
29.	IPC	Investment Promotion Centre
30.	ITU	International Telecommunications Union

31.	KDC	Konza Data Centre
	<b>Acronym</b>	<b>Meaning</b>
32.	KIXP	Kenya
33.	LAN	Local Area Network
34.	LION	Lower Indian Ocean Network
35.	M&E	Monitoring and Evaluation
36.	MCDA	Ministries, Counties, Departments and Agencies
37.	MDA	Ministries, Departments and Agencies
38.	MTPs	Medium Term Plans
39.	NEMA	National Environmental Management Authority
40.	NGOs	Non-Government Organization
41.	NIIMP	National ICT Infrastructure Master Plan
42.	NOC	Network Operation Centre
43.	NOFBI	National Optic Fiber Backbone Infrastructure
44.	PKI	Public Key Infrastructure
45.	POPs	Point of Presence
46.	R&D	Research and Development
47.	SDG	Sustainable Development Goals
48.	SLAs	Service Level Agreements
49.	SMEs	Small and Medium Enterprises
50.	SOC	Security Operation Centre
51.	TB	Terabyte
52.	TEAMS	The East Africa Marine subsystem
53.	EASSY	The East African Submarine cable Systems
54.	SEACOM	Undersea cable connecting India to Northern, Eastern and Southern Africa
55.	DARE	Djibouti Africa Regional Express
56.	SEAS	Seychelles East Africa Submarine
57.	VoIP	Voice over IP
58.	WGIG	Working Group on Internet Governance
59.	WSIS	World Summit on Information Society

## MESSAGE FROM THE CABINET SECRETARY, MINISTRY OF INFORMATION & COMMUNICATION TECHNOLOGY

The National ICT Infrastructure Master Plan (2019-2029) has been developed to streamline the management of the country's ICT infrastructure.

This document is anchored Vision 2030, the country's economic blueprint which aims to transform Kenya into an industrialized middle-income country with a high quality of life for its citizens. The Vision, which is being implemented in five (5) year medium term plans. We are currently on the third Medium Term Plan (MTP III) which puts emphasis on the improvement of the ongoing ICT infrastructural development in order to support the government development agenda including the "Big Four" agenda.

The Master Plan has also been aligned to other government policy documents including The National ICT Masterplan (2014-17), Cyber Security Strategy ( ), Constitution of Kenya 2010, Smart Africa 2063 Agenda, Digital GOK Transformation and the Ministry of ICT Strategic Plan( ), among others. There will however be need to review of the existing policies, legal, regulatory and institutional frameworks. There will also be a National ICT infrastructure Master Plan (NIIMP) Steering Committee to provide strategic oversight for the effective implementation of NIIMP 2019-2029 and will coordinate all the necessary inputs and resources as necessary.

The implementation of this Plan is envisaged to change the economic and social landscape as it will accelerate economic growth and spur job creation in the next ten years. It will transform the delivery of services in all areas of the economy such as health, manufacturing, housing, agriculture and security. It will also support the fight against corruption by reducing human interaction through digitization and automation of government services. It will also support the ongoing implementation of programmes such as Ajira Digital and the Digital Literacy Programme which are imparting digital skills to the children and the youth.

I therefore call upon all the stakeholders to work together to ensure the successful implementation of this Plan as it is our shared responsibility to do so. My Ministry will work very closely with all partners to create synergies needed to deliver on the targets set in the National ICT Infrastructure Master Plan.

**Joe Mucheru, EGH**

Cabinet Secretary

Ministry of Information, Communications and Technology

## MESSAGE FROM THE PRINCIPAL SECRETARY IN THE STATE DEPARTMENT OF ICT & INNOVATION

Over the last five years, the Government of Kenya, through the Ministry of ICT has made great strides in rolling out ICT infrastructure across many parts of the country. Today, there is broadband infrastructure presence in all the 47 county headquarters that is currently being used to access government services. A lot of investment has already been put into the deployment of the existing ICT infrastructure and this Plan is aimed at ensuring that the utilization of this investment is optimized, and the coverage broadened to reach the underserved and unserved communities.

This has been made possible through the joint efforts of the government of Kenya, the private sector and our development partners whose ideas and input are captured in this document.

It is my hope that this Master Plan will go a long way in alleviating some of the challenges faced as we develop and deploy ICT infrastructure and spur improved services to the citizens. Some of these challenges the government is seeking to address through the National ICT Infrastructure Master Plan include the uncoordinated approach in deployment, missed priorities, fiber cuts during road construction, vandalism and fiber degradation among others. This Plan will propose the approach the country can use so that we leverage on our ICT capabilities to the maximum so that it can drive our social and economic development.

This plan also takes cognizance of the new technologies and emerging issues and has addressed them within the strategies. This is with the view of leveraging on the new capabilities in technology and exploit the opportunities inherent in the emerging issues. The goal is to facilitate the provision of broadband throughout the country as well as provide cross border connectivity to neighbouring countries and secure storage for data for both national and county governments.

I wish to thank all those who participated in the development of this document. It is my sincere hope that once implemented, this Plan will go a long way in transforming the lives of the people in Kenya and beyond and I urge all of us to support this endeavour to the best of our abilities.

**Jerome Ochieng**

Principal Secretary

State Department of ICT

Ministry of Information, Communications & Technology



## MESSAGE BY THE CHIEF EXECUTIVE OFFICER, ICT AUTHORITY

The National ICT Infrastructure Master Plan (2019-2019) focuses on creating an environment where ICT will support growth in every sector of Kenya's economy and in a citizen-driven approach. This document will guide the ICT Authority as it rolls out ICT infrastructure projects and referenced by all government agencies when they are carrying out new deployments, upgrades or expansion of existing ICT infrastructure.

This Master Plan also defines how the country can meet the demand for skills it requires to roll out and sustain the implementation of various ICT infrastructure. With the increasing sophistication of ICT Infrastructure and its applications, high-end skill sets are increasingly being required hence the need for strategies to address that. In this regard, human capacity development has been identified as a key component as well as a strong governance structure.

The current ICT infrastructure comprises of undersea cables, the Fibre Optic Cable Backbone (NOFBI), Local Area Networks, wireless networks and data centers. There are also the East African Marine System (TEAMS) undersea cable that connect the country to the rest of the world with backup being provided by other similar cables including SEACOM, EASY and LION2 among others. The NOFBI cable currently at around 9,000km spans across the country to cover all the 47 counties with metro LANs at the county headquarters.

In order to implement and manage this infrastructure, ICT authority has opened county offices and deployed staff. The Authority has also partnered with the private sector players for maintenance and to provide redundant links for high availability of the infrastructure. The ICT Authority will continuously engage stakeholders and involve them in decision making. We will also review the link between set priorities, corresponding budgetary provisions as well as the resultant outputs and outcomes over the plan.

It is my belief that this Master Plan will steer us to inculcate the right ICT values, build the needed digital skills and efficiently manage the country's national ICT infrastructure, all of which are critical ingredients for the digital transformation we are all working towards.

**Dr. Katherine W. Getao, EBS**  
CHIEF EXECUTIVE OFFICER

## Executive Summary

### 1.0 Introduction

In order to address the government's aspirations as outlined in Vision 2030, MTP III as well as the "Big Four" Agenda, investment in ICT infrastructure is paramount. This Master Plan is in line with the national aspirations as articulated in various government policy documents including the Kenya Vision 2030, Third Medium Term Plan (MTP III), and the "Big Four" initiatives, the National ICT Masterplan, Cyber Security Strategy, Constitution of Kenya 2010, Smart Africa 2063 Agenda, Digital GOK Transformation and the Ministry of ICT strategic plan among others.

The Kenya Vision 2030 envisages Kenya to be a globally competitive economy with its citizens enjoying high quality of life. The Information and Communications Technology (ICT) sector has undoubtedly huge potential to propel the country to a middle-income economy by the year 2030 and ICT has been identified as an enabler towards realizing a knowledge-based economy.

The ICT sector in Kenya has grown tremendously thanks to initiatives by the government of Kenya, liberalization of the telecommunications sector as well as a robust regulatory environment. However, there still exists a wide "digital divide" in access to digital services in the country hence the need to streamline the ICT infrastructure and so bridge that divide. During the ten-year implementation period of this Master Plan, the government will streamline the development and deployment of ICT infrastructure to bring inequity in the country.

It is hoped that access to universal, available and affordable broadband will address the unemployment as well as enhance the culture of innovation and creativity in particular to the youth who are the majority of the Kenyan population. ICT infrastructure will catalyze the growth of the SMEs as well as open up opportunities in every corner of the country for innovation, Foreign Direct Investment (FDI) and social development.

In order to meet the need of growing ICT Services demand and at an affordable cost, the government has come up initiatives such as the National Optical Fiber Backbone Infrastructure (NOFBI), TEAMS, Government Common Core Network, Data Centers, Government Private Cloud and County Connectivity Project (CCP), among others.

In addition, the ICT infrastructure components such as submarine cable, optic fiber cables, transmission towers, ducts and data centers need to be classified as critical infrastructure and will need to be protected and an inventory of all the assets documented.

All government offices at both national and county levels, schools, academic institutions, hospitals and other public institutions are set to be connected through last mile connectivity to access e-Government services including internet. This blueprint is aimed at ensuring that an ordinary Kenyan is employed or has a reliable source of livelihood, owns a home, has enough food and is able to access universal health care. This will in turn result in a vibrant workforce to drive the country to more growth in economic development and improve the living standards of Kenyans.

## 1.1 ICT as a key driver of the Big Four Agenda

The government has outline four priority areas namely the ‘Big Four Agenda’ which as directly drawn from Vision 2030. The four areas are food security, affordable housing, universal health care and manufacturing and ICT is a key driving force in their realization as outlined below:

### 1.1.1 Manufacturing

Kenya’s manufacturing has the potential to advance socio-economic development through increased and diversified exports and enhanced employment creation. The government has put in place policy interventions towards promoting the competitiveness of the manufacturing sector.

With focus on promoting local assembly of phones, TV sets, laptops and other digital devices, it is envisaged that about 10,000 jobs will be created annually fuelled by the numerous business process outsourcing (BPO) services.

No one-size-fits all approach to nurturing the development gains of digital technologies but governments should start by being future-orientated. Equipping populations with the skills needed to innovate and leverage digital tools, promoting investment and market entry to attain greater coverage of networks and driving inter-operability across policy and regulatory landscapes.

These efforts are towards enhancing product diversity and complexity, enhancing credit and market access. ICT is supporting the improvement of the country’s business environment and deepening E-Commerce. Through Programmes such as Whitebox, the government is strengthening technology transfer and innovation. Through DLP the government is supporting local assembly of the digital devices installed in schools. This will extend to assembly of other devices for the market (phones, computers etc). Eventually, the government hopes to build an industrial culture that is enabled by emerging technologies such as AI and robotics.

### 1.1.2 Affordable Housing

Article 43 of chapter four of the Constitution of Kenya, 2010 states that every person has a right to accessible and adequate housing with reasonable standards of sanitation. This pillar entails the development of adequate, standardized and well-spaced houses with continuous supply of clean water and electricity.

The Ministry of Lands has recently adopted blockchain in the digitization of land records to drive efficiency and speed in processing of the documents. This will see increased transparency and visibility of land ownership through a single source of truth thus facilitating development and construction that could spur economic growth.

Lack of transparency in the process of buying, selling and renting of land parcels could increase the value of land and in some instances cause conflicts due to the sensitivity of land matters. An internet platform could be used to streamline this process to inform the public on the details of the land and properties including value and standardizing this process and making rentals and ownership more accessible to the public. To support the above initiatives, a robust, reliable, efficient and secure ICT infrastructure and connectivity is required.

The ICT Authority will provide technical support on the digitization of land, supporting the innovation of appropriate building technologies as well as facilitating geospatial efforts.

### 1.1.3 Universal Health Care

This document aspires that ICT facilitates Universal Health Care (UHC) by scaling up the National Health Insurance Fund (NHIF) as well as other efforts to increase insurance coverage to all Kenyans. Other ICT-supported initiatives are the Health Insurance Subsidy Programme and Linda Mama Programme (Free Maternity Service). The two programmes are partnerships and collaboration between the two levels of government and are working closely with the health service providers in the private sector to enhance universal healthcare coverage countrywide.

This policy seeks to support policy interventions that will see the country realize universal health care. They include development of adequate healthcare workforce, equitable distribution of healthcare human resources, reduction of reliance on external support. ICT will go a long way in strengthening of county supply chain management systems, as well as enhancing coordination in disease prevention, detection and response.

The tracking of available medicines available to the public could be done through an online database that is securely accessible for the health facilities through an appropriate ICT infrastructure. Such a database could support supply-chain management system of

pharmaceuticals that could then make medicine available to the public and ensure that it gets to their location in time and in the right quantities.

In addition, through identification, automation and records management of beneficiary details for the National Hospital Insurance Fund (NHIF), enhanced access and speed of service in health institutions, adoption of telemedicine and artificial intelligence capabilities for diagnosis could be realized.

#### **1.1.4 Food & Nutrition Security**

The Food & Nutrition pillar aims at reducing the cost of food as a percentage of income, halving the number of food insecure Kenyans, creating direct and indirect jobs, as well as increasing average daily income of farmers, fishermen and pastoralists.

In order to make food readily available, the Government intends to reduce average post-harvest losses and increase irrigated land through construction of smallholders' water pans and de-silting existing old dams to increase the quantitative volumes of available food and hence making it readily available and cheaper.

ICT is expected to enable the above-mentioned initiatives through the provision of the requisite ICT systems, datasets as well as applications. Basic ICT is already helping farmers in developing countries keep pace with accelerating demand for milk products that have aided in improving quality of life and boosting rural economic growth. Developing ICT Control systems could provide the automation and maintenance solutions necessary to ensure a hygienic, efficient environment for processing and preserving the health benefits of perishable products such as milk.

## DIGITAL WHEELS FOR BIG 4 AGENDA



The digital wheels of the “Big Four” Agenda

### 2.0 Vision of the Master Plan

The vision of this Master Plan is to provide an accessible, affordable, reliable, quality and secure ICT infrastructure in Kenya.

### 2.1 Objectives

The objectives of this ICT Infrastructure Master Plan are as follows:

- 2.1.1 - Provision of a comprehensive ICT network connectivity to all government MDAs
- 2.1.2 - Achieving universal, affordable access to broadband connectivity to accelerate “Big Four” agenda across the country
- 2.1.3 - Delivery of essential cost-effective digital services through secure data transmission and storage
- 2.1.4 - Facilitating skilled human resource to manage and maintain ICT infrastructure as well as skilled users to exploit all the capacity provided by the net.
- 2.1.5 - Well organized secure integrated networks that facilitate the deployment of Smart Cities across Kenya
- 2.1.6 - Reduction of cost of implementation through consolidation of different fragmented networks and leveraging on economies of scale;
- 2.1.7 - Supporting the medium- and long-term goals of consolidation and delivery of online services through multiple channels supporting advanced computing, infrastructure, applications and disaster recovery facilities;
- 2.1.8 - Implementing and standardize security across the GoK One network and related infrastructure

## 2.2 Pillars and Guiding Principles

**2.2.1** - Four (4) pillars have been identified as critical to the delivery of the vision of this Master Plan. These are the Connectivity, Services, Skills and Values and finally Governance. The four pillars are meant to facilitate the achievement of real socio-economic growth. They will also facilitate the achievement of Vision 2030 targets that seek to strengthen local industry using ICT and create ICT businesses thus causing a thriving ICT sector for the benefit on citizens, investors and other critical stakeholders.

**2.2.2** - The successful implementation of the masterplan will be guided by the principles of partnerships, equity and non-discrimination, technology neutrality, environmental protection and conservation and good governance.

## 2.3 Governance

A National ICT infrastructure Master Plan (NIIMP) Steering Committee to be headed by the Cabinet Secretary in charge of MoICT will be formed with membership from relevant key institutions. This committee will provide strategic oversight for the effective implementation of NIIMP 2019-2029 and will coordinate all the necessary inputs and resources as necessary. Its membership will comprise key agencies that will be implementing various aspects of the Master Plan.

**2.3.1** - In addition, this Master Plan has identified several stakeholders whose roles are defined, and cooperation is of critical to the delivery. They include MDAs, private sector, development partners, general public and civil society each of which has defined roles. For effective governance of the country's ICT Infrastructure, there needs to be a sustained engagement with all stakeholders to solicit their support and cooperation.

**2.3.2** - The Authority will develop a communication strategy to map all stakeholders and define interventions for their communication needs. It will also guide on issues such as attitude change as well as change management while taking into account cultural mechanisms for communication and dispute resolution. This is to ensure that the ICT Authority receives every support needed to facilitate data integration and business process re-engineering.

**2.3.3** - Regarding policy and legal framework, the most crucial ones are the Critical Infrastructure Bill (CIB) and the ICT Authority Act. A draft version has already been developed that still needs revision to focus on key areas that were not included in the draft such as fostering creativity and artistic expression; infrastructure sharing policy; industry code of practice; e-waste management; expansion of infrastructure; serving disadvantaged groups; network integrity, trust, security and e-commerce.

**2.3.4** - There will be need to harmonize all related policies, legislations and regulations as appropriate with recognition of ICT infrastructure as a basic utility so that infrastructure assets can receive similar protection and rights as other utilities such as water and electricity, especially during road construction or routine maintenance.

**2.3.5** - As part of governance, this document recommends risk identification, analysis and mitigation as another key aspect of this Master Plan.

## **2.4 E-Government Infrastructure**

Economic and social development of any country is highly dependent on the ICT infrastructure and the implementation of this Master Plan will unlock the high potential inherent in the ICT sector in the country as an enabler of development. Strategic initiatives, programmes and projects of key infrastructure areas of connectivity infrastructure, data centers & cloud infrastructure, Infrastructure security and human capital development will be undertaken that will unlock growth potential and build the resilience of the economy.

## **2.5 Implementation Framework**

The realization of this Master Plan will require the mobilization of significant financial and human resources. Funding of the flagship projects in this Master Plan will come from the national and County Governments, commercialization of the infrastructure, development partners, capital markets and other public or private institutions through Private Public Partnerships (PPPs) and collaborations.

## **2.6 Social and Environmental safeguards**

The implementation of some of the projects envisaged in this Master Plan will pay attention to both environmental and social concerns. This document identifies a range of issues and at the same time defines safeguards and mitigation measures that will be implemented before, during or after the initiatives are completed and closed.

## **2.7 Monitoring and evaluation**

Monitoring, evaluation and reporting is a critical component for the successful implementation of this Master Plan that will provide the necessary feedback and enable management to make evidence-based decisions. This framework is geared towards improving the achievement of desired results, optimization of available resources and at maximizing the impact of the initiatives.



## 2.8 Conclusions

It is the desire of the government to provide the right ICT infrastructure to support the digital economy agenda. This Masterplan is intended to provide the roadmap in the short, medium and long term to realize the set-out aspirations. It will require the goodwill, effort, dedication and support from each stakeholder and a lot of resources will be needed to facilitate the implementation of the earmarked programmes and projects.

## Chapter 1.0

### 1.0 Introduction

This Master Plan regards Information and Communications Technology (ICT) as a range of technologies for gathering, storing, retrieving, processing, analysing, and transmitting information. It recognizes the technological developments that have led to convergence of ICT services, networks, and business practices. ICT has also disrupted various sectors of the economy and created new dynamics in enterprise and the marketplace. The Master Plan considers the local, regional and global dynamics that have influenced the ICT sector. At the global level, Kenya is a participant and a signatory to several international Conventions and Standards relating to ICT. Kenya is also an active member of the International Telecommunications Union (ITU) and the World Summit on the information society (WSIS). It is also spearheading issues of Internet Governance in the region, particularly the development and application by governments, the private sector and civil society. According to WGIG (2005), this is regarding their respective roles, of shared principles, norms, rules, decision-making procedures, and programmes that shape the evolution and use of the Internet. Kenya is active at the Internet Corporation for assigned names and numbers (ICANN) headquartered in the United States, which is responsible for the coordination of the global Internet's systems of unique identifiers and, in particular, ensuring its stable and secure operation. In addition, Kenya's Internet exchange Point (KIXP) has been used as a successful model of public private partnership and is being emulated by other countries developing their own Internet exchange Points. Kenya has enhanced its competitiveness through investor friendly arrangements such as Export Processing Zones (EPZ) program which offers attractive incentives to export oriented investors, and the Investment Promotion Centre (IPC) which promotes all other investment in Kenya. These arrangements have created a conducive environment not only for the growth of the ICT sector but has changed the nature of doing business in the finance, education, tourism, agriculture and health sectors, among others. At the regional level, Kenya aims at improving its trade of goods and services with fellow East Africa Community (EAC) members and Common Market for Eastern and Southern Africa (COMESA). ICT plays a major role in facilitating communication and engagement among member states. It is envisaged that ICT will support the various planned integrations such as implementation of the customs union, common market, monetary union and political federation including the legal, regulatory, and policy reforms required to accomplish the plans. This is critical to the realization of the seamless ICT infrastructure within the community that will address

the digital divide, the emerging mobile and cyber security issues perpetuated through ICT and fuelled by the borderless nature of technology- delivered services. In addition, the Kenyan Government has underscored universal access to ICTs as a major objective of Vision 2030. There has been tremendous growth in the ICT sector particularly in the mobile sector, which by September 2018, had 20.9 million subscribers and a penetration of 44.9 percent. At the same time, there are estimated 30 .8 million Internet users with 47.1 per 100 inhabitants having access to Internet services (CAK, 2018). This is an indication that Kenyans are ready to embrace information and communication technology if it enhances their perceived quality of life. The government of Kenya recognizes that ICT infrastructure and services are prerequisites to development in each County Government. It is for this reason that the Commission on Revenue allocation (CRA) has already indicated that 84.5 percent of the revenues will be allocated to the national Government while 15 percent will be allocated to County Governments. The remaining 0.5 percent is designated as an equalization fund. It is in view of this emerging changes that the Master Plan has considered the role of ICT infrastructure at the national and county levels and how the infrastructure and services can be integrated to serve every Kenya citizen. Finally, it is expected that the implementation of this ICT Infrastructure Master Plan will unlock the high potential of the ICT sector in the country. This will create a digital society and economy that is able to exploit the global, regional, national and local opportunities presented by the dynamic sector of information and communication technologies to advance its socio-economic growth leading to an enhanced quality of life by all the people of Kenya.

## **1.1 Vision Statement**

Accessible, Affordable, Reliable, Quality and Secure ICT infrastructure in Kenya.

## **1.2 Background**

The ICT Infrastructure Master Plan is in tandem with the national aspirations as articulated by the Kenya Vision 2030 and the MTP III. The Kenya Vision 2030 envisages Kenya to be a globally competitive economy with its citizens enjoying high quality of life. The vision identifies ICT as an enabler towards realizing a knowledge-based economy. The Information and Communications Technology (ICT) sector has undoubtedly huge potential to propel the country to a middle-income economy by the year 2030. In 2017, the ICT sector contributed 7.1 % of the GDP registering a surge of 12.9 % in its value from 345.6 Billion in 2017 to KES. 390.2 Billion in 2018. This figure indicates a positive growth trajectory in the next ten (10) years. This was largely driven by growth in the digital economy (Kenya National Economic Survey Report, 2019). Kenya's digital economy spans

consumer information communication, e-government, enterprise technology, interactive digital media and telecommunications. This is a clear indicator that the Information and Communication Technology will support the Country's efforts to realize its national goals. Kenya will leapfrog into a transformed society which creates opportunities for prosperity, where every citizen has improved access to basic needs, leading tech-enabled and fulfilled lives and harnessing the benefits of a digitized economy. ICT infrastructure in Kenya has experienced tremendous growth largely due to government initiatives, liberalization and a robust regulatory environment. However, despite heavy investment in ICT infrastructure, there still exists a wide "digital divide" in access to digital services especially by the citizens who live in the country's rural areas. The government of Kenya has come up with initiatives to bridge that divide. They include National Optical Fiber Backbone Infrastructure (NOFBI), TEAMS, Government Common Core Network, Data Center, Cloud and County Connectivity Project (CCP), among others. The last mile connectivity is also supporting efforts to provide connectivity to all government offices at the national and county governments, schools, academic institutions, hospitals and other public institutions. This is meant to improve access e-Government services, including internet and meet the need of growing demand for ICT Services at an affordable cost.

### 1.3 Rationale

The Master Plan is envisaged to provide a holistic and coordinated approach to the management of the country's ICT Infrastructure as follows:

- Align and Optimize ICT resources with changing needs of State entities and local governing Authorities.
- Enable the effective implementation of State business strategies.
- Highlight and promote the value of ICT to executive and policy makers.
- To reduce implementation and operation cost through a consistent enterprise-wide approach to ICT solutions.
- Consolidate or integrate existing systems and technical infrastructure.
- Provide the ICT foundation to support the business process of State agencies and local governing Authorities.
- Reduce the number of duplicate technologies solutions across the State.
- Ensure interoperability by elimination technology silos.
- Share and reuse viable ICT assets.
- Reduce security risks of the state ICT infrastructure and Data.
- Increase support for funding a functional secure and reliable infrastructure.

- Improve delivery efficiency and accessibility of government services to the government.
- Support the state-wide ICT vision.
- Align with national compliance standards.
- Increase the consistency accessibility and sharing of data application.
- Leverage the advantage of new technologies while balancing investment in existing ICT systems.
- Respond to MDAs changing technology and business requirements
- Empower all citizens including children in primary schools and adults across the country through digital literacy and awareness.

#### 1.4 Objectives

The objectives of this ICT Infrastructure Master Plan as follows:

- 1) Provide a comprehensive ICT network connectivity to all government MDAs.
- 2) Achieve universal, affordable access to broadband connectivity to accelerate “Big Four” agenda across the country.
- 3) Deliver essential cost-effective digital services through secure data transmission and storage.
- 4) Facilitate a skilled human resource to manage and maintain ICT infrastructure as well as skilled users to exploit all the capacity provided by the net.
- 5) Facilitate well organized secure integrated networks that facilitate the deployment of Smart Cities across Kenya.
- 6) Reduce cost of implementation through consolidation of different fragmented networks and leveraging on economies of scale.
- 7) Support the medium- and long-term goals of consolidation and delivery of online services through multiple channels supporting advanced computing, infrastructure, applications and disaster recovery facilities.
- 8) Implement and standardize security across the GoK One network and related infrastructure.

#### 1.5 Pillars

The below pillars are one of the ways of delivering the vision of the Master Plan. They are meant to facilitate the achievement of real socio-economic growth and Vision 2030 targets through e-Government services that benefit citizens, businesses and other stakeholders; strengthening local industry using ICT; and creating ICT businesses that help to create a thriving ICT sector. Four pillars were derived from the situational analysis as follows.

- 1) **Connectivity:** ICT connectivity to all the unserved and underserved corners of the country is a key prerequisite for transformation towards the realization of the Vision 2030, MTP III and the Big Four Agenda.
- 2) **Service:** Government is by far the biggest player in all key sectors in provision of information and services to citizens, businesses, government employees and other stakeholders. The provision of e-Government information and services is key to improving productivity, efficiency, effectiveness and governance in all sectors.
- 3) **Governance:** Streamlining the development of infrastructure through policy formulation legal frameworks, stakeholder and risk management.
- 4) **Skills and Values:** This is the development of a digitally skilled workforce that is grounded on ethical practices and social culture values to implement and operationalizes this master plan.

## 1.6 Guiding Principles

The following principles will guide the implementation of this Plan:

- 1) **Partnership and stakeholder engagement:** There will be conscious and deliberate efforts to engage and collaborate with the private sector, academic institutions, County Governments and local and international partners in implementing the National ICT Master Plan. This will include areas such as entrepreneurship, building a culture of research and development as well as value addition.
- 2) **Equity and non-discrimination:** There will be equitable and non-discriminate availability of and access to ICTs across County Governments, urban and rural areas, gender, women, youth and disadvantaged communities.
- 3) **Technology neutrality -** The use of common, interoperable Standards and protocols must be encouraged.
- 4) **Environmental protection and conservation:** All institutions involved in implementation of the National ICT Master Plan will adhere to the green ICT concept by environmentally friendly equipment that are cheaper and easy to implement and ensuring there is no e-waste dumping.
- 5) **Good governance:** All institutions and persons involved in procurement of ICTs and the implementation of the ICT Master Plan will adhere to the highest standards of good governance and ethical behaviour.
- 6) **Public Participation and communication:**

## Chapter 2.0

### 2.0 Governance

This document recognizes the need for a clear structure to govern the implementation of the ICT flagship and ensure the delivery of this Master Plan. To accomplish that, a National ICT Infrastructure Master Plan Steering Committee (NIIMPSC), to be headed by the Cabinet Secretary in charge of ICT, will be formed. The Committee will provide strategic oversight for the effective implementation of the Master Plan. The committee's membership will be drawn from relevant key government institutions who are implementing various aspects of the Master Plan. The NIIMPSC will also ensure timely decision making and implementation of projects (operations, maintenance of the ICT systems as well as ensuring effective monitoring and evaluation). The NIIMPSC will coordinate all the inputs and resources needed for effective delivery of ICT infrastructure by all these key agencies. This coordination is necessary because of the following reasons:

- 1) For the provision of critical services such as Optic fiber infrastructure, Data centers and cloud, Last Mile, Metro, Power/Energy installation to MCDAs. This includes the supply of ICT equipment to other facilities.
- 2) To ensure that the deployment of Infrastructure ICT Master Plan is aligned with the implementation of e-government and other government priorities/initiatives.
- 3) To mitigate risks that may hinder implementation of this Master Plan.

### 2.1 Partnership and Stakeholder Management

In the context ICT Infrastructure, the key stakeholders include Government of Kenya, private sector, development partners, general public and civil society. The implementation of the Master Plan will transform the operational processes of key sectors, e-Government services, access to data and information, and the citizens attitude towards ICT. This calls for careful management of this transformation to ensure continuous engagement, support, cooperation, attitude and cultural change. To mitigate this, cooperation of stakeholders is required for data integration, business process re-engineering, and change management should be sought and managed.

### 2.1.1 Roles of Stakeholders

- 1) Government
  - Formulation and enforcement of policies to support ICT infrastructure in the country for both national and county governments.
  - Allocation of resources for development and operation of ICT infrastructure.
  - Consumption of ICT infrastructure services.
  - Sensitizing the Citizens.
  - Implementation of ICT infrastructure.
- 2) Development partners
  - Financing ICT infrastructure development.
  - Consultancy services.
  - Capacity building.
- 3) Private sector
  - Participate in policy formulation.
  - Consumption of ICT infrastructure services.
  - Provision of ICT services.
  - Financing ICT infrastructure development through Public Private Partnership.
- 4) Citizens
  - Consumption of ICT infrastructure services.
  - Participation of policy formulation.
  - Ownership of ICT infrastructure.
- 5) Civil society
  - Consumption of ICT infrastructure services.
  - Participation in policy formulation.

### 2.2 Policy and Legal Framework

This document calls for the consideration of several policies needed to facilitate the successful implementation of the ICT Infrastructure Master Plan. The most crucial one is the Critical Infrastructure Bill (CIB). The State Department of ICT has developed a draft ICT policy to guide towards the realization of ICT infrastructure issues as stipulated in Vision 2030. This Bill focuses on, among other key areas, fostering creativity and artistic expression; infrastructure sharing policy; industry code of practice; e-waste management;



expansion of infrastructure; serving disadvantaged groups; network integrity, trust, security and e-commerce.

In addition, there is need to harmonize policies and legislations related to energy, roads and ICT infrastructure appropriately, with provisions for categorization of ICT services as high energy users benefiting from special tariffs. There should also be recognition of ICT infrastructure as a basic utility so that infrastructure access can receive similar protection and rights as other utilities, especially during road construction and maintenance. Some of the Key policies to be considered for implementation in this Master Plan are the following among others:

- a) National broadband strategy (2018-2023) which aims at extending the broadband to ward level.
- b) Big Four Agenda blueprint.
- c) Vision 2030/MTP III Plan.
- d) Digital Economy Blueprint.
- e) ICT Authority Strategic Plan.
- f) Existing Government Standards.
- g) Cyber Security Strategy.
- h) Smart Africa 2063.
- i) Ministry of ICT Strategic Plan (2019-2023).
- j) Draft National ICT Policy.

### 2.2.1 Legal Documents

Several legislations dealing with various issues that affect ICT infrastructure have been enacted including the following:

- Kenya Information and Communication Amendment Act 2013.
- The ICT Authority Legal Notice no 183.
- Consumer Protection Act no 46 of 2012.
- Access to Information Act no 31 OF 2016.
- Computer Misuse and Cybercrime Act of 2018.
- Science Technology and Innovation Act of 2013.

### 2.2.2 Required Policies

Several pending ICT infrastructures enabling regulations, legislations and policies are:

- Critical Infrastructure Bill
- Mandatory infrastructure registration and mapping Policy

- The ICT Authority Act

### 2.3 Risk Analysis and Management

In order to successfully implement this ICT Infrastructure Master Plan, there are critical risks factors which must be identified managed. The following table shows an outline of the risks that have been identified, analysed and mitigation measures proposed:

Table 1: Overall Master Plan Risks

	Risk Category	Contributing Factors	Mitigating Actions
1.	Financial Risk	<ul style="list-style-type: none"> <li>• Over reliance on Exchequer for budgetary support.</li> <li>• High inflation rates may lead to increased cost.</li> <li>• Low absorption rate of project funds.</li> <li>• Inadequate financial management controls.</li> </ul>	<ul style="list-style-type: none"> <li>• Widening scope of revenue streams</li> <li>• Utilizing a wider range of lending/financing instruments from development partners.</li> <li>• Optimal use of resources through cost reduction and prioritization.</li> <li>• Enhancing financial monitoring and adherence to International Public Sector Accounting Standards.</li> <li>• Proper planning for expenditure and implementation</li> </ul>
2.	Organizational Capacity	<ul style="list-style-type: none"> <li>• Inadequate organization capacity</li> <li>• Staff turnover</li> <li>• Inadequate skilled personnel in some specialized areas.</li> </ul>	<ul style="list-style-type: none"> <li>• Continuous Capacity building and training on industry technological changes</li> <li>• Succession planning and skill retention management</li> <li>• Enhance performance-contracting goals.</li> </ul>
3.	Stakeholder Management	<ul style="list-style-type: none"> <li>• Information asymmetry</li> <li>• Inability to effectively influence policy.</li> <li>• Inadequate response to urgent changes in policy and regulation.</li> <li>• Limited funding for stakeholder engagement</li> </ul>	<ul style="list-style-type: none"> <li>• Implement cooperation frameworks.</li> <li>• Closely monitor changes to policy and regulations and proactively identify advocacy measures.</li> <li>• Continuously map stakeholders and then identify/assess their needs</li> <li>• Develop and implement a comprehensive communication Strategy to guide the proactive</li> </ul>

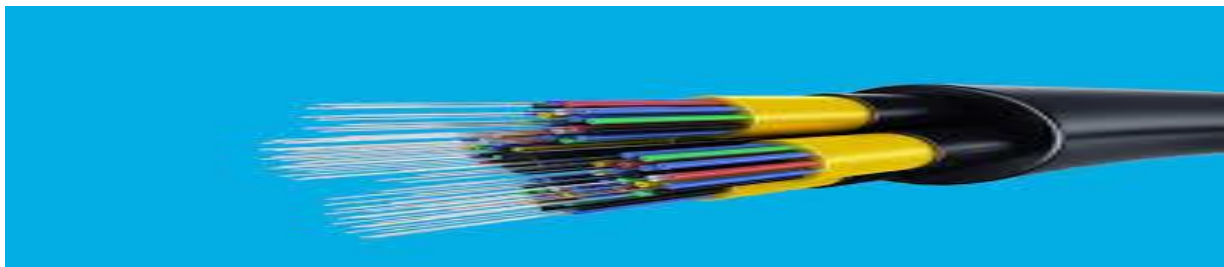
		<p>activities/community outreach programmes</p> <ul style="list-style-type: none"> <li>• Limited knowledge by the media on ICT Infrastructure related issues and so limited media coverage</li> <li>• Non-cooperation of relevant stakeholders.</li> <li>• Limited visibility of the ICT Authority</li> </ul>	<p>engagement of all stakeholders and carry out community outreach programmes and enhance media relations</p>
4.	Operational Risks	<ul style="list-style-type: none"> <li>• Policy changes that result in emergence of unplanned activities.</li> <li>• Litigation</li> <li>• Implementation uncertainty</li> </ul>	<ul style="list-style-type: none"> <li>• Develop communications and records policies to guide awareness creation on the provisions of the Master Plan as well as documentation</li> <li>• Ensure directives are in line within the provisions law and this Master Plan</li> <li>• Prioritize negotiations, mediation and make provision for litigation costs.</li> </ul>
5.	Technological Risks	<ul style="list-style-type: none"> <li>• Lack of investment in new technology.</li> <li>• Lack of research to understand emerging issues in the ICT sector</li> <li>• Cybersecurity threats</li> <li>• Loss of useful data due to poor ICT equipment</li> </ul>	<ul style="list-style-type: none"> <li>• Develop updated investment policy on new technology</li> <li>• Develop and implement cyber security policy and systems.</li> <li>• Establish of ICT Research and Development center</li> </ul>

## Chapter 3.0

### 3.0 E-Government Infrastructure

ICT infrastructure is a prerequisite to development in any country and the implementation of this Master Plan will unlock the high potential of the ICT sector in the country as an enabler of development. It will guide the provision of E-government services This will in turn create a digital society that is able to leverage on the global, regional, national and local opportunities presented by this dynamic sector and position Kenya as a digital economy. The ICT Infrastructure Master Plan will focus on the following four key infrastructure areas below:

- 1) Connectivity Infrastructure
- 2) Data Center and Cloud infrastructure
- 3) Infrastructure Security
- 4) Human Capital Development



### 3.1 Connectivity Infrastructure

Kenya currently boasts of being one of the most connected countries on the eastern Coast of Africa. There are six submarine cables; TEAMS, EASSY, SEACOM, DARE, SEAS and LION that offers connectivity to the rest of the world via redundant routing. Inland, there is a backbone, metro and last mile connectivity that has cut across the country through government National Optic Fiber Infrastructure (NOFBI). However, Kenya still faces several challenges in developing and providing connectivity infrastructure among them being the following:

- 1) Limited coverage of national fibre infrastructure and limited internet penetration, especially in the rural areas.
- 2) Lack of last mile infrastructure connectivity to all government institutions.
- 3) Internet access in homes, schools, social centers and villages should be key drivers to ensuring a knowledge economy.
- 4) High cost of ICT for businesses, households and individuals.
- 5) Limited sharing of communication infrastructure by infrastructure operators.

- 6) Inadequate and high cost power infrastructure.
- 7) Limited uptake of connectivity by SMEs due to lack of proper ICT sensitization as per survey done by ICT Authority in Naivasha town in June 2019.

This ICT Infrastructure Master Plan will address some of these key connectivity challenges hindering the country from transitioning into a knowledge economy.

### 3.1.1 Objectives, Strategies and Desired Outcomes

#### 3.1.1.1 Objectives

Reduced cost of doing business: Deploying internet services to counties and under-served remote parts of the country has facilitated business communities with the rest of the world without travelling for long distances to access some of the government services e.g. e-procurement, business licenses application as well as enhancing IT related business industry.

- 1) **To bridge the digital divide:** The digital divide between rural and urban populations will be bridged through provision of backbone connectivity to the rural area and underserved areas as envisaged in this master plan.
- 2) **To spur the use of ICT products and services:** Telcos are utilizing government infrastructure to deliver ICT services and products to the citizens in areas they have not invested in their own backbone infrastructure.
- 3) **To Increase access to government digital services:** Increased public value of e-Government services with 50% of adults accessing at least one e-service increasing digital presence and economic competitiveness using ICT as per ICT master plan 2017.
- 4) **To provide and promote cost effective delivery of ICT services:** This will be achieved through shared infrastructure and economies of scale of ICT operation because of consolidation, standardization and interoperability of ICT infrastructure.

#### 3.1.1.2 Desired Outcomes By 2029

A robust connectivity is mandatory in facilitating the development of ICT enabled economy. Despite the progress made so far, there is a need to step up development a secure, trusted, well managed connectivity that promotes integration and sharing of ICT infrastructure. The outcomes envisaged in end of the planned connectivity period are:

- 1) Increased coverage of the national E-government infrastructure especially in the rural areas to achieve:

- 2) High quality E-government Infrastructure (99.99% availability, high reliability and secure);
- 3) Affordable ICT Services for citizens
- 4) Additional 3.9% contribution to GDP. This is possible given the huge increases in penetration of ICT services going by the World Bank's estimate that very 10% increase in internet penetration results in a 1.3% increase in economic growth.

### 3.1.1.3 Strategies

**Strategy 1:** Develop and Implement financial support mechanism

**Strategy 2:** Develop and implement connectivity management framework, shared infrastructure and policies, standards and structures.

**Strategy 3:** Ensure that all critical e-Government services are delivered through Government infrastructure.

**Strategy 4:** Ensure that all Government facilities countrywide are connected to the E-government infrastructure.

**Strategy 5:** Consolidate and Register all ICT infrastructure.

**Strategy 6:** Develop and Implement annual implementation connectivity plans.

**Strategy 7:** Expand the universal access fund to facilitate internet connectivity to underserved areas.



## 3.1.2 Submarine Cables

### 3.1.2.1 Situation Analysis

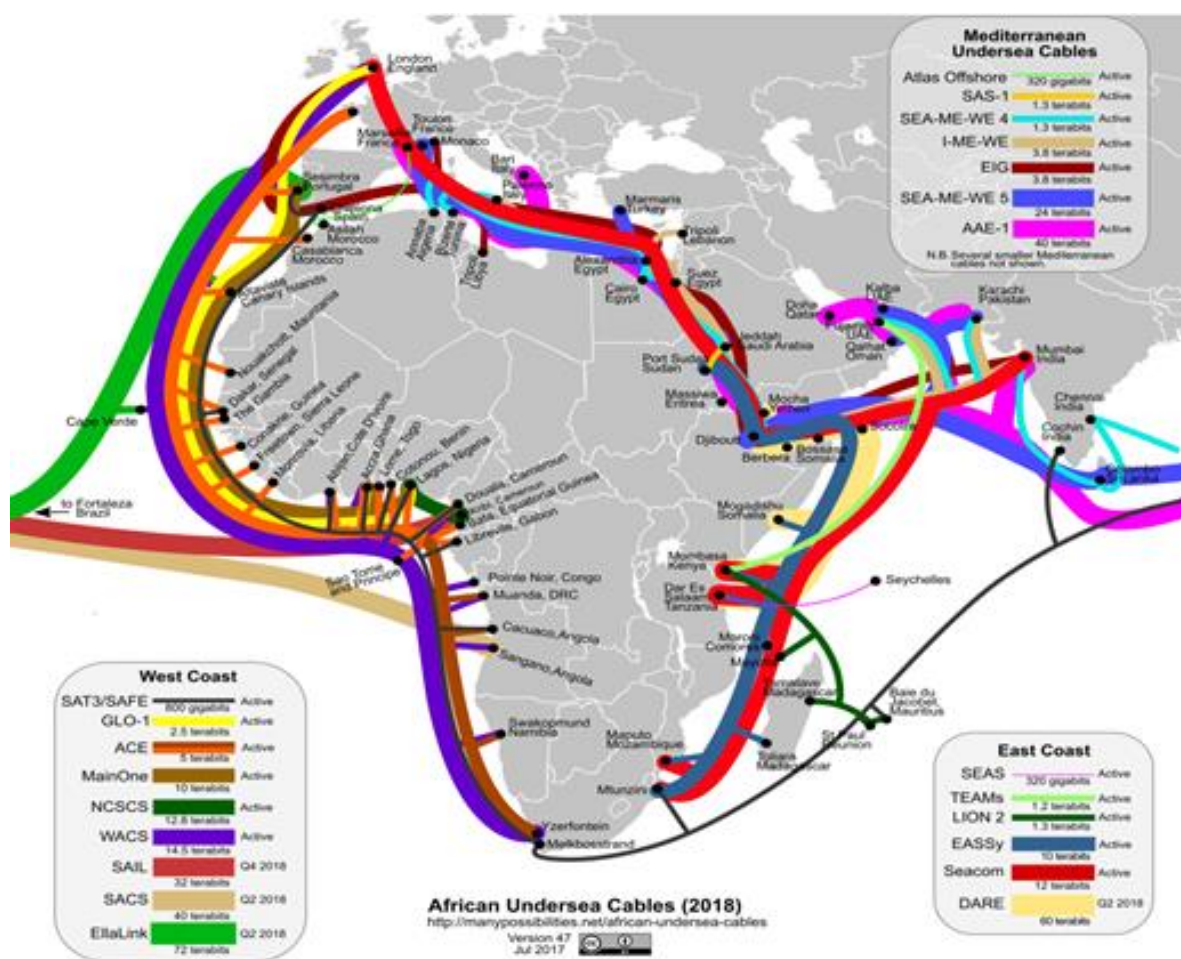
Subsequently, the Government network is connected to the international broadband highway through TEAMS, undersea Fiber cable providing activated internet capacity of 10 Gbps. GoK has a 20% shareholding of 5.2 TB (current capacity of TEAMS). The current TEAMS cable has no redundancy and thus affects the service availability and compromises on the quality of the service. There are other submarine Cables at the coast which are as follows:

- 1) DARE 1 - Currently in deployment

- 2) SEACOM
- 3) LION
- 4) EASSY

The Government intends to acquire a second cable to provide redundancy to the TEAMS cable. In addition, a smart hub at Mombasa will be set up to address the issues of cable landing and the highly availability of cloud services.

The following diagram shows the submarine cables landing around the Africa coast.



### 3.1.2.2 Programmes / Projects

- 1) Building of smart hub at Mombasa Smart-Hub - All the submarine cables will land at the smart hub in Mombasa where the capacity will be distributed to the other Points of Presence (POPs). The smart hub will also be used as a Data Center for hosting critical applications.

- 2) Acquire redundancy for TEAMS through a second submarine cable.



### 3.1.3 Backbone

The government in the last ten (10) years has built about 8,900km of terrestrial fiber that have reached to the sub-county level mainly connecting key government institutions and offices to offer service delivery. Due to connectivity challenges in the delivery of government services through ICT there is a great demand for the government to take connectivity to the ward level for effective service delivery. There is also a huge demand for the government to provide alternative failover routes that will give government network the much-needed redundancy to serve all citizens and address market demands as well as extending broadband connectivity across the country as per the Sustainable Development Goals (SDG), Digital economy blueprint, National Broadband Strategy 2018-2023 and Smart Africa 2063.

#### 3.1.3.1 Situation Analysis

The government implemented the National Optic Fibre Backbone Infrastructure (NOFBI) in Phases. NOFBI phase I was implemented between 2005-2009 and covered 4300Km of terrestrial fiber. NOFBI Phase 1 was largely a linear network and needed to be improved to make it more reliable and available; hence in 2010 the Government embarked of NOFBI Phase 2 in order to provide a more reliable, stable and efficient basic backbone network and also offer protection/redundancy leveraging on the NOFBI Phase I implementation. The NOFBI Phase 2 project work started from September 2014 and its scope included 2,100 KM fiber links and IP equipment to all the 47-county headquarters, building of metropolitan area networks in all 47-county headquarters, and create a redundancy to the national backbone. In 2017, the government embarked on NOFBI 2E network with a scope of 2,500 KM fiber links and IP equipment majorly covering sub-counties and creating sub-rings to further increase redundancy as shown in figure 1. Kenya has since achieved a more



reliable, stable and efficient national backbone network that is being used by the Government at the National and County levels.

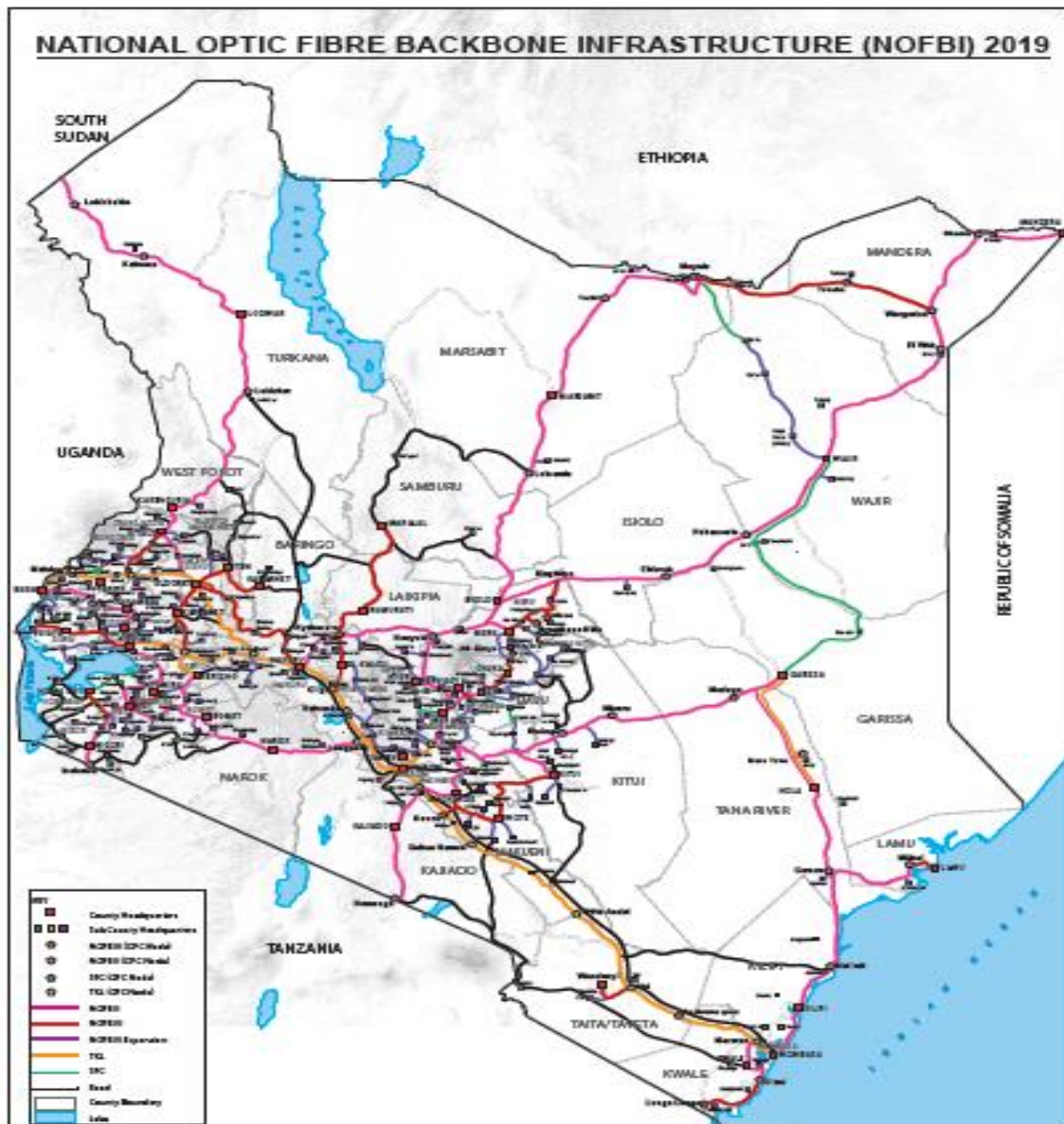


Figure 1: Current backbone connectivity

However, the development and provision of the backbone connectivity infrastructure faces the following hurdles:

- 1) Limited coverage of backbone infrastructure in the rural areas.
- 2) Over Utilization/capacity constraints. The capacity of the network is not able to serve all the government needs as well as the private sector. This Master Plan will standardize all the backbone in Kenya to have a cable not less than 96 cores and will rename all the optic fiber cables.

- 3) Unusable sections. The government network has also faced challenges of some of its section destroyed and therefore not useable. This master plan addresses this issue by rehabilitation all the destroyed and unused sections.

### 3.1.3.2 Programmes / Projects

The government’s national broadband strategy articulates in greater detail strategies towards the realization of connectivity in the country. The flagship projects to be implemented within the planned period are:

- 1) Providing quality and secure connectivity to key government offices
- 2) Rehabilitation of all unusable backbone optic fiber cable segments
- 3) Centralize NOFBI equipment to ICTA offices or to any other appropriate government office.
- 4) Backbone to cover all Counties, sub-counties, wards
- 5) Establishment of one National NOC mirrored in all the 47 counties.

### 3.1.3.3 Project Activities

Table 2 shows the flagship projects’ activities that will be implemented during the plan period. The flagship projects activities shown in the first column will take relatively long to implement. However, even as components of these long-term project’s activities are implemented, it will be possible to implement this activity in an annual project implementation matrix as indicated in Appendix 1.

Table 2A: Backbone project activities

	<b>Backbone Project Activities</b>	<b>Output Distance (KM)</b>
1.	Upgrading of degraded Backbone Routes	2521
2.	New build backbone connectivity to underserved Sub Counties	723
3.	Build new OFC to complete existing backbone infrastructure	4,701
4.	New build backbone connectivity to all wards	20,320
	<b>Total</b>	<b>28,265</b>

Table 2B: Shelters project activities

	<b>Shelters Project Activities</b>	<b>Output (NO)</b>
1.	Construction of ICT shelters in all counties to house ICT infrastructure equipment and offices (NOC, SOC, training	47

	room and call centers)	
2.	Construction of ICT equipment shelters	580
3.	Network Operation Centre	47

### 3.1.4 Metro

In the last 10 years the government has built a total of 534km of metro mostly in the Nairobi and County headquarters mainly connecting key public institutions and offices to offer service delivery. Due to metro connectivity challenges and need for interconnectivity in public institution there is a great demand for the government to expand metro connectivity for effective service delivery as per the Sustainable Development Goals (SDG), Digital economy blueprint, National Broadband Strategy 2018-2023 and Smart Africa 2063.

#### 3.1.4.1 Situation Analysis

The Government has developed a Government Common Core Network (GCCN) within Nairobi meant to serve as a shared and secure interoperable Government-wide ICT architecture and improve inter-ministerial sharing of databases and exchange of information to eliminate duplication and redundancies, improve public access to Government services and ensure responsiveness in reporting, monitoring and evaluation (Kenya e-Government Master Plan, 2013). Within the Nairobi Central Business district, all major government buildings are connected to the Government Common Core Network (GCCN) to facilitate the Ministries and other agencies in providing services. This metro is 24 km long and it forms the infrastructure backbone for data services in the government within CBD that facilitate ICT business planning, shared infrastructure and leverage on technology opportunities. The current GCCN network was commissioned in the year 2009 with the initial purpose of accessing a centralized financial system by MDAs within Nairobi. Over time, other services have introduced including internet, voice, video, Huduma and MCDAs specific applications. Like any other technology, active equipment has reached end of life and therefore, the support of these equipment by the manufacturer is not fully guaranteed. In addition, the network architecture is no longer appropriate for the current use of the network considering the level of reliability expected by the business it serves. The government also during implementation of Nation Optic Fiber Backbone Infrastructure (NOFBI) implemented county metros in the county headquarters to interconnect government institutions.

A total of 457 km was implemented under the NOFBI 2 Project and an additional 53km implemented under the NOFBI 2 Expansion Project. However, the government faces several challenges in developing and providing metro connectivity infrastructure among them being the following:

- 1) Limited coverage of Metro infrastructure.
- 2) GCC equipment reach end of support and cannot be monitored.
- 3) Over Utilization/capacity constraints. The metro capacity of the network is not able to serve all the government needs as well as the private sector.
- 4) Overall network stability, response, availability and security is not optimal.
- 5) Lack of redundancies in the fiber ring or active equipment.

### 3.1.4.2 Programmes / Projects

The flagship projects to be implemented before 2017/2029 are:

- 1) Re-engineering of metros Optic Fiber Cable network to integrate to urban development plan.
- 2) Upgrading of end of support and obsolete equipment.
- 3) Provision of Metro connectivity in all Counties, Sub counties and Ward headquarters to facilitate last mile connectivity.
- 4) Implement shared service duct with the road agencies in all the metros.

### 3.1.4.3 Project Activities

Table 3 shows the flagship projects’ activities that will be implemented during the 10-year plan period. The flagship projects activities shown in the first column will take relatively long to implement. However, even as components of these long-term project’s activities are implemented, it will be possible to implement this activity in an annual project implementation matrix as indicated in Appendix 2.

Table 3: Metro project activities

	<b>Metro Project Activities</b>	<b>Output Distance (KM)</b>
1.	Build new Nairobi metro re-engineering	700
2.	Build new county metro	1,060
3.	Build new sub county metro	1,000
4.	Ward metro	1,700
	<b>Total</b>	<b>4,460</b>

### 3.1.5 Last Mile

The foundation of ICT infrastructure is the physical connectivity. That is a combination of First Mile, Middle Mile, and Last Mile. First Mile is the underwater cables, the Middle Mile is the backbone and metro networks along with transmission and core network, and the Last Mile is the final connection to users. In this Infrastructure Master Plan Last mile connectivity aims to ensure that national, county and other government institutions are connected to the backbone network for delivery of digital services across the country.

#### 3.1.5.1 Situation Analysis

The government has implemented last mile connectivity through County Connectivity Project (CCP) with the objective of connecting all government Institutions across the country to the backbone infrastructure. CCP Phase I and II have been completed, while phase III is ongoing expected to be completed by early 2020. The aim of this project is to interconnect all counties with VoIP (county and inter-county communication; voice services), internet connection (promoting online services using telephones, emails and video conferencing) and access to critical government applications like the IFMIS. Kenya faces a number of challenges in developing and providing infrastructure across the country. A key challenge is the provision of last mile infrastructure connectivity, which if appropriately addressed can leapfrog the country into a knowledge economy. Internet access in homes, schools, social centers and villages should be key drivers to ensuring a knowledge economy. Among the challenges in developing and providing last mile connectivity infrastructure are:

- 1) High demand for last mile connectivity.
- 2) Lack of proper standards for interoperability as some solutions deployed utilize only proprietary protocols.
- 3) Lack of sustainability model for the last mile infrastructure.
- 4) Limited and non-functional Local Area Network (LAN) connectivity.

#### 3.1.5.2 Programmes/Projects

The flagship projects to be implemented before 2017/2029 are:

- 1) Last mile connectivity to key government institutions in the County, Sub county and Ward including government offices, schools, hospitals, police stations, courts, training institutions among others.
- 2) Connectivity to key common public places such as Libraries, Constituency Innovation Hubs (CIH), Markets, rest stops and Museums.
- 3) Upgrade and installation of Local Area Network (LAN) in government institutions.

### 3.1.5.3 Project Activities

Table 4 shows the flagship projects activities that will be implemented during the 10-year plan period. The flagship projects activities shown below will take relatively long to implement. However, even as components of these long-term project’s activities are implemented, it will be possible to implement this activity in an annual project implementation matrix as indicated in Appendix 3. These last miles connectivity can also be implemented using wireless solution where appropriate.

Table 4: Last mile project activities

	Last Mile Project Activity	Distance (KM)
1.	Police Station Connectivity	400
2.	Judicial Institution Connectivity	69
3.	Health Facilities Connectivity	6,500
4.	County Government Connectivity	597
5.	Constituency Offices and Constituency Innovation Hub Connectivity	435
6.	Education Institution Connectivity	12,000
7.	Key Public Areas (Museum, Libraries)	77
	<b>Total</b>	<b>20,078</b>

NB: Local Area Network upgrade and installation will also be completed for the 41,055-government institution under the last mile connectivity activities.



### 3.2 Data Center and Cloud Infrastructure

Data Center and cloud are critical ICT infrastructure that ensures E-Government services continuity by protecting critical applications and data against loss that could arise from natural disasters, acts of terrorism, sabotage, and technical faults among others. The Government in 2008 developed a tier-2 Government Data Center (GDC) infrastructure to

ensure the security of Government data, applications and hosting of government critical data. The GDC houses the power, storage, and applications of the most critical and sensitive data and information necessary to support government services. Through this centralization, government data is easy to access and is protected from natural or man-made disasters that may occur at the primary service sites/Government offices. GDC is connected to the Government Common Core Network (GCCN) with a high-speed connection links for faster access.

The Government is also implementing a disaster recovery facility and Konza Data center (KDC) for data and systems as part of the business continuity plan. This will ensure that the Government services continue to be provided even in case of any disaster at the primary sites. These facilities will also offer an environment for cloud computing for all MCDAs. However, Kenya still faces a number of challenges in developing and providing Data and Cloud infrastructure among them being the following:

- 1) Lack of smart data center to host Local and international Internet Exchange and Content Delivery Networks (CDN).
- 2) Lack of functional Recovery data Center.
- 3) GDC equipment are end of support and no backup power.
- 4) Lack of integrated monitoring for data center.
- 5) Capacity constraints to host all government institution.
- 6) Partially operationalized government private cloud.
- 7) Lack of sustainability model for government cloud and data centers.

In order to develop a modern ICT Infrastructure, there is a need for government to put in place an integration cloud computing environment, big data and the internet of things with modern technologies that promotes e-commerce, industrial networks, Internet banking and new systems supporting high-tech in agriculture, Housing, Health and manufacturing as per the 'BIG FOUR AGENDA.'

### **3.2.1 Objectives, Strategies and Desired Outcomes.**

#### **3.2.1.1 Objectives**

- 1) To provide a cost effective, centralized, reliable and highly secure environment for hosting critical Government data and applications.
- 2) To provide business continuity and Disaster Recovery services.
- 3) To efficiently connect and share strategic Government data and private entities
- 4) To cost effectively enable public institutions to store and access their administrative data.



### 3.2.1.2 Desired Outcomes By 2029

A modern and operational data centers and cloud infrastructure is essential in facilitating the development of ICT enabled economy. Despite the progress made so far, there is a need to step up development of a secure, trusted, well managed data storage that promotes integration and sharing of ICT infrastructure. The outcomes envisaged in end of the planned period are:

- 1) Efficient Cost-effective storage of data.
- 2) Minimization of data security incident.
- 3) Business Continuity Achieved.
- 4) Large accessible data sets.
- 5) Integrated cloud computing, big data and the internet of things.
- 6) Reliable government recovery services.

### 3.2.1.3 Strategies

The government recognizes the important economic role of data centers across all sectors of the economy and in order to deliver value to stakeholders and to guide the continuous growth of the same in both public and private sectors; it will adopt the following strategies:

**Strategy 1:** Ensure government Ministries, Departments and Agencies share and optimize data center ICT infrastructure in order to save costs by eliminating the need for infrastructure expenses incurred by individual agencies and also provide cost efficient, scalable and secure environment for Government data and information.

**Strategy 2:** Ensure the security of the Government information is harmonized and managed centrally.

**Strategy 3:** Encourage businesses to partner and invest jointly in data center infrastructure deployment or share data center infrastructure to minimize network duplications.

**Strategy 4:** Ensure the availability of basic infrastructure especially reliable cost-effective grid power and connectivity.

### 3.2.1.4 Programmes/Projects

- 1) Reengineering of all Government Data Centers.
- 2) Develop and implement data center policy.
- 3) Integration of cloud computing, big data and the internet of things with modern technologies that promotes e-commerce, industrial networks, internet banking and

new systems supporting high-tech in agriculture, Housing, Health and Manufacturing as per the ‘Big 4 Agenda.’

### 3.2.1.5 Project Activities

Table 5: GDC Project Activities

	Data Center & Cloud Project Activities	Output	Outcomes
1	Upgrade the current Data center	An upgraded data center that is operational	Enable citizens enjoy government services by assuring availability 24/7
2	Complete and operationalize the DR	A working DR site	Business continuity. Citizens continue to enjoy e-government services even when the main site is down
3	Build a new smart hub/data center	A smart datacenter / hub	Reduced cost of content in that content producer will be hosting their content locally in a neutral carrier data center. With carriers, cloud and content providers physically connected/hosted at the smart hub/data center, whatever network services you require are readily available e.g. google, Netflix etc.
4	Develop data center ICT infrastructure policy	Policy document in place	Promotion of data sharing culture which leads to more quality research papers,
5	Implement cloud infrastructure	Fully operational cloud infrastructure	<p>New Business Models: it will become easier to create and innovate new business model by taking advantages of existing cloud resources. The New business models will add a value for both citizens and government agencies. By creating new business models, new revenue models will take a place in the local economy.</p> <p>Cost-effective approach: one of the main challenges that face e- government is a shortage in budget. By implementing cloud paradigm, governmental agencies create a</p>

			<p>pool of shared and common resources as: software, hardware and network infrastructure even employee that leads to reduction in cloud-government budget.</p> <p>Agility: Cloud computing ensures the resources availability when they are needed by eliminating activities that consume time for resources allocation. So, citizens will have real time services.</p>
--	--	--	---



### 3.3 Infrastructure Security

In the past decade there has been expansive ICT infrastructure roll out including countrywide network connectivity and data centers which are the backbone of the growing reliance on automation and provision of government services to the public. As more e-services are being delivered through the infrastructure, it is becoming increasingly important that information and cyber security controls keep pace with the advances of threats to information and assets. Ensuring data security, privacy, online safety and cyber security is fundamental to building public confidence and uptake in government’s digital initiatives.

#### 3.3.1 Situation Analysis

As government envisages delivering more services through ICT, more emphasis should be given to information security to ensure that current and emerging threats are being addressed. In addressing information security challenges, the government has enacted the following critical legal frameworks:

- 1) Computer and cybercrimes act 2018.
- 2) Data protection bill 2018.

However, government ICT infrastructure is still exposed to various challenges among them the following:

- 1) Lack of national government policies for information security implementation.
- 2) Lack of security integration in government projects at inception.
- 3) Lack of proper security controls across the infrastructure resulting in service disruptions and outages.
- 4) Successful cyber-attacks resulting from lack of security management systems to manage security vulnerabilities on critical infrastructure.
- 5) Lack of real time monitoring to identify vulnerabilities and threats.
- 6) Lack of clear critical systems User Identity Management.
- 7) Low and / or lack of skilled personnel in Cybersecurity.
- 8) Software and systems designed and manufactured from a variety of sources giving rise to the possibility of compromised supply chains.
- 9) Larger attack surfaces in the government, stemming from the increased complexity of systems and digital connectivity use models.
- 10) Social and technology trends, such as teleworking, mobile devices, leading to an increased number of insecure devices accessing government networks and blurring the perimeters of systems.

### 3.3.2 Objectives, Strategies and Desired Outcome

#### 3.3.2.1 Objectives

- 1) To identify and classify government information assets to ensure proper administration of security across critical government installations
- 2) To identify and create a formal list of Critical National Infrastructure (CNI) on a multi-sectoral stakeholder consultation and work with respective agencies on securing them.
- 3) To enhance the information security level for the Government ICT infrastructure to support e-Government services.
- 4) To continuously manage information security events and incidents across the ICT infrastructure
- 5) To identify and assess internal and external information security risks that may threaten the Government infrastructure
- 6) To ensure swift recovery from information security incidents and restoration of normal operations and services.

- 7) To identify a center of excellence in cybersecurity research and education to locate strengths and provide focused investment to address skillset and gap areas.
- 8) Promote greater levels of trust in on-online services, such as e-government and e-commerce services.

### 3.3.2.2 Desired Outcomes By 2029

A resilient and secure infrastructure to facilitate the achievement of an ICT enabled economy. Despite the progress made so far, there is need to continuously improve the security of the infrastructure to inspire public confidence in government e-services. The outcomes envisaged in end of the planned period are:

- 1) A government infrastructure that will enable secure e-services provisioning.
- 2) Informed government workforce on information security.
- 3) Capability to effectively deter, detect, investigate and counter the threat from the cyber activities targeted to government systems
- 4) Developed Cybersecurity Skills across the Public service.
- 5) Increased public and investor confidence in government delivering secure digital services.

### 3.3.2.3 Strategies

In a constantly changing environment, there is a need to have flexible and dynamic information security strategies to meet new, global threats. The following are the strategies to be implemented:

**Strategy S1:** Develop, implement and institutionalize an infrastructure security management framework. This will facilitate the establishment of appropriate policies, procedures and standards to safeguard ICT infrastructure.

**Strategy S2:** Develop an ICT security policy that will strengthen implementation of various existing national ICT statutes.

**Strategy S3:** Enhance the nation's infrastructure security posture which will enable the country's digital growth, safety, and prosperity.

### 3.3.2.4 Programmes / Projects

- 1) Implementation of a national Government Security Operations Center to proactively monitor, coordinate, defend and prevent against infrastructure security threats.
- 2) Develop a government cyber security strategy

- 3) Implementation of the National Public Key Infrastructure to facilitate digital economy & information security for e-Government services
- 4) Fibre Network (NOFBI) being a critical National Infrastructure, Security (both Physical and Logical early warning) shall be inbuilt and incorporated as a safeguard built which includes but not limited to sensors, alert systems and geo-fencing system.
- 5) Installation and configuration of security controls to the country’s gateways cross borders and Metro.
- 6) Integration of threat discovery & intelligence capability, Anti- Denial of Services systems and Indicators of possible compromise to secure all the internet gateways, data centers and cross border points.
- 7) Implement network security and access control to localize security threats and encryption of traffic within the infrastructure.
- 8) Implement continuous network scanning systems to identify vulnerabilities that arise for quick remediation.
- 9) Implement systems to apply security fixes and updates across the identified Critical infrastructure & Systems.
- 10) Implement Digital Authentication and Access Management (DAAM) & DAM.
- 11) Implement remote security surveillance systems for network sites.
- 12) Develop ICT infrastructure security policy.
- 13) Development of data protection standards for government.

### 3.3.2.5 Project Activities

#	Infrastructure Security Project Activities	Output
1	Build a national Government Security Operations Center	This will provide a clear visibility into our environment for potential threat sources. Provide agile response when addressing incidences & outages. Monitoring, detect and enable analysis of intrusions.
2	Build Security Operations Centers at the regions	Provide a clear visibility into our environment for potential threat sources. Provide agile response when addressing incidences & outages. Monitoring, detection and analysis of intrusions.

#	Infrastructure Security Project Activities	Output
3	Installation and configuration of internet next-generation gateway and cross boarder firewalls	Prevention of overall security threats at the Gateway, before entry to network. Provide a secure, robust GCCN & overall government network. Address continued issues of IP Blacklists, malware and Botnets
4	Installation and configuration of metro next generation firewalls	Enhanced security threat at the Gateway, Provide a secure, robust GCCN & overall government network. Address continued issues of IP Blacklists and Botnets
5	Implement a National Public Key Infrastructure	Enable GOK adoption of e-commerce and digital economy. Provide locally available and cheaper digital certificates/signatures to the citizenry
6	Implement Network Access Control systems at the infrastructure access level for all Critical Infrastructure.	A defined and enforceable logical access, managed privileges to system and the information in accordance with the access control policy and Criticality of Infrastructure.
7	Installation of Anti-Denial of Service systems for all gateways and datacenters.	Provide layered Infrastructure security for the Gateway; core Infrastructure Installation (GDC) and hosted applications. Provide a secure, robust GCCN & overall government network.
8	Implement vulnerability management systems	The result of this is an ICT Infrastructure that has an understood risk posture that is updated and documented.
9	Implement patch management systems for infrastructure active devices	The result of this is an ICT Infrastructure that has an understood risk posture that is updated and documented.

#	Infrastructure Security Project Activities	Output
10	Installation of surveillance systems and smart locks for network sites and GPS for fiber cables	Provide layered Infrastructure security for the Gateway; core Infrastructure Installation (GDC) and hosted applications.
10	Implement Digital Authentication and Access Management (DAAM) & DAM.	Provide better, faster, more efficient access to government services Safeguard privacy by protecting access to personal data Improve mobility by using widely interoperable credentials across both physical and logical domains Establish trust between the governments issuing agencies
11	Security, sensors, alert systems and geo-fencing system for National Fiber Optical Transmission Network	To safeguard Fiber as a critical national Infrastructure to ensure immediate resolution of and remediation of issues including outages and possible Physical damages.
12	Development of data protection standards	An established ecosystem & levels of information security for all related Infrastructure and critical Installations Provides an alignment to International Data Standards (GDPR) which ensures international cooperation.
13	Continuous risk assessment of critical assets	The result is an ICT Infrastructure that has an understood risk posture that is updated, documented and acceptable.
14	Develop ICT infrastructure security policy.	Defined Governance structure for Infrastructure security. The is an ICT Infrastructure that has an understood risk posture that is updated, documented and acceptable to risk owners.
15	Develop a cybersecurity strategy	A high-level Government's commitment to cybersecurity, protection of Critical Information and leadership.

Table 6: Infrastructure security project activities



### 3.4 Human Capital

The development of quality ICT human resources is a prerequisite to the development of a viable ICT sector. It ensures that ICT development, implementation and exploitation are an integral and sustainable component of development. While the Government and the private sector have been investing heavily in the ICT infrastructure there has comparatively been little investment in the human resources required to design, develop and operate this infrastructure and the associated e-applications. With the increasing sophistication of ICT Infrastructure and its applications, high-end skill sets are increasingly required, and availability presents a challenge of achieving the vision of this ICT Infrastructure Master Plan. The local universities and tertiary colleges continue to develop ICT human capital and workforce that is neither guided by a human resource development policy nor well aligned to the industry needs, especially at the high end. This Master Plan suggests mechanism for developing and sustaining high-end talent by removing the skills gap between industry requirements and the capabilities of the local workforce. This includes reducing the need for foreign expertise in ICT projects, retaining current high-end talent, and creating a mechanism for effective skills transfer and training. High-end skills set that are found in ICT professionals are ICT projects managers, network engineers, network administrators, system administrators, application developers, Security information system analysts and Data Center expert who manage complex system design, development, and integration.

Some of the challenges experienced in Human Capital Development include the following:

- 1) Lack of adequate funds especially for the highly specialized skills.
- 2) Non-alignment to the industry needs by the universities/colleges ICT human development programmes.
- 3) High training costs for highly specialized ICT skills.
- 4) Dynamic nature of the ICT industry that requires continuous training.

#### 3.4.1 Objectives, Strategies and Desired Outcome

##### 3.4.1.1 Objectives

- 1) Develop ICT Ready Workforce.
- 2) Increase digital literacy of Citizens.
- 3) Building capacity of ICT Authority.
- 4) Develop a critical mass of local high-end ICT skills.

### 3.4.1.2 Strategies

**Strategy S1:** Implement awareness programs on the role of information and ICT for quality life.

**Strategy S2:** Build technical and leadership capacity in ICT Authority. It will be necessary to develop and implement a staff development program for professional ICT staff and a leadership and management program for all ICT Authority senior managers.

**Strategy S3:** Competitive and strategic recruitment against ICT Authority Organizational structure.

**Strategy S4:** Institutionalize a performance evaluation system at all levels of ICT professional staff.

**Strategy S5:** Institutionalize Constituency Innovation Hub for ICT high end skills development and scholarship program.

**Strategy S6:** Collaborate with the Commission of University education (CUE) and Industry to strengthen ICT degree programs in all Kenyan Universities. A pre-requisite for high-end ICT professional development is good ICT degree programs. Although there are many ICT graduates, local industry has complained about the quality of entry-level ICT employees from the universities as earlier noted.

**Strategy S7:** Review the terms of service of ICT staff and make them competitive. These terms should be reviewed to make working at ICT Authority comparable to working in leading public parastatals.

**Strategy S8:** Establish and operationalize a section to be in-charge of planning, designing and costing of ICT infrastructure projects at the ICT Authority.

### 3.4.1.3 Desired Outcomes

The master plan seeks to improve the ICT human capacity in Kenya with the following outcomes by 2029:

- 1) Availability of sustainable local high-end ICT skills to meet the needs of the industry.
- 2) Adequate workforce to transform and innovate business using ICT.
- 3) ICT literate population capable of exploiting ICT products and services for improved quality of life.

### 3.4.1.4 Programmes/Projects

- 1) Increase digital literacy of citizens through Ajira programme and Innovation hubs.
- 2) Competitive and strategic recruitment of ICT Authority staff.

- 3) Develop and implement a staff development program for professional ICT staff and a leadership and management program for all ICT Authority senior managers.
- 4) Institutionalize a performance evaluation system at all levels of ICT professional staff.

#### 3.4.1.5 Project Activities

- 1) Training programmes for staff at all levels (technical, Supervisory & managerial)
- 2) Implement and Research & Development Center at the ICT Authority.
- 3) Partnerships and collaboration with training institutions on technical capacity development in ICT infrastructure.

## CHAPTER 4.0

### 4.0 Implementation Framework

#### 4.1 Resource Mobilization

Achieving the vision of the national ICT infrastructure Master Plan will require the mobilization of significant financial and human resources. Funding of the flagship projects in this Master Plan will come from the national and County Governments, development partners and other public or private institutions through Private Public Partnerships (PPPs) and collaborations.

- 1) **Government:** In 2018 / 2019, Government of Kenya allocated KSH 28.7 Billion which is 1% of overall government budget. This will need to increase and be reallocated based on planned priorities. Due to financial limitations in public it is essential to develop innovative funding mechanisms to mobilize additional resources from other sources as outlined below:
  - a) Increase Government allocation on ICT to 5% of overall government budget as recommended in the national broadband strategy.
  - b) Use of Universal Access Fund to fund broadband roll-out in under-served areas, as recommended in the national broadband strategy.
  - c) Use of the equalization fund to fund ICT projects in marginalized counties.
- 2) **Commercialization of the infrastructure:** The already existing infrastructure will have a sustainability business model that will generate revenue, which will be used by government to fund this master plan and debt servicing.
- 3) **Private sector:** Development of suitable incentives and tax breaks to private sector both within and outside the ICT sector to fund the Master Plan projects. The incentives may include; Development of special Purpose Vehicles/ Private sector Consortiums and Public Private Partnership.
- 4) **Development Partners:** Government will leverage on funding from development partners who prioritize ICT as an enabler of social economic development. The flagship project in this ICT Infrastructure Master Plan will form the basis of this engagement. The funds may be on the following engineering procure and construct (EPC) or Build Operate and Transfer (BOP)
- 5) **Capital markets:** This needs to be developed to support the issuance of relevant instruments (such as ICT infrastructure bonds), which are considered to have investment grade credit rating. The national broadband strategy recommends KES 70 billion broadband infrastructure bond to fund broadband strategy implementation.

## 4.2 Sustainability

Sustainability is the ability of an organization to continue its mission or programmes/Projects far into the future. All projects must end eventually, but the project impact should continue and last for a longer period. A project can be sustainable in three main categories: organizational, financial, and community sustainability. The Sustainability of ICT infrastructure will be ensured through the following among others:

- 1) Commercialization of ICT infrastructure.
- 2) Implementation of IT Charge back for all ICT infrastructure services.
- 3) Partnering with other government agencies on Capital Expenditure sharing cost to enhance last mile connectivity.
- 4) Annual Maintenance Contracts, Support and qualified technical staff.

## 4.3 Social and Environmental Safeguards

Environmental issues may present themselves as temporary or permanent changes to the atmosphere, water, and land due to human activities, which can result in impacts that may be either reversible or irreversible. Social issues may emerge in the workplace of a client’s/investee’s operations and may also impact surrounding communities. A client’s/investee’s performance in the areas listed below can represent environmental and social risks to the operation:

### Adverse / Negative Impacts and Mitigation

Impacts and Risks	Mitigation Measures
<p><b>Terrestrial Habitat Alteration</b></p> <p>Terrestrial habitats may be altered primarily during the construction depending on the type of infrastructure component and propose location</p> <p>Potential adverse impacts may result from a number of activities such as vegetation clearing, trending and increased human traffic along previously undeveloped land.</p>	<ul style="list-style-type: none"> <li>• Activities be limited to the existing transport corridor, whenever possible:</li> <li>• No construction activities to be undertaken during the breeding season and other sensitive seasons or times of day:</li> <li>• Revegetation of disturbed areas with native plant species.</li> </ul>
<p><b>Soil Erosion and Sedimentation</b></p> <p>Loss, damage or distribution of soil,</p>	<ul style="list-style-type: none"> <li>• Early installation and regular maintenance of drainage and diversion</li> </ul>

<p>with possible introduction of sediments to watercourses, as a result of trenching and vegetation clearing.</p>	<p>structures, silt traps, etc., drainage into vegetated areas if possible, vegetation along watercourses and drainage lines to be retained if possible.</p> <ul style="list-style-type: none"> <li>• Retention of topsoil for restoration (including tilling and revegetation) as soon as practicable.</li> <li>• Removed soil from trenching operation shall be used for backfilling.</li> <li>• Careful planning of timing of works (overall duration and seasonality specially avoiding works during the rainy season if possible).</li> <li>• Clear demarcation on project drawings of vegetation to be affected.</li> <li>• Minimization of cleared areas and soil disturbance, with revegetation as soon as feasible with species adapted to local conditions when applicable.</li> <li>• If the surface to be intervened is small, protection of erodible areas with mulch, and planting with protective vegetation once works are finished: preferable, execution of works during the dry season.</li> <li>• If the surface to be intervened is large, presentation of an adequate erosion and sedimentation control plan, specifying type of device to be applied, installation sequence and location: preferably, execution of works during the dry season.</li> </ul>
<p><b>Water and Soil Pollution, and Landscape Degradation</b> Trenching and Vegetation clearing may</p>	<ul style="list-style-type: none"> <li>• Train personnel on waste handling and segregation.</li> <li>• Segregated waste storage containers</li> </ul>

create exposed sites. Sediment-laden runoff from cleared could impact water quality of downstream watercourses.

Release of hazardous substances associated with construction and maintenance activities or with transport materials (e.g., accidental spills and leaks), may lead to soil, surface or groundwater contamination.

Inefficient waste management during construction and maintenance activities may lead to inadequate disposal of solid (domestic and construction) and liquid wastes that may pollute soils and watercourses, and visually degrade natural and man-made landscapes.

with appropriate signs (hazardous or non-hazardous) shall be provide at construction sites.

- No garbage, refuse, oil waste, fuel waste oil or removed/excess materials (e.g., asphalt, sidewalks, metal scrap, etc.) shall be discharged into drains, onto site grounds, natural areas or watercourses.
- If feasible, reuse of removed/demolished materials (e.g., - banded area with impervious - polyline or similar) for both new and waste fuel, oil and hazardous materials to prevent and contain any spillage and leaks.
- Prompt removal and safe disposal of soil contaminated with hydrocarbons.
- Hazardous and oil waste shall be collected and disposed by NEMA licensed waste handlers.
- Implementation of hazardous materials handling and control procedures (e.g. identify chemical products and store in storage area with restricted access, keep track of movement of each chemical, etc.)
- Maintenance and cleaning of vehicles, trucks and equipment should take place offsite and prohibition of vehicle washing in watercourses.
- Toilet facilities shall be provided for construction workers to avoid indiscriminate defecation in nearby bush. See soil erosion above for control of water pollution due to released sediments from disturbed construction

	sites.
<p><b>Air Pollutions</b></p> <p>Dust and exhaust emissions from construction activities, and movement of constructive vehicles and trucks may affect human health.</p>	<ul style="list-style-type: none"> <li>• Whenever dust generation at construction sites becomes a problem, water spraying to suppress dust shall be undertaken.</li> <li>• Truck drives shall be sensitized on and ensure they observe speed limits on earth roads to reduce dust generation.</li> <li>• Contractors shall operate only well-maintained construction machinery, vehicles and trucks, and implement a routine maintenance program for all vehicles and trucks.</li> <li>• Engines of vehicles, trucks and earth-moving machinery shall be switched off when not in use.</li> </ul>
<p><b>Noise and Vibration</b></p> <p>Use of earth-moving equipment and heavy vehicles may generate noise and vibration</p> <p>Excessive noise can be a nuisance to local communities and business. In addition, noise may affect wildlife when optical fiber cables is laid in close proximity to natural areas.</p> <p>Vibration from compacting trenches may crack walls of structures adjoining work sites.</p>	<ul style="list-style-type: none"> <li>• Contractors shall implement best driving practices when approaching and leaving construction sites to minimize noise generation created through activities such as unnecessary acceleration and braking.</li> <li>• Strict control of timing of activities within authorized working hours, including banning work at night.</li> <li>• Minimize noise levels and vibrations (e.g. sound insulation, select equipment with lower sound power levels, install acoustic enclosures for equipment, install suitable mufflers on engine exhaust and compressors components).</li> <li>• See also air pollution above.</li> </ul>
<p><b>Traffic Congestion, Creation of Hazardous Driving Conditions and Obstruction of Access</b></p>	<ul style="list-style-type: none"> <li>• Trenching across roads, and construction vehicles and trucks movement shall be scheduled during general traffic off-peak</li> </ul>



<p>Potential traffic congestion, creation of hazardous driving conditions and obstruction of access to homes, businesses and community services during trenching and cable operation.</p>	<p>hours to avoid traffic congestion and hazards/</p> <ul style="list-style-type: none"> <li>• Employ safe traffic control measures, including temporary road signs and flag persons to ward of dangerous conditions, and traffic diversions.</li> <li>• Only experienced and trained drivers/operators shall drive/operate construction vehicles, trucks and machinery.</li> </ul>
<p><b>Interruption of Water, Telephone or Internet Services</b></p> <p>Excavation and removal of materials (pavement, sidewalks, soil etc.) required for the laying of optical fiber cable may accidentally rupture pipes, lines and cables, which will result in the interruption of services until affected infrastructure is repaired.</p>	<ul style="list-style-type: none"> <li>• Undertake a joint survey together with telecommunications technical personnel, construction personnel, and all affected individuals to inform on the selection of the appropriate installation method, most efficient route, property issues and rights-of-ways, identification of existing facilities and where applicable, identification of fiber splice points and land mark references,</li> <li>• Define on the final route map the depth at which the cable is to be buried. Mark on the route path with identification stakes or labels printed with the infrastructure owner details to caution the public and demarcate and properly secure points where manholes are to be placed.</li> <li>• Trench excavation within a market center or a township shall only be done after verifying that all utility lines (water pipes, electric cables and sewer lines) in the area are marked and known. All reasonable steps necessary must be taken and special consideration given to</li> </ul>

	<p>water, electricity and sewer systems within the area that cannot be located accurately.</p> <ul style="list-style-type: none"><li>• Where damage has occurred of existing infrastructure while undertaking underground cable works, the license shall immediately inform the affected owner and suspended the ongoing work until the matter is resolved.</li><li>• The work team must place barriers along the trench area, to warn people of "Dangerous Trench" as required by current laws, during excavation works. The work team must place large and visible WARNING signs to warn road users and pedestrians of "Excavation Works" along the cable route. All open concrete pole holes must be guarded with red/white barrier tape to warn local community of possible hazard. Trenches should be backfilled as soon as possible and to the original state.</li><li>• If the excavation must remain open or the road will be otherwise obstructed during the night or under low-visibility conditions, reflective road signs shall be complemented by lighting devices of the color, shape and size stipulated by the Kenyan traffic code, and</li><li>• The OFC cables shall be laid as stipulated in the plan but any deviation to this rule, due to technical or practical reasons must be documented and authority to do so given by ICT Authority. This is to avoid disputes or fights with the local community - to avoid injury or damage to</li></ul>
--	--

	the cable and equipment.
<p><b>Solid Waste</b></p> <p>A significant amount of solid waste will be generated during the construction phase through clearing of vegetation and excess soil, excavations and wastes from the construction materials, some which may be electronic waste. Adequate measures to manage this solid waste onsite should be adopted and implemented including working with NEMA and county government licensed waste handlers.</p>	<ul style="list-style-type: none"> <li>• Waste generated by the project from excavation shall be re-used for backfilling and landscaping.</li> <li>• Solid wastes that cannot be recycled or reused shall be segregated to source into e-waste, hazardous and non-hazardous waste then disposal conducted through NEMA licensed solid waste handlers.</li> </ul>
<p><b>Biosecurity</b></p> <p>The fiber optic cables will need to be imported as there are not locally manufactured in Kenya. Imported cables and equipment can harbor plant and animal species which may pose a threat to Kenya's biodiversity and ecosystem.</p>	<ul style="list-style-type: none"> <li>• All materials and equipment must be fumigated, and official certificates issued prior to arrival in Mombasa to ensure no plant or animal pests are accidentally introduced. On arrival at the Port of Mombasa, the materials and equipment must be inspected by Kenya Plant Health Inspectorate Service "KEPHIS" to protect from pests, weeds and invasive species.</li> </ul>
<p><b>Occupation Health and Safety Hazards</b></p> <p>Occupational health and safety hazards are anticipated during&gt;</p> <p>Trenching operations for laying of optical fiber cable.</p> <p>Installation of equipment at existing ICT sites to expand capacity and improve efficiency.</p> <p>Installation of equipment on some overhead power transmission lines to create backup routes for fiber cables using existing Optical Ground Wires on transmission lines.</p>	<ul style="list-style-type: none"> <li>• Conduct a risk assessment of site safety hazards, and design and implement measures specific to identified hazards.</li> <li>• Train workers on safe work practices and conduct toolbox talks.</li> <li>• Provide and enforce use of adequate Personal Protective Equipment (PPE) on site including, as applicable, hard hats, overalls, high-visibility vests, safety boots, gloves etc.</li> <li>• Put a system in place to track respond to accidents, incidents, near misses and</li> </ul>

<p>Construction of telecommunications compounds and other physical structures.</p> <p>Optical fiber installation activities may also pose a risk due to the presence of flammable materials in high-powered laser installation areas.</p>	<p>fatalities.</p> <ul style="list-style-type: none"> <li>• Except for areas secured by fencing, all active construction areas shall be marked with high-visibility tape, in particular open trenches, to reduce the risk of accidents involving workers, pedestrians and vehicles.</li> <li>• All open trenches and excavated areas shall be backfilled as soon as possible after cable laying and construction has been completed.</li> <li>• Implement good construction site-housekeeping and control access to active construction sites.</li> <li>• Clear signage shall be used at construction sites.</li> <li>• For risk of permanent eye damage due to exposure to laser light during cable connection and inspection activities. <ul style="list-style-type: none"> <li>○ Train workers on specific hazards associated with laser lights.</li> <li>○ Prepare and implement laser light safety management procedures.</li> </ul> </li> <li>• For risk of microscopic glass fiber shards penetrating human tissue through skin or eyes, or by ingestion or inhalation/ <ul style="list-style-type: none"> <li>○ Train workers on optical fiber management.</li> <li>○ Prepare and implement optical fiber management procedures</li> <li>○ Avoid exposure to optical fibers through use of protective clothing and separation of work and eating areas.</li> <li>○ Proper disposal of microscopic fiber</li> </ul> </li> </ul>
---	--

	<p style="text-align: center;">glass as a result of splicing</p> <ul style="list-style-type: none"> <li>• For risk of fire due to the presence of flammable materials in high-powered laser installation areas/             <ul style="list-style-type: none"> <li>○ Same as above</li> <li>○ For risks associated with contact with live power lines</li> <li>○ Allow only trained and certified workers to install electrical equipment.</li> <li>○ Deactivate and properly ground live power distribution lines before work is performed on or in close proximity to the lines.</li> <li>○ Ensure that live-wire work is performed by trained workers with strict adherence to specific safety and insulation standards.</li> <li>○ Workers not directly associated with power transmission and distribution activities that are operating around power lines shall adhere to recognize standards and guidelines relating to minimum approach distances for excavations, tools, vehicles, pruning and other activities.</li> <li>○ Measures to prevent, minimize and control injuries related to electric shock must also be developed and implemented.</li> </ul> </li> <li>• For physical hazards due to falling objects when performing elevated and overhead work /             <ul style="list-style-type: none"> <li>○ The area around which elevated work takes place shall be barricaded to prevent unauthorized access.</li> </ul> </li> </ul>
--	--

	<p>Working under other personnel shall be avoided.</p> <ul style="list-style-type: none"><li>○ Hoisting and lifting equipment shall be rated and maintained, and operators shall be trained in their use.</li><li>○ Equipment and fall protection measures shall be used and implemented by individuals.</li><li>○ Ladders shall be used according to pre-established safety procedures (proper placement, climbing, standing, use of extensions).</li></ul> <ul style="list-style-type: none"><li>● For risk of fall when working at elevation/<ul style="list-style-type: none"><li>○ Implementation of a fall protection program that includes techniques and use of fall protection measures, inspection, maintenance and replacement of fall protection equipment and rescue of fall-arrested workers among others.</li><li>○ Establishment of criteria for use of 100 percent fall protection (typically when working over 2 meters (m) above the working surface). The fall protection system should be appropriate for the tower structure and necessary movement, including ascent, descent and moving from point to point.</li><li>○ Installation of fixtures on tower components to facilitate the use of fall protection systems.</li><li>○ Provision of adequate work-positioning device system for workers. Connectors on positioning</li></ul></li></ul>
--	---

	<p>systems should be compatible with the tower components to which they are attached.</p> <ul style="list-style-type: none"> <li>○ Safety belts shall be of not less than 16 millimeters (mm).</li> <li>○ Ropes should be 5/8 inch (1.6 cm) in diameter, tow-in-one nylon or material of equivalent strength. Rope safety belts should be replaced before signs of aging or fraying of fibers become evident.</li> <li>○ When operating power tools at height, workers shall use a second (backup) safety strap.</li> </ul> <ul style="list-style-type: none"> <li>● For risks associated with confined spaces when performing manual boring operations <ul style="list-style-type: none"> <li>○ Develop and implement confined space entry procedures, including&gt; require work permits for all confined space entries, install appropriate access controls for non-permitting personnel, use ventilation and oxygen/explosive level detection and alarm equipment prior to access.</li> </ul> </li> </ul> <p>See also traffic congestion, creation of hazardous driving conditions and obstruction of access above.</p>
<p><b>Partial Loss of Productive Assets, and Temporary Limitation of Access to Commercial and Institutional Establishments, and to Residential Properties,</b> Excavation and backfilling operations required to install underground optical fiber cable may, Impact partially agricultural crops and</p>	<ul style="list-style-type: none"> <li>● For the partial impact on agricultural fields and areas with ornamental vegetation and fruit trees, implementation for compensation measures for affected parties in accordance with the Resettlement Policy Framework enclosed as Annex XI.</li> <li>● For the temporary limitation of access to commercial and institutional establishments, and to residential buildings, careful planning</li> </ul>

<p>fruit trees, as well as ornamental vegetation.</p> <p>Temporarily impede access to commercial and institutional establishments and to residual buildings.</p>	<p>of construction activities to minimize duration of impact.</p>
<p><b>Community Health and Safety</b></p> <p>HIV/AIDS. The project may lead to migration of people (contractors and workers) from outside the local community in search of employment opportunities especially during construction. This influx of people in the project areas may lead to increase incidences of sexually transmitted disease which may exacerbate HIV/AIDS situation among the locals. Several mitigation measures have been identified including awareness training (offered by the Ministry of Health, County Government and local NGOs) for foreign workers employing local laborers.</p> <p><b>Gender-Based Violence (GBV).</b> Men dominated the unskilled market in most project areas. Providing equal opportunities for women unskilled laborers may exacerbate existing households' problems. Particularly, this is possible where the men have more limited resources and feel threatened by the additional income brought by the women. The fear of GBV, therefore, make women less free and</p>	<ul style="list-style-type: none"> <li>• For HIV/AIDS mitigation <ul style="list-style-type: none"> <li>○ Conduct awareness campaigns on HIV/AIDS among the workers and the locals. This can be undertaken by the various NGOs and government agencies in the Counties.</li> <li>○ Erection of billboards to sensitize locals on the need to practice safe sex to help in the fight against HIV/AIDS.</li> <li>○ Provision of free condoms</li> </ul> </li> <li>• For Gender-Based Violence Mitigation <ul style="list-style-type: none"> <li>○ Establish multiples modes of communication and outreach for awareness raising to ensure outreach to women and girls,</li> <li>○ Creating and enabling environment for women participation by enlisting support of village elders and others respected and trusted by community,</li> <li>○ Inclusive community meetings ensuring substantial presence of women or separate meetings for women required, and quotas for women beneficiaries of 50</li> </ul> </li> </ul>



comfortable to participate in development activities.

**Conflicts with local communities.**

Projects of such magnitude usually attract public uproar especially from the local community if they are not involved in its implementation. Conflicts usually arise due to inadequate consultations with the local community, importation of unskilled labourers, livestock injuries due to uncovered trenches, destruction of grazing lands, private property and non-provision of equal opportunities to women.

**Internet User Safety.** During stakeholder engagement forums, concerns were raised regarding the safety of users. It was noted that ICT Authority will have little or no influence over the safe use of the OFC by their clients and how cases of fraud and cyber bullying, among others will be handled.

percent in livelihoods support.

- For conflict with Local Community mitigation
  - Consultation with the host communities and all relevant stakeholders on the mitigation measures proposed for the negative impacts and while utilizing traditional conflict resolution mechanisms
  - Offer all equal employment opportunities to both men and women.
  - Utilize Area Chiefs and Ward Administration in the recruitment of local unskilled labor and pay attention to dynamics like clans and minorities
  - Developing IEC materials using local dialects and using local media channels (radio, traditional forums) to disseminate messages targeting the attitude of the communities towards the projects
- Internet Security Assurance
  - To assure internet security ICT Authority will partner with Ministry of Information and Communication Technology (MoICT) to promote the safe use of internet
  - ICTA will carry out customer information campaigns distribute information at the time of customer service sign-up or by mail with billing information

	<ul style="list-style-type: none"> <li>○ Run nationwide public communication campaigns targeting all citizens</li> </ul>
--	--

### 4.3.1 E-Waste

There’s an increasing level of cyber waste (or e-waste) which not only cannot biodegrade but is generally hazardous to the environment. Governments from the national to local levels, as well as international organizations, need to provide guidance and resources that require and encourage proper recycling and safe disposal of ICT waste. Many used items such as mobile phones and computers cannot always be easily recycled directly for reuse or refurbishing. Government and industry cooperation can help manage e-waste costs and ensure sector-wide compliance with recycling mandates. The regulations would empower the government to investigate and prevent illegal waste dumping, including inspecting imported equipment to determine if it may be actually for sale and use, or is merely intended to be disposed of illegally within Kenya. All e-waste emanating from ICT infrastructure shall be managed in accordance with the existing ICT Authority Standards, NEMA e-waste Guidelines, and EMCA act of 1999.

## CHAPTER 5.0

### 5.0 Monitoring and Evaluation

Monitoring, evaluation and reporting will form a critical component for the successful implementation of this Master Plan. It is meant to examine the link between the set priorities, corresponding budgetary provisions and the resultant outputs and outcomes over the plan period. It will provide the necessary feedback and enable management to make evidence-based decisions.

#### 5.1 Monitoring and Evaluation Framework

The framework provides details of roles and responsibilities which different departments and directorates will undertake for this to be operational. The framework also provides a standardized template for M&E reporting. The framework will assist in ensuring timely and successful delivering of services, projects and Programmes in line with the ICT Infrastructure Master Plan. There will be continuous management process to factor in emerging issues during the project period and for improved results. This will provide early indications of progress or lack thereof in the achievement of the intended results at activity, output, outcome and impact level so that the necessary mitigations are put in place. To this end, a structured feedback mechanism to the stakeholders will be developed in the communication strategy and then executed in a targeted and sustained manner. The monitoring framework will track actual performance against what was planned in the ICT Master Plan and will involve continuous collection and analysis of data as well as results and recommend corrective measures. The monitoring function will be:

- Results-oriented to report on progress, output, outcome and strategic objective.
- Lesson-learning oriented.
- Cost effective.
- Involve professional documentation (signed reports, professional videos & photos, recorded & documented oral submissions from communities)
- Building the ability to predict about projects.
- Building lessons and mitigations for the programme/project.
- The Evaluation will help the Authority understand why and to what extent intended and unintended results are achieved and their impact on stakeholders. It will be important source of evidence for the achievement of the objectives as well as performance. It is also intended to feed into management decision making processes and make an essential contribution to planning, programming, budgeting, implementation and reporting cycle of master plan.

- Finally, the M&E framework aims at improving the ICT Authority institutional relevance, achievement of desired results, optimization of available resources and ensuring that the impact of all programmes/ projects the Authority is undertaking is measured.

## 5.2 Research and Development

As Kenya seeks to transform into a digital economy with universally accessible and affordable broadband research and development will play a crucial part in the development of innovations to spur the digital growth. Science and technology keep changing and improving, therefore staying ahead means transforming these advancements into products or services that will contribute to improved quality of life and enhanced economic competitiveness. In light of this, the Master Plan seeks to create an enabling framework for the advancement of R&D.

### 5.2.1 Objectives

- a) To stimulate a human workforce with advanced capabilities.
- b) To develop a world class research with active local and international collaboration.
- c) Create a strong Kenyan ICT brand, focusing on innovative solutions which address the needs of the developing world.
- d) A shift from the traditional ICT economy to give greater emphasis to development, production and export.
- e) A market-driven approach that addresses needs through innovative products, services and solutions.
- f) Create effective mechanisms for technology transfer, from idea generation through to productive implementation (including export).
- g) Creation of state-of-the-art research infrastructure including sufficient and affordable bandwidth.
- h) Development of organizational and regulatory policy and other support infrastructure to govern the R&D process from generation to implementation.

### 5.2.2 Strategies

- a) Identifying and supporting key application and technology domains which contribute to improved quality of life and enhanced economic competitiveness.
- b) Implementing a supportive environment and funding mechanisms which allow young people to work under the leadership of experienced ICT professionals.

- c) Establishing research centers and partnership with academic institutions and other industry players.
- d) Establishing networks of researchers and other role-players to collaborate in joint research locally and internationally.
- e) Supporting R&D initiatives that address identified socio-economic needs.
- f) Conducting regular road mapping to updates continuously update focus domains that are being supported.
- g) Setting national challenges to stimulate integrative R&D and inspire researchers and research groups.
- h) Developing and refining indicators and processes to assess the state of ICT R&D and innovation.
- i) Market development of R&D outputs and outcomes.
- j) Communicating and marketing the R & D outputs & outcomes.
- k) Setting up an implementation framework for industry to use the outputs of R&D and innovation.
- l) Partner with other government institutions to develop an Intellectual Property Framework (IPF)

#### 5.2.4 Projects

- a) Establishment of a national ICT Research and Development center.

## ANNEXES

### Annex 1: Backbone (NOFBI Expansion) Implementation Matrix

YRS	1500	3000	4500	6000	7500	9000	10500	12000	13500	15000	16500	18000	19500	21000	22500	24000	25500	27000	28500	30000	
1.	█																				
2.		█	█																		
3.				█	█																
4.						█	█														
5.								█	█	█											
6.											█	█	█								
7.														█	█	█					
8.																	█	█			
9.																				█	█
10.																					

### Annex 2: Last Mile Implementation Matrix

YRS	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
1.										
2.										
3.										
4.										
5.										
6.										
7.										

### Annex 3: Implementation Estimates

No	Projects / Programs	Objectives /Program	Expected outcomes / Outputs	Performance Indicators	Time Frame	Total Budget (KES Billions)
1	NOFBI Expansion to 30,000km	To improve access to ICT services	30,000 Km of fiber cable laid	No. of km laid	2018-2029	118
2	Last Mile Connectivity to 20,000Km and establishment of point of presence (No. 8)	To improve access to ICT services	20,000 Km of fiber cable laid	No. of km laid	2018-2029	60
4	Nairobi Metro to 4500 km and implementation of the active devices	Provide all the Government building with reliable connectivity	Reliable and stable interconnectivity in MDA's, Hospital, Police, Schools availed	No. of MDA's, Hospital, School, Police with stable reliable connectivity	2019-2029	17
7	Data center (Main, DR, Smart hub)	To Ensure continuity in Government operations	Data center and DR established	Percentage of establishment of a functional DRC	2019-2029	10
8	Cyber Security Infrastructure	To reduce cyber-attack incidence	Secure Government Infrastructure	Percentage of cyber security initiatives implemented	2019-2029	10
9	Security Operation Centre	To reduce cyber-attack incidence	Security Operational Center	Security Operational Center	2019-2029	3
10	Critical Infrastructure Bill	Provide and safe guide all the critical Infrastructure	Bill Creation	Pass the critical Bill	2019-2021	0.01
11	Standards	To protect the	Standards	Revised	2019-2020	0.01



		customer from inferior goods	review and dissemination	Standards		
12	Data Protection Bill	Protect of Data and information	Passed Data Protection Bill	Pass the Data Protection Bill	2019-2021	0.01
13	Cyber Security Bill	Protect the system, Data, Information for attacks	Restructured institutions	Cyber security Bill	2019-2021	0.01
14	Second Gateway for sub marine cable	Redundancy of the Internet connectivity	Second cable at Mombasa	Second cable and 3T of capacity	2019-2022	1
15	Activation of TEAMS to 100G	Improve on service	Activation to 100TEAMS	100G activated	2019-2022	0.5
16	Maintenance	Improve on service	Comprehensive Repair and Maintenance plan	One broadband Connectivity Corrective and Preventative Maintenance	2019-2029	30
17	Capacity Development	Improve on service	Capacity building plans	Train of 200 Staffs on security, Network, Fiber, Datacenter, Sub Marine cable	2019-2019	1
18	M & E	To monitor and evaluate implementation of projects	M & E reports	No. of M & E reports	2019-2029	0.3