**Part 2: Infrastructure**

# Fiber Optic-Backbone, Metro and Last Mile Infrastructure Standard- ICTA.2.2.004:2025



Second Edition 2025

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**REVISION OF ICT STANDARDS**

In order to keep abreast of progress in industry, ICT Standards will be reviewed annually. Suggestions for improvements to published standards, addressed to the Chief Executive Officer, ICT Authority, are welcome. The Standard Review Board will consider the requests during their quarterly meetings and if appropriate recommend them to be incorporated during annual review of the Standard.



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**DOCUMENT CONTROL**

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FOREWORD

The ICT Authority has the mandate to set and enforce ICT standards and guidelines across all aspects of information and communication technology including Systems, Infrastructure, Processes, Human Resources and Technology for the public service. The overall purpose of this mandate is to ensure coherent and unified approach to acquisition, deployment, management and operation of ICTs across the public service in order to achieve secure, efficient, flexible, integrated and cost effective deployment and use of ICTs.

To achieve this mandate, the Authority established a standards committee to identify the relevant standard domains and oversee the standards development process. The committee consulted and researched broadly among subject matter experts to ensure conformity to acceptable international and national industry best practices as well as relevance to the Kenyan public service. The committee eventually adopted the Kenya Bureau of Standards (KEBS) format and procedure for standards development. In an engagement founded on a memorandum of understanding KEBS, participated in the development of these Standards and gave invaluable advice and guidance.

For example, the Fiber-Optic Backbone, Metro and Last Mile Infrastructure Standard, which falls under the overall Government Enterprise Architecture (GEA), has therefore been prepared in accordance with KEBS standards development guidelines which are, in turn, based on the international best practices by standards development organizations including ISO.

The Authority's Directorate of Programmes and Standards has the oversight role and responsibility for management, enforcement and review of this standard. The Directorate shall carry out quarterly audits in all the Ministries, Counties, and Agencies (MCA) and private entities to determine compliance to this Standard.

The Authority shall issue a certificate for compliance to entities upon inspection and assessment of the level of compliance to the standard. For non-compliant entities, a report detailing the extent of the deviation and the prevailing circumstances shall be tabled before the Standards Review Board who shall advise and make recommendations to remedy the shortfall.

The ICT Authority management, conscious of the central and core role that standards play in public service integration, fostering shared services and increasing value in ICT investments, shall prioritize the adoption of this standard by Government and third parties. The Authority therefore encourages adherence to this standard in order to obtain value from ICT investments.

**Stanley Kamanguya, OGW**
**Chief Executive Officer**
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Contents

FOREWORD ..... 4
1.0 INTRODUCTION ..... 6
2.0 Scope ..... 6
3.0 Application ..... 6
4.0 Normative references ..... 6
5.0 Definitions ..... 6
6.0 Abbreviations ..... 8
7.0 Sub- domains ..... 9
**8.0 REQUIREMENTS** ..... 9
8.1 Ducts ..... 9
8.2 Maintenance Chambers ..... 11
8.3 Hand Holes ..... 12
8.4 Way leaves ..... 12
8.5 Poles ..... 13
8.6 Fiber cables ..... 15
8.7 Markings ..... 23
8.8 Equipment ..... 24
8.9 Security ..... 29
8.10 Aerial Cable ..... 29
8.11 Design Process ..... 32
8.12 Fiber Test Process ..... 33
**ANNEXES** ..... 38
Annex 1: Standard physical requirement of the ducts ..... 38
Annex 2: OFC Duct Technical Requirements ..... 42
Annex 3: Trenching of all soil types ..... 42
Annex 4: Trenching on Hard rock ..... 42
Annex 5: Optical Fiber Characteristics ..... 43
Annex 6: Pre Installation for cable Drum ..... 44
Annex 7: OTDR Pre- test ..... 45
Annex 8: Technical details of fiber optic cable 8,24,48,72 96 & 144 fibre (g652d) dry core, multi loose tube design, single sheath, glass yarn armoured ofc suitable for duct installation 45

## 1.0 INTRODUCTION

The Kenya National Digital Masterplan 2022 - 2032 identifies the lack of ICT standards to guide implementation of territorial ICT connectivity as having affected deployment, design and integration of both roads and ICT infrastructure across the country. This Standard is intended to address these gaps to ensure sustainable fiber infrastructure deployment.

## 2.0 Scope

This Standard sets out minimum requirements for the planning, design, deployment, operation, maintenance and management of back- bone, metro and last mile fiber optic cable.

## 3.0 Application

This Standard applies to entities planning, designing, developing and operating fiber optic infrastructure within the boundaries of the Republic of Kenya.

## 4.0 Normative references

The following Standards contain provisions which, through reference in this text, constitute provisions of this Standard. All Standards are subject to revision and, since any reference to a Standard is deemed to be a reference to the latest edition of that Standard, parties to agreements based on this Standard are encouraged to take steps to ensure the use of the most recent editions of the Standards indicated below. Information on currently valid National and International Standards can be obtained from the Kenya Bureau of Standards.

- Communications Authority - The Kenya Information and Communications (Importation, Type Approval and Distribution of Communications Equipment) Regulations, 2010
- GoK Information Security Standard
- GoK End-User Equipment Standard, ICTA-2.002:2019
- GoK Information Security Standard Second Edition 2019 ICTA.3.002:2019
- IEC 60794-4-20 Part 4-20: Sectional specification – Aerial optical cables along electrical power lines – Family specification for ADSS (all dielectric self-supported) optical cables
- ISO/IEC 27002:2013 Information technology — Security techniques — Code of practice for information security controls
- ITU - T L.10 Optical fiber cables for duct, tunnel, aerial and buried application
- Kenya Standard KS 516:2008 Wood poles for power and Telecommunication lines
- KS 1933:2018 Concrete poles for telephone, power and lighting Purposes-Specification.
- KPLC Specification for treated wooden poles KP1/3CB/TSP/03/001-1
- KS 1933:2018 Kenya Standard — Concrete poles for telephone, power and lighting purposes — Specification, Second Edition
- KS 2611:2016 Kenya Standard — HDPE ducts — Main, mini and micro
- NEMA E-waste guidelines
- Other procurement guidelines are released by the Public Procurement Oversight Authority, from time to time.
- Public Procurement and Disposal Act & Regulations
- Roads Act 2019
- Water Act 2016

## 5.0 Definitions

### a. Authentication

This is the process of verifying the claimed identity of a session requestor. The confidential authenticator that provides the verification can be based on a password, Personal Identification

Number (PIN), token, smart card, biometrics, exchange of keys, etc.

b. **Duct**
This is a medium which underground cabling is housed to protect the fiber cable from any damage or interference.

c. **Hand hole**
These are holes constructed under the ground to access telecom cables/components by inserting our hands. During installations, these hand holes serve as space to assist the cable pass through ducts smoothly.

**d. Identification**

This is the process whereby the network equipment recognizes a user's unique and auditable identity such as the User-ID.

**e. Infrastructure owner**
One responsible for construction of the shared infrastructure

**f. Maintenance chambers**
They are access chambers designed for underground conduit systems; they enable access to pipes during pulling, connecting and maintaining telecommunication cables, fiber-optic cables and tele-technical ones.

**g. Micro duct**
These are mini ducts bundled together to form one large duct which micro cables are housed in.

h. **The per link subscriber to subscriber availabilit**y: -

This is defined as the availability between any two data or equipment users between Remote Terminal Unit to reporting Control Centre and between control centers.

**i. The calculated availability**

This is defined as the theoretical availability determined by a statistical calculation based on the mean-time-between-failure (MTBF) and the mean-time-to-repair (MTTR) of the components and subsystems comprising the FOTS.

**j. User-ID**

This is the name by which a valid user is recognized by the Network equipment. This item of

information is generally not considered confidential.

k. **Backbone**- refers to the high-capacity, long-distance segment of a fiber optic network that interconnects major data centers, core routers, national and regional hubs, or cities.

l. **Last Mile**-refers to the final leg of the network that connects the backbone or distribution node to the end-user premises—such as homes, schools, hospitals, or offices.

m. **Metro**- is the intermediate layer that interconnects the backbone to various access or distribution nodes within a city, municipality, or densely populated region.

6.0 Abbreviations

| | |
|---|---|
| ADSS | All-Dielectric Self-Supporting |
| CFOT | Certified Fiber Optic Technician () |
| CFOT | Certified Fiber Optic Technician |
| EIA | Environmental impact assessment |
| ESIA | Environmental and Social Impact Assessment |
| EOL | End of life |
| EOM | End of manufacture |
| EOS | End of support |
| FOTS | Fiber-Optic Transmission System |
| GIS | Geographic Information System |
| GoK | Government of Kenya |
| GRP | Glass Reinforced Polymer |
| GSM | Global System for Mobile Communications |
| GSM | The Global System for Mobile Communications |
| HDPE | High-density polyethylene |
| ICTA | ICT Authority |
| IEC | International Electro Technical Commission |
| ISO | International Organization for Standardization |
| ITU | International telecommunications union |
| KEBS | Kenya bureau of standards |
| KeNHA | Kenya National Highways Authority |
| KeRRA | Kenya Rural Roads Authority |
| KMZ | Keyhole Markup Language |
| KPC | Kenya Pipeline Corporation |
| KPLC | Kenya Power and Lighting Company |
| KRC | Kenya Railways Corporation |
| KS | Kenya standard |
| KURA | Kenya Urban Roads Authority |
| Mbps | Megabytes per second |
| Mbps | megabits per second |
| MTBF | Mean-Time-Between-Failure |
| MTTR | Mean-Time-To-Repair |
| NE | Network element |
| NE | Network Equipment |
| NOFBI | National optic Fiber Backbone Infrastructure |
| OFC | Optical fiber cable |
| OLTE | Optical Line Termination Equipment |
| OTDR | Optical Time Domain Reflectometer |
| SLA | Service level agreement |
| SMC | Sheet Molded Compound |
| UTM | Universal Transverse Mercator |
| UTM | Universal Transverse Mercator |
| UV | Ultraviolet |
| V/UHF | Very high/Ultra High Frequency |
| OPGW | Optical Ground Wire |
| HV | High Voltage |
| LV | Low Voltage |

## 7.0 Sub- domains

The sub- domains of this standard are:

a. Ducts
b. Maintenance Chambers
c. Hand Holes
d. Way Leaves
e. Poles
f. Fiber Cables
g. Markings
h. Equipment
i. Security
j. Aerial Cable
k. Civil Works
l. Fiber Test Process

## 8.0 REQUIREMENTS

### 8.1 Ducts

#### 8.1.1 OFC Duct Physical Requirements

a) The physical requirement of the ducts shall meet the minimum specifications as defined on Annex 1.

#### 8.1.2 OFC Duct Technical Requirements

a) OFC ducts shall meet the minimum technical requirements as specified in Annex 2.

#### 8.1.3 Duct installation

8.1.3.1 Trenching of all soil types shall be done as guided by the Roads Authority and shall be as per the minimum requirements in Annex 3.

8.1.3.2 Concrete envelope shall be used in all the areas where the soil is not stable and the installation shall meet the following minimum requirements:

a. Concrete mixture used shall be Class A: 1:2:4 (Cement-Sand-Gravel) ratio by weight or volume, ratio by weight will be used: x1 50kg bag of cement that is accredited by Kenya Bureau of Standards.
b. The following minimum specifications shall be adhered to for proper concrete mixture:
    i. Cement shall be fresh (not expired) and without damage from humidity or from water splash.
    ii. The river Sand shall be clean and without foreign particles like soil, wood, plastics, etc.
    iii. The Aggregate can be collected locally or brought in from ballast stone crusher plant. However, it shall be clean and contain particles that are within 15mm to 20mm in diameter.

iv. Clean Water shall be added and mixed to a thick but fluid mix that pours freely and is easily workable. Water–cement ratios of 0.45:1 to 0.60:1 by weight are more typically used.
v. A Concrete Mixing machine shall be used to attain a clean homogenous mix.
vi. A Concrete Vibrator machine shall be used to attain a perfect concrete consolidation; free from air bubbles and homogenous across the covered area—helps to avoid cracks from weaker areas.
vii. Concrete Curing shall be undertaken for a minimum of seven (7) days. In hot areas, water is poured on the curing concrete early in the morning and late in the evening when the temperatures are low to avoid immediate evaporation. The curing concrete should be covered in guinea bags and covered with a two (2) inch layer of sand; to help retain the water longer over the curing concrete.

8.1.3.3 Gabions shall be employed mainly at river/lagga crossings, where installed optic fiber cables can be damaged by flood waters. Gabions' trenching and construction shall meet the following minimum specifications:

a. Gabion mesh-wire shall be of minimum 2.8mm galvanized wire with double twist. The Wire shall be Hot Deep Galvanized class 1 at 366g/m2 of zinc coating.
b. Gabion rocks shall be of a minimum of 100mm diameter and maximum of 150mm diameter and be of natural solid non-porous hard-rock.
c. Inside the gabion, the ducts shall be GI 50mm OD galvanized steel pipe and must protrude 1m on both ends of the gabion to interface with the regular HDPE duct.
d. The minimum trenching requirements for Gabion that is covered with a soil erosion protection treatment—soil stabilization over gabion shall be as specified in appendix 10.

8.1.3.4 Road crossing shall be done using directional drilling or thrust boring and shall meet the following minimum requirements:

a. Bores shall be at a depth of 1.8m across spur subsidiary roads and 2m across the carriageway from the tarmac level.
b. Bores shall exit at a depth of 1.8m; same level as the trench.
c. Bores shall typically span to lengths of 15m-20m but could span to a maximum of 30m if need be.
d. The equipment used shall drill bores spanning to a maximum of up to 30m long:
e. The drilling head shall accommodate rock drilling bits: for rocky ground.
f. After making a bore across the road, two (X2) 102 mm diameter galvanized pipes or two 110mm HDPE plastic pipes (one to act as spare for future use) shall be inserted through the bore.
g. Bores shall be well marked on both ends with marked reinforced concrete pillars.
h. Conduits inside a bore shall be equipped with draw-wires.
i. The operation pits shall be backfilled, unless there is need to install a Hand-hole on the pit location.

8.1.3.5 Railway crossings shall be done using directional drilling or thrust boring. Any drilling or thrust boring on railway crossings shall be done in accordance with the existing government regulations. Construction of bores for Railway crossings shall meet the following minimum requirements:

a. Bores shall be at a depth of 1.5m across spur subsidiary roads and 2m across the railway track from the ground level.
b. Bores shall exit at a depth of 1.5m; same level as the trench.
c. Bores shall typically span to lengths of 20m.
d. The equipment used shall be able to drill bores spanning to a maximum of up to 30m long.
e. The drilling head shall be able to accommodate rock drilling bits: for rocky ground.
f. After making a bore across the road, two (X2) 102 mm diameter galvanized pipes or two 110mm HDPE plastic pipes (one to act as spare for future use) shall be inserted through the bore.

g. Bores shall be well marked on both ends with marked reinforced concrete pillars.
h. Conduits inside a bore shall be equipped with draw-wires.
i. The operation pits shall be backfilled, unless there is need to install a Hand-hole on the pit location.

8.1.3.6 River/swamp/laggas crossing shall be done using directional drilling or thrust boring, trenching, bridge attachment. Any drilling or thrust boring on river crossings shall be done in accordance with the existing government regulations. Construction of bores for river crossings shall meet the following minimum requirements:

a. Depth shall be at a depth of 1.8m from river bed across and across the whole river.
b. Drilling bore shall start and exit at riparian land.
c. Gabions Stone pitching shall be used at the river slopes.
d. A concrete envelope of C15 shall be installed.
e. Drill bores should span to a maximum of up to 30m long.
f. The drilling head shall be able to accommodate rock drilling bits: for rocky ground.

g. After making a bore across the road, two (X2) 102 mm diameter galvanized pipes or two 110mm HDPE plastic pipes (one to act as spare for future use) shall be inserted through the bore.
h. Bores shall be well marked on both ends with marked reinforced concrete pillars.
i. Conduits inside a bore shall be equipped with draw-wires.
j. The operation pits shall be backfilled, unless there is need to install a Hand-hole on the pit location.

**8.2 Maintenance Chambers**

8.2.1 The maintenance chambers shall meet the following minimum requirements.

a. Size of the chambers shall be: 1600mm [L]*1300mm [W]*1600mm [D].
b. The cover shall be mechanically lockable with special key and fully water and weather proof and shall have digital locking solution.
c. Upon leasing of the infrastructure, access to the manhole shall be the responsibility of the infrastructure owner and authorized agents.
d. Chamber materials shall be of high strength with reinforced concrete or polymer composite.
e. Cover materials shall be of high strength; made of a Glass Reinforced Polymer (GRP) such as Sheet Molded Compound (SMC).
f. The chamber cover shall have a load rating of at least 135KN.
g. The manhole shall have a slack management bracket inside the chamber, position to secure the splicing boxes and at least 8 x 50mm split cable entry holes.
h. The chamber shall be equipped with a knock out drain at the bottom.
i. Maintenance chambers (with polymer hardened cover) shall be used (With owner Logo) 100mm below the top.
j. The maintenance chamber shall have a digital locking solution that can be monitored in the NOC.

8.2.2 The maintenance chamber installation shall meet the following minimum requirements:

a. Maintenance chamber pit shall be dug to fit the maintenance chamber installation with minim 1600mm [L]*1300mm [W]*1600mm [D].
b. Labeling shall be done using Stencil on both cover, body and inner side of the wall after installation, the serial number shall follow approved design.
c. After the installation of the maintenance hole the soil shall be backfilled and compacted
d. Concrete grade shall meet a minimum ofC25.
e. The maintenance hole shall have all its accessories including brackets etc.
f. The maintenance hole shall have provision of a drain hole at the bottom of every chamber to drain water.

g. Maintenance holes shall be located in interceptions, road crossings, Building /Home entrances and intervals of 1000m along main roads.
h. There shall be provision of slack brackets to manage the cables and closures in the manhole.

**8.3 Hand Holes**

8.3.1 The hand hole chambers shall meet the following minimum requirements.

a. Chamber and cover materials shall be of high strength; made of a Glass Reinforced Polymer (GRP) such as Sheet Molded Compound (SMC).
b. Chambers shall be cylindrical in shape.
c. Sizes of the two chambers shall be: - 1000mm deep and 900mm
d. The cover shall be mechanically lockable with a special key and fully water and weatherproof.
e. The chamber cover shall have a load rating of at least 40KN.
f. Slack management brackets shall be placed inside the chamber, position to secure the splicing boxes and at least 8 x 50mm split cable entry holes.
g. The chamber shall be equipped with a knock out drain at the bottom.
h. The chamber shall have a digital locking system that will be monitored at the NOC.

8.3.2 Installation of the hand hole shall meet the following minimum requirements:

a. Hand-holes shall be covered by a flat watertight lid.
b. Hand-hole lids shall be labeled with the provisioning owner's name.
c. Hand-holes shall be located outside of sidewalks and side [1] roadways.
d. Hand-holes shall be located a minimum of 2 meters off the edge of pedestrian way, and 3m from the off of the side-roadways.
e. Hand-holes shall not be located in the ditch line or in an erosion [1] prone location.
f. All Underground OFC Joint splicing shall be housed inside the 900/1000mm Hand-hole.
g. All Access Point splicing shall be housed in the 600/600mm Hand [1] holes.
h. The pulling of the cable shall be hand assisted at each Manhole or Hand hole. Sufficient slack shall be left at each end of the cable to allow proper cable termination and enough spare cable (50 meters at the Joint Hand-hole and 50 meters at the Access Hand-hole) to facilitate repair of damaged OFC sections.
i. Slack coils shall be stored without violating the minimum recommended slack coil diameter; as specified in the cable specs depending on the size. Typically, D>=20x Cable OD 326. The cable shall be marked and labeled at each Manhole and Hand-hole and at all entry and termination points of the fiber optic cables.
j. The soil around the Hand-hole shall be compacted and stabilized and in line with the provided drawings on the Hand-hole chamber installation.
k. Upon final acceptance of the conduit system, all Hand-holes shall be free of debris.

**8.4 Way leaves**

8.4.1 All fiber ducts shall run along and across the Road, Railway and pipeline corridors respectively where the corridors width allows.

8.4.2 Way leaves shall be categorized under the respective jurisdictions as described below:

a. KeNHA – These are way leaves that are along the trunk roads
b. KURA – These are way leaves along KURA Road reserves.
c. KeRRA – These are way leaves along KeRRA Road Reserves.
d. County way leave – These are way leaves along County Road Reserves.
e. KRC- These are way leaves that are along and across railways.

f. KPC- These are way leaves that are along the pipeline.
g. Way leaves along Private properties.

8.4.3 All roads' designs shall incorporate provision for optic fiber infrastructure as per the standards defined herein.
8.4.4 Way leaves unit of measure shall be expressed in Meters.
8.4.5 Where the road corridor permits, way leave shall be located on the right side of the road - considering the west most point on a road to be the start point and, 0.5 to 1 meter from the extreme end of the corridor.
8.4.6 Installed fiber way leave shall be geo-mapped as well as marked with visible marker post
8.4.7 The fees and charges for way-leaving permits shall be standardized across jurisdiction. The fees and charges shall encompass the cost of processing applications and inspection of the installed fiber ducts.

## 8.5 Poles

### 8.5.1 Transportation of poles

8.5.1.1 Poles shall not exceed the 0.5m vehicle overhang and shall have a red flag secured on the overhang.

8.5.1.2 Poles that are loaded onto a pole carrier shall be secured to ensure that the cargo does not move while on transit.

### 8.5.2 Wooden Poles

8.5.2.1 A wooden pole shall not be less than 20 ft tall

8.5.2.2 It shall be of a minimum circumference of 34.6 at the bottom and 21.6 at the top.

8.5.2.3 Entities shall ensure the pole is fitted with end plates and strapping at both ends.

### 8.5.3 Concrete poles

8.5.3.1 The concrete poles shall be used to support the Aerial Optic Fiber cable in areas where the use of Underground OFC cable is not feasible due to the difficulty of the terrain in question or due to lack of space to trench for the Underground cable.
8.5.3.2 The manufacture of concrete poles shall conform to KS 1933:2018.

### 8.5.4 Pole Holes

8.5.4.1 All excavations for pole holes shall be such that the survey peg indicates the center line.

8.5.4.2 Holes for the poles shall be 1200mm deep and 200mm wider for 8m pole and 1800mm for 12m pole.

8.5.4.3 Where a hole is dug on the sloping ground, the depth of the hole shall be measured from the lowest point on the ground surface.

8.5.4.4 In extreme rocky conditions where holes cannot be excavated to the specified depth, an arrangement between contractor and client can be reached for poles to be set in concrete.

**8.5.5 Pole Set in Concrete**

8.5.5.1 Where poles are planted in soil that is difficult to compact, such as sand and swampy areas and in extreme rocky conditions, the poles shall be cast in concrete.

a. Only new wooden poles shall be set in concrete.
b. The hole shall be circular in shape. The hole diameter shall be kept.

**8.5.6 Pole Spacing**

8.5.6.1 A uniform span length shall be maintained and only depart from this when it is rendered necessary by conditions such as;
a. Uneven ground
b. Sharp bends

This may necessitate the planting of additional poles or omitting poles.

**8.5.6.2** ADSS span lengths based on fiber cable route type shall be considered.The distance between poles shall be 50m as per IEEE Std 1222-2011 standard for ADSS installation guidelines. For distances more than 50 m, ICTA shall provide approvals on need basis as required.

| **Type of the route** | **(m)** |
|---|---|
| Short span | 50 |
| Medium span | 80 |
| Long span | 120 |

**8.5.7 Pole Planting Process**

8.5.7.1 All holes necessary for pole dressing shall be drilled before the pole erection.

8.5.7.2 A pole should be erected by laying it on the ground in such a position that by raising the top section the base should slide into the hole.

8.5.7.3 Poles shall be erected vertically and in straight lines, one to the other, as much as possible, except where the road curves.

8.5.7.4 Backfilling and ramming shall take place in 300mm intervals.

8.5. 7.5 Where stones are available they should be used to stiffen the holding.

8.5.7.6 Pole Plumpness shall be maintained during the backfill and ramming process.

8.5.7.7 Poles shall be erected vertically and in straight lines, one to the other, as much as possible, except where the road curves.

8.5.7.8 For structural stability and safety, the standard depth of the hole shall be 1.2 meters for 8-meter poles and 1.8 meters for 12-meter poles depending on soil conditions and loading requirements

8.5.7.9 12-meter poles shall be used at road crossings, river crossings, and other high-clearance areas to ensure compliance with safety and utility clearance requirements.

8.5.7.10 8-meter poles shall be used for standard aerial deployments along regular routes such as road reserves, rural paths, and peri-urban corridors where clearance requirements are moderate and line-of-sight can be maintained within the 50-meter span standard

8.6 **Fiber cables**

**8.6.1 Color and labeling of the cable**

8.6.1.1 Color coding shall be determined by the organization

8.6.1.2 Aqua blue with red stripe shall be the standard color for the backbone, metro, and last mile fiber optic cables for both overhead and underground installation, in accordance with the **TIA/EIA-598-C** color coding standard.

8.6.1.3 The cable shall be labeled with the following characteristic

a. Organization logo or organization initials or abbreviations
b. Year of manufacture
c. owner of the cable
d. Number of cores
e. Meter marking

In addition to external sheath markings, each tube within the cable shall be color-coded according to TIA/EIA-598-C standards to facilitate fiber identification and splicing operations.

8.6.1.4 The labeling shall be done at every 1-meter interval

**8.6.2 Design considerations**

8.6.2.1 The design of any cable infrastructure should be alive to the service intended to be offered.

8.6.2.2 The fibers shall be compliant with ITU-T for wideband operation over the 1310 nm and 1550 nm windows.

8.6.2.3 The fiber shall have loose tube with water-blocking gel and yarn to prevent moisture ingress.

8.6.2.4 The fiber should be armored (corrugated steel tape or dielectric armor) for protection in rugged or rodent-prone areas for applications that require high cable protection

8.6.2.5 The fiber outer sheath shall be UV-resistant

8.6.2.6 The cable chosen shall conform to the ITU -T specifications for the required service as detailed on Annex 4.

**8.6.3 Optical and Mechanical Performance**

8.6.3.1 The fiber shall have a maximum Attenuation of ≤ 0.36 dB/km for 1310 nm frequency and ≤ 0.23 dB/km for 1550 nm frequency

8.6.3.2 The fiber shall have Tensile Strength of ≥ 1,500 N short-term and ≥ 600 N long-term

8.6.3.3 The fiber shall have a Crush Resistance of 2,000 N/10 cm

8.6.3.4 The fiber shall have Impact Resistance of ≥ 10 impacts at 1 Joule

8.6.3.5 The fiber shall have bent radius of Minimum 10x the cable diameter during operation, 20x during installation

### 8.6.4 Pre-Installation Cable Drum Inspection

8.6.3.1 The client shall conduct an onsite pre-installation inspection of the cable drum. See Annex 5 for the checklist

### 8.6.5 Placement conditions for underground cables as per the duct depth

8.6.5.4 The highest point of optic fiber cable duct shall be: -

**Backbone**

a. Not less than 1.5m below the current centerline level of the carriageway
b. Not less than 1.5m below the surface of the road reserve or side drain or verge at any point along the cable alignment.

**Spur connectivity**

a. Not less than 1.5m below the current centerline level of the carriageway
b. Not less than 1.5m below the surface of the road reserve or side drain or verge at any point along the cable alignment.

**Metro**

a. Not less than 1.5m below the current centerline level of the carriageway
b. Not less than 1.5m below the surface of the road reserve or side drain or verge at any point along the cable alignment.

**Last Mile**

a. Not less than 1.5 m below the current centerline level of the carriageway
b. Not less than 1m below the surface of the road reserve or side drain or verge at any point along the cable alignment.

### 8.6.6 Fiber Cables categorization.

8.6.6.1 The fibers shall be categorized as follows: -

a. Backbone management – minimum of 96 core – should have 2 (96 cores) running parallel
    i. Cable 1 is actual backbone (Express)
    ii. Cable 2 is the access cable
    iii. Recommended cable specification compliant with ITU-T G654.E
b. Spur Cable Installation
    i. Minimum of Metro 48 core
    ii. Minimum of Access 48 core
    iii. Recommended cable specification compliant with ITU-T G652
c. Metro Cable Installation
    i. Minimum of Metro 144 core
    ii. Minimum of Access 48 core
    iii. Recommended cable specification compliant with ITU-T G652
d. Last mile
    i. Minimum of 2 – 24 core
    ii. Recommended cable specification compliant with ITU-T G652

8.6.6.1 Cables running parallel to the road reserve shall be placed not more than two (2) meters from the edge of the road reserve as provided.

8.6.6.2 The method for placing cables across the carriageway shall be strictly through micro tunneling.

8.6.6.3 Where ducts and sleeves have been provided by the Authority, they shall be used for crossing the carriageway.

8.6.6.4 The level of workmanship shall be to the highest standards. Supervision shall be provided by an Engineer.

**8.6.7 OTDR Pre-Test**

8.5.7.1 The client shall conduct a minimum OTDR Pre-Test. See Annex 6 for the checklist

8.6.8 **Cable Installation along Roadways**

8.6.8.1 Cable installation along Roadways shall strictly observe the following requirements:

8.6.8.2 The cables shall be laid in ducts buried to depths of not less than 1500mm.

8.6.8.3 The cables shall be laid 1.5m to 2m from the edge of the Road Right of Way on Class A roads and 0.5m to 1.0m on Class B roads and other roads. Any deviation to this rule, due to technical or practical reasons will be documented and authority to do so given by the road Authority. All designs will be signed by the road authority before implementation.

8.6.8.4 Horizontal distance of 1 meter between the existing underground utilities will be reserved and the new OFC cable, and if not possible, an appropriate duct protection and document and affected local authorities informed and network providers of the change possibly five days before the intended excavation.

8.6.8.5 Barriers will be placed and road signs required by current laws during excavation works.

8.6.9 **Cable Installation**

8.6.9.1 When pulling optical cables into conduits, cable trays, or raceways, the strength member(s) of the cable shall bear all or nearly all of the pulling force.

8.6.9.2 Cable jackets shall not be directly pulled unless designed for the purpose or unless the run is very short and requires a minimal pulling force. Pulling of cables will only be allowed where blowing is not possible.

8.6.9.3 Optical cables shall not be pulled into place by applying tension directly to the fibers (pulling the fibers).

8.6.9.4 Install junction boxes between the full length of an optic fiber cable (in the middle of the span) to allow pulling the cable into two equal opposite directions.

8.6.9.5 Optical cables shall be attached to a pulling line only by methods recommended by the manufacturer of the cable.

8.6.9.6 Unless stated otherwise by the cable manufacturer, the maximum pulling tensions used for optical cables shall be 273 kg for outdoor cable. The pulling force shall be uniform and consistent; cables shall not be jerked.

8.6.9.7 Cable pulling shall be done by hand, except when tension meters, tension-controlled, or breakaway swivels are employed.

8.6.9.8 When powered pulling equipment is used to install optical cable, tension monitoring equipment or breakaway swivels shall be used. Swivels shall be used when pulling optical cables into conduits. Exceptions shall be made to this requirement only for very short runs, which require a minimum pulling force.

8.6.9.9 If Pull Boxes are to be used with optical cables, they shall be designed for the purpose, and shall be equipped with cable supports and shall be sized so that no cables in the box shall be tightly bent.

8.6.9.10 A length of free cable shall be provided at each end of a cable pull. Loops of cable (commonly called service loops) shall be provided at all intermediate pulling points or at Pull Boxes. The cables' minimum bending radii shall not be violated.

8.6.9.11 When pulls are accomplished in two or more stages, and spare unreeled, it shall be configured in large figure-eight on a safe, flat surface, such as the ground or a clean floor.

8.6.9.12 The entry of outside plant cables into a structure may require special fire safety considerations.

8.6.10 **Splicing and Termination**

8.6.10.1 All fiber terminations and jointing shall be done by fusion splicing methods such that the signal attenuation at each connector and joint is less than 0.06 dB and 0.03 dB, respectively, at 1310 nm and less than 0.07dB and 0.04 dB at 1550 nm.

8.6.10.2 The average loss for all joints in any one fiber link (from one Core substation to another Core substation or one OFC repeater to another) shall not exceed 0.12 dB.

8.6.10.3 OFC fibers shall be arranged in the termination and splicing boxes with loops contained within trays in an orderly and consistent identifiable pattern with sufficient slack to allow re-jointing without resorting to extra optical fiber cable.

8.6.10.4 All splicing boxes shall be sealed to ensure full watertight integrity preventing ingress of moisture and dust. Materials used for securing the fiber cable and the splicing boxes shall be UV-resistant, corrosion-proof, and rated for a maintenance-free service life of at least 50 years.

8.6.11 **Post installation Testing:**

8.5.11.1 The attenuation of all fibers shall be checked with an OTDR after installation and splicing of all the fibers.

**8.6.12 Slack Installation**

8.5.12.1 The slack recommended is 4% of the backbone and 6% of the Metro & Last fiber of the distance between the two neighboring manholes.

8.5.12.2 The maximum slack in the manholes shall not exceed 30% of the manhole size.

**8.6.13 Earthling, Bonding and Surge protection**

8.5.13.1 The armoring of optical fiber cables shall be lugged and bonded to an earth bar using soft multi-stranded 6mm$^2$ green/yellow insulated bonding cables.

8.5.13.2 Bonding cables shall be kept as short as practically possible and shall contain no sharp bends.

**8.6.14 Work safety**

8.6.14.1 Optic Fiber Cable workers along the roadway shall strictly observe the following requirements:

8.6.14.2 Workers shall wear gloves, hard-hats, steel-toe work boots and brightly colored reflective worker’s garments (Clearly marked with a label of implementing authority).

8.6.14.2 Aerial cable installers shall use body harnesses or appropriate rigging gear at all times; when climbing and while aloft. Any operation at height will be carried out by technicians certified to work at heights.

8.6.14.3 A ladder shall be secured at the base by one person during climb and by a safety rope before work on the pole commences.

8.6.14.4 During optic fiber splicing, workers shall wear protective goggles (safety glasses) to protect them from fiber splinters.

8.6.14.5 All cut fiber pieces shall be put in a safe place and away from ingestion and from the public, especially the local community.

8.6.14.6 A vehicle will be available within a short distance/time (20Km or 20 minutes away, whichever is less) from the workers in case of an emergency.

8.6.14.7 Where there is no GSM coverage, team leaders shall have V/UHF radio communication with the nearest vehicle

8.6.14.8 Each working team shall be equipped with a complete First Aid kit and shall have at least one member who is First Aid certified.

8.6.14.9 Where personal security is at risk due to banditry, local Administration Police Reservist (APR) personnel shall be engaged to secure the workers.

8.6.14.10 Unskilled labor should as much as possible be sought from local residents. This will enhance security for the whole team and avert confrontation between foreign workers and local job seekers.

8.6.14.11 The work team shall place barriers along the trench area, to warn people of “Dangerous Trench” as required by current laws, during excavation works.

8.6.14.12 The work team shall place large and visible WARNING signs to warn road users and pedestrians of “Excavation Works” along the cable route.

8.6.14.13 All open concrete pole holes will be guarded with red/white barrier tape to warn the local community of possible hazards.

8.6.14.14 Trenches shall be backfilled as soon as possible and to the original state.

8.6.14.15 No environmental pollution or degradation shall be allowed as a result of OFC cable works in any area.

8.6.14.16 If the excavation shall 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.

8.6.14.17 The OFC cables shall be laid as stipulated in the plan but any deviation to this rule, due to technical or practical reasons, shall be documented and authority to do so given by Implementing Authority. This is to avoid disputes or fights with the local community—to avoid injury or damage to the cables and equipment.

8.6.14.18 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.

8.6.14.19 All reasonable steps necessary shall be taken and special consideration given to water, electricity and sewer systems within the area that cannot be located accurately

**8.6.15 Sharing**

8.6.15.1 To limit duplication, gear investments towards underserved areas, encourage product innovation, improve customer service experience, reduce entrance and development costs, facilitate the use of existing infrastructure and minimize the need for frequent excavations and environmental impacts that go with this, utility providers should share infrastructure as much as possible. In this regard telecommunication cables can be installed in sewer ducts as per ITU-T Recommendation L.77 while joint use of tunnels by

pipeline and telecommunication cables shall be as provided by ITU-T Recommendation L.11.

8.6.15.2 The backbone fiber and Metro fiber should be shared by all Telcos.
8.6.15.3 All Cross connect and landing stations should be shared by all the Telcos.
8.6.15.4 Peering and meet me points should be shared by all the Telcos.
8.6.15.5 The planner of the network shall consider the future expansion as they carry out the fiber expansion program.
8.6.15.6 The telco should be encouraged to open data sharing.

**8.6.16 Environmental Management**

8.6.16.1 The project owner shall conduct or contract for an initial Environmental and Social Impact Assessment (ESIA) screening and prepare a report which should include a mitigation plan.
8.6.16.2 The contractor or subcontractor shall adhere to the mitigation plan and submit a report regularly.
8.6.16.3 The project owner shall conduct periodic reviews to establish effectiveness of the mitigation plan.
8.6.16.4 The project owner/ contractor shall develop procedures and operational controls of onsite storage of project materials.
8.6.16.5 E-waste resulting from ICT infrastructure deployment, maintenance or upgrade shall be disposed of in accordance with National Environment Management Authority (NEMA) guidelines on e-waste management.

8.6.16.6 Reinstatement of the Environment After Backbone, Metro, and Last-Mile Deployment

Upon completion of backbone fiber optic civil works, contractors shall ensure full reinstatement of the affected environment to its original or better condition. This requirement applies to all locations where trenching, duct laying, pole erection, or manhole installation has occurred, including but not limited to road reserves, sidewalks, footpaths, medians, landscaped areas, and natural terrain.

Reinstatement activities shall include the following:

a) **Surface Restoration**: All disturbed surfaces (cabro paving blocks, tarmac, gravel, grass verges, etc.) shall be restored to match adjacent sections in quality, level, and finish. Cabros must be reinstalled to original alignment and securely compacted within **7-10 working days** of duct or cable installation.

b) **Waste Management**: All excavated material not suitable for reuse shall be safely disposed of in designated sites approved by the local authority. No debris or surplus material shall be left at the site.

c) **Vegetation Restoration**: Where trenching crosses green spaces or landscaped zones, topsoil shall be replaced, and vegetation replanted within **10 working days**, in consultation with relevant county authorities or property owners.

d) **Drainage and Safety**: Any disruption to natural or artificial drainage systems shall be rectified. Trenches must not create water retention areas or pose a safety risk to the public.

e) **Signage and Markers**: Permanent polymer route markers must remain visible after reinstatement. All site reinstatement shall ensure markers are not obstructed or removed.

The supervising engineer from ICT Authority or its designated representative shall inspect and approve all reinstatement works prior to project closure. Failure to comply with environmental reinstatement requirements shall attract contractual penalties and may result in revocation of project certification

**8.6.17 Fiber Optic Cable Maintenance**

8.6.17.1 The responsibility for maintenance shall be borne by cable owners and shall adhere to the below guidelines.

a. **Maintenance procedure: -** A maintenance procedure shall guide all aspects of maintenance work and shall include authorization for the works, documentation and signoffs by technician/Engineer carrying out the works.

b. **Network Operations Centre: -**Cable owners/operators shall establish and operate a Network Operations Center.

c. **Incident /Fault reporting: -** All incidents shall be reported, categorized and recorded. At a minimum, the fault report shall include description of incident, contact details of reporting entity, location of the incident, time of occurrence, a fault ticket and the responsible entity for the resolution.

d. **Fault Categorization: -** Each incident shall be categorized as either a Critical Fault when total loss of service is experienced, Severe if significant degradation of services occurs or a Minor Fault if only minor service degradation occurs.

e. **As built diagram: -** Updating of the as built diagram whenever there is a change.

f. **Preventive Maintenance: -** Quarterly testing shall be done for all fiber installations to detect performance deterioration and apply corrective measures to within agreeable parameters (Annex 7).

g. **Unscheduled Maintenance**: - Unscheduled or emergency maintenance activities shall require issuance of a notice to service subscribers within the hour of the emergency occurrence.

h. **Planned Maintenance: -** Where the Owner requires conducting a planned maintenance activity the Owner shall issue a Change Request Notice to subscribers ten (10) days in advance.

i. **Personnel**

i. Installation & Maintenance personnel shall have certification issued by the relevant body.
ii. Installation & Maintenance shall have a valid Certified Fiber Optic Technician (CFOT) certificate or its equivalent.

**8.6.18 Documentation**

8.6.18.1 Upon completion of the construction, the "as-built" drawings of the cable and all other facilities, shall be prepared and submitted to the Authority. The drawings will consist of a properly geo-referenced location map and longitudinal profile of the power line (UTM Map projection on Arc 1960 datum), on A3 Size paper, indicating the exact locations of all installed underground fiber cable line placements along or across the roads. A copy of the map should also be forwarded in digital (AUTOCAD) format. The map should be clearly labelled and should also show the plots abutting the road. Coordinates (X, Y) list for all the utility line bends and road crossings should also be included in the map.

8.6.18.2 As built, at minimum shall be provided in standard formats:

i. Auto- Cad drawings (In soft copy).
ii. KMZ files.
iii. Hard copy drawings (At least 2 copies).

8.6.18.3 Such documentation shall contain the following information:

i. Photos taken of every procedure as proof of existence.
ii. Position of the completed trenches.
iii. Position and location of installed Gabions and Bores and their lengths.
iv. Position of the installed conduits and cables.
v. Position and location of installed Hand-holes.
vi. Position and location and span length of installed poles.
vii. Soil Stabilization accomplished; position and length of stabilized area.
viii. Network loss link budget.
ix. Equipment Shelter and Power Connectivity.

**8.6.19 Quality assurance**

8.6.19.1 Inspections shall be conducted for installation in progress. It is the responsibility of the Contractor to schedule regular and milestone inspection times. It is incumbent upon the Contractor to verify that the installation and material used has been inspected before it is enclosed within building features, buried, or otherwise hidden from view.

8.6.19.2 The Contractor shall provide electronic test results and a 20-year manufacturer's warranty with a copy of the warranty to be submitted to the owner at the completion of work.

8.6.19.3 All cables and termination hardware shall be 100% tested for defects in installation and to verify cable performance under installed conditions. All conductors and fibers

of each installed cable shall be verified usable prior to system acceptance. Any defect in the cabling system installation including but not limited to cable, connectors, feed-through couplers, patch panels, and connector blocks shall be repaired or replaced at the provider's expense in order to ensure 100% usable conductors in all installed cables.

8.6.19.4 Manufacturers and suppliers shall provide factory test reports, compliance certificates, and OTDR traces for each reel of cable supplied. These documents must be verified by the ICT Authority or its appointed inspectors before deployment. Only cables from prequalified vendors with proven compliance histories shall be accepted for national infrastructure use

**8.7 Markings**

For every fiber optic cable route implemented under the National Optic Fibre Backbone Infrastructure (NOFBI) or any other ICT Authority-managed deployment, standardized and permanent polymer route markers shall be installed to enable physical identification of the fiber path for operational, maintenance, and safety purposes

8.7.1 Marker Material and Durability- All route markers shall be constructed from high-density, UV-resistant polymer material capable of withstanding prolonged exposure to sunlight, rain, wind, and soil acidity. The polymer markers must be corrosion-resistant and mechanically robust to endure accidental impact, thermal expansion, and general wear over time.

8.7.2 These markers shall have a length of not less than 1.8M and a diameter of not less than 100mm.

8.7.2 Markers shall be planted 600mm deep and well compacted.

8.7.3 Installation Guidelines- Polymer markers shall be installed along the entire fiber route as follows;

a. Markers shall be installed at an interval not exceeding every 500 meters in rural or open terrain,
b. Markers shall be installed at every joint chamber handhole, manhole, or cable entry/exit point,
c. Markers shall be installed at critical crossing points, such as roads, bridges, culverts, and railway lines and
d. Markers shall be installed at all customer premises where last-mile connectivity is terminated.

8.7.4 A standard equipment shall be used for GIS coordinates.

8.7.5 Text should be black – manhole number, Handhold Number, Joint and Joint Number, whether is Backbone or access, Operator/Owner.

8.7.6 Electromagnetic markers shall be built in a hand hole and also be placed at the undercover of the manholes and handholes.

8.7.7 Color and Visibility- The standard color for the polymer markers shall be white with black writings to improve visibility and maintain consistency across all ICTA infrastructure projects. The coloring must be resistant to fading and discoloration over time.

8.7.8 Marking Content-Each marker shall be engraved or embossed with the following minimum information:

a. The marker shall have ICTA (ICT Authority)
b. The marker shall have Directional arrow **(>)** or (<) for directional marker
c. The marker shall have Joint sign (J) for joint marker
d. Text should be black – manhole number, Handhold Number, Joint and Joint Number, whether is Backbone or access, Operator/Owner.

8.7.9 Mounting and Stability- Markers shall be securely embedded in concrete or installed with precast bases to prevent dislodgement, vandalism, or tampering.

8.7.10 Installation must ensure that markers are upright, visible, and not obstructed by vegetation or surrounding infrastructure.

8.7.11 Quality Assurance and Compliance- All installed markers shall be subject to inspection and certification as part of the project handover process. Non-conforming markers—such as those with illegible text, unstable foundations, or wrong color—shall be replaced at the contractor's expense. ICT Authority reserves the right to revise marker specifications based on terrain, visibility requirements, or safety considerations.

**8.8 Equipment**

**8.8.1 Availability**

**8.8.1.1** The availability of fiber optic link and equipment (E2 to E2) shall be at least 99.95% over any 12-month period. This accounts for the total operational uptime of both the optical fiber and the active equipment involved in the transmission path.

**8.8.1.2** The average per link subscriber to subscriber availability shall be at least 99.97%. The down time of available standard fiber optic cable shall also be considered in the aforesaid availability calculations.

**8.8.1.3** The calculated failure rates of the units and the calculated availability of the equipment being offered shall be provided. The analysis shall be based on an availability block diagram and shall include:

a. The mean-time-between-failure (MTBF) for each equipment component
b. The mean-time-to-repair (MTTR) values, based on field data or manufacturer benchmarks
c. Failure rates (λ) for individual modules or subsystems
d. Cumulative availability percentages derived from system reliability modeling

**8.8.1.4** An MTTR of at least 4 hours shall be provided.

**8.8.2 Built in Testing**

All active equipment shall provide a built-in mechanism for testing installed modules and its subsystem components. Equipment specifications as per accompanying data sheets and white papers shall conform as specified and testable. The datasheet and all testing criteria shall be available for audit.

**8.8.3 Equipment life time**

**8.8.3.1 End of Manufacture** - The Supplied Fiber transmission equipment end of manufacture date shall be no more than three (3) years from the manufacture start date

**8.8.3.2 End of Life** - The supplied optical transmission equipment shall provide guaranteed eight (8) years equipment support.

**8.8.3.3 End of Support** - The supplied optical transmission equipment shall provide guaranteed twelve (10) years End of life Specification.

**8.8.4 Interoperability considerations**
A multi manufacturer environment shall be SUPPORTED.

**8.8.5 Optical Equipment Compliance and Certification**

**8.8.5.1 Hazardous Substances** - The product should conform to standards for restricted hazardous substances to human health and environment

**8.8.5.2 Emissions** - Optical transceivers and networking equipment should not emit radiofrequency (RF) energy (intentionally or unintentionally) that cause harmful interference, exceed limits for RF emissions and pose risk to health and safety.

**8.8.5.3 Documentation** - Provide documentation and certification from Global regulatory bodies.

**8.8.6 Optical Equipment Management and Monitoring**

**8.8.6.1 Management Interfaces** - Support global industry management interfaces such as CLI, Web GUI, SNMPv2/v3, NETCONF, RESTCONF, etc

**8.8.6.2 Telemetry and real-time monitoring** - Support performance monitoring such as Optical performance, OTDR, etc

**8.8.6.3 Open APIs** - Support integration with NMS/OSS platforms

**8.8.6.4 OTN Management** - Support end-to-end OTN Management

**8.8.7 Optical Equipment General Requirements**

**8.8.7.1 Networks Capability** - Equipment must be carrier-grade and support long-haul, metro and regional networks

**8.8.7.2 Compliance** - Equipment must be compliant to relevant industry standards and certifications

**8.8.7.3 Automation** - Equipment must support software-defined networking (SDN) for automation and programmability

**8.8.7.4 Protection** - Equipment must support both inline and client-side protections and where applicable 1+1 protection switching, multiplex section, optical path protection and support mesh and ring architectures

**8.8.7.5 Resilience** - Equipment must support optical restoration, automated optical protection switching (AOPS), GMPLS and wavelength path computation for dynamic restoration.

**8.8.7.6 Reconfigurable multiplexers** - Must be colorless, directionless, contentionless, gridless, multi-degree level, wavelength switching, dynamic provisioning and integrated optical power monitoring

**8.8.7.7 Optical Amplification and dispersion management** - Equipment amplifiers (pre-amplifiers, booster and inline) must support long-haul,automatic gain control (AGC), automatic power control (APC) and chromatic dispersion compensation (CDC)

**8.8.7.8 Transponders and Muxponders** - Must support, on the client interfaces, multiplexing to lower-rate signals, pluggable optics and coherent optics

**8.8.8 Routers (Core and Aggregation)**

**8.8.8.1 General requirements** - Equipment must be carrier-grade suitable for core or aggregation network, support scalable port options, designed for high availability, redundancy and modular scalability, compliance with industry standards, capable of IPv4/IPv6 dual stack, support SDN (Software Defined Networks) and programmable interfaces. In addition, the equipment must support forward and backward compatibility and is able to integrate with existing networks.

**8.8.8.2 Hardware requirements** - Equipment must have a modular chassis-based system with hot-swappable components, redundant supplies and fans, front-to-back/side-to-side airflow options, support non-blocking architecture and high-speed backplane.
The interfaces and inline cards should support multiple interfaces types, auto-negotiation and port bonding (LCSP) and Zero-touch provisioning (ZTP)

**8.8.8.3 Routing and Protocols** - Equipment must support layer 2 features such as VLAN, Link aggregation, Ethernet OAM and MPLS for VPNs and traffic engineering; layer 3 features

such as static routing, OSPF, IS-IS, BGP-4, IPv4 and IPv6 full internet table, virtual routing and forwarding (VRF) and segment routing (SR-MPLS, SRv6) capability and support high availability and redundancy via Non-Stop Forwarding (NSF), Graceful Restart (GR), Bidirectional Forward Detection (BFD) and multi-chasis clustering or virtualization.

**8.8.8.4 Traffic Management and Security** - Equipment must support QoS (Classification, policing, shaping, scheduling), Access Control Lists (ACL)for security and traffic filtering and DDoS protection and Control Plane Policing, MACsec/IPsec support for encryption

**8.8.8.5 Management and Monitoring** - Equipment must support global industry management interfaces such as CLI, Web GUI, and API (NETCONF, RESTCONF, gNMI), SNMPv2/v3, Syslog, Telemetry, sFlow, NetFlow/IPFIX; integration with NMS/OSS platforms and redundant management interface (Ethernet/Console/USB)

**8.8.8.6 Compliance and Certifications** - Equipment must be compliant to relevant industry standards and certifications

**8.8.9 Switches**

**8.8.9.1 General requirements** - Equipment must be enterprise-grade, carrier-class or datacenter switch depending on use case , fixed or modular chassis design support for scalability and redundancy compliance with industry standards and support SDN (Software Defined Networks)with APIs such as openFlow, NTECONF, RESTCONF,gNMI APIs, . In addition, the equipment must support forward and backward compatibility and is able to integrate with existing networks.

**8.8.9.2 Hardware Specifications** - Equipment shall be rack mountable or stackable and support front-to-back or side-to-side airflow options.

**Access Switch**: Support 24 or 48 ports of of of 1G/2.5G/5G/10G Base-T (RJ-45) or SFP/SFP+ fiber ports and at least 2x10G/25G uplink ports

**Aggregation Switch**: Support 24 or 48 ports of 10G SFP+ fiber ports and 2 to 4 ports of 40/100G uplinks and support multi-gigabit Ethernet auto-negotiation.

**Core Switch**: Support 32 or 64 ports of 10G/25G/40G/100G/400G, modular chassis, support multi-chassis or VSS (Virtual Switching System) and up to 8 switches in a stack with more than 480 Gbps backplane bandwidth

**8.8.9.3 Switching and Routing Capabilities:**

**Layer 2 and Layer 3 Support:** Support industry features for Layer 2 and layer 3 such as VLANs, Link aggregation, STP Support, Ethernet OAM, carrier-grade deployment, PIv4/IPv6 routing, network segmentation, policy-based routing, fast failure recovery and load balancing

**8.8.9.4 Security and Traffic Management:**

Support industry features such as routing and integration, data encryption, filtering and traffic security, DHCP Snooping, ARP inspection, IP Source Guard, Storm control, broadcast/multicast suppression and QoS.

8.**8.9.5 Network and Management Features:**

Support industry features such as consoles, real-time traffic monitoring, zero-touch provisioning, redundant management ports.

8.**8.9.6 High Availability and Redundancy:**

Support industry features such as Non-Stop Forwarding(NSF) and graceful restart (GR), redundancy, traffic engineering and hitless software upgrades

8.**8.9.7 Compliance and Certifications:**

Compliance to industry standards and certifications with an MTBF (Mean Time Between Failure) of more than 200,000

**8.8.10 Wireless Access Controller**

**8.8.10.1 General requirements** - Equipment shall support enterprise-grade or carrier-class wireless LAN controller (WLC), centralized and distributed deployments (cloud-based, appliance-based, or virtualized), scalable architecture supporting thousands of Access Points (APs) and clients, high availability (HA) with N+1, N+N, or Active-Active redundancy and seamless

integration with SDN/NFV and Open APIs (NETCONF, RESTCONF, gRPC, OpenFlow).

**8.8.10.2 Hardware requirements** - Equipment shall support hardware appliance (1RU, 2RU, modular chassis) or virtualized deployment (VMware, Hyper-V, KVM, private/public cloud); 50 to 100,000+ APs and 1,000 to 1,000,000 concurrent clients, 1G/10G/25G/40G/100G Ethernet uplink ports, LACP (802.3ad) for link aggregation and Out-of-band (OOB) management port.

**8.8.10.3 Wireless Features** - Equipment shall support Wi-Fi 5 (802.11ac), Wi-Fi 6 (802.11ax), and Wi-Fi 6E and beyond,automatic RF optimization (channel selection, power control, load balancing), band steering, airtime fairness, client load balancing, seamless layer 2 and layer 3 roaming, dynamic adjustable transmit power (TPC) and coverage hole detection, multiple SSID and VLAN mapping, pre-SSID traffic shaping, bandwidth control and QoS policies.

**8.8.10.4 Security and Authentication** - Equipment shall support 802.1X with RADIUS/TACACS+ integration shall support Wi-Fi 5 (802.11ac), Wi-Fi 6 (802.11ax), and Wi-Fi 6E and beyond,automatic RF optimization (channel selection, power control, load balancing), band steering, airtime fairness, client load balancing, seamless layer 2 and layer 3 roaming, dynamic adjustable transmit power (TPC) and coverage hole detection, multiple SSID and VLAN mapping, pre-SSID traffic shaping, bandwidth control and QoS policies, WPA3, WPA2-Enterprise, WPA2-PSK, and Open Authentication, MAC filtering and rogue AP detection/prevention, DDoS protection, wireless IDS/IPS, Guest access with Captive Portal & Social Login and Zero Trust Network Access (ZTNA) & Role-Based Access Control (RBAC).

**8.8.10.5 Network & Traffic Management-** Equipment shall support VLAN and QoS, 802.1Q VLAN tagging, WMM (Wi-Fi Multimedia) support for traffic prioritization, Application-based QoS (Layer 7 DPI), Traffic Optimization, Deep Packet Inspection (DPI) & Application Layer Firewall, and Dynamically adjustable bandwidth limits per SSID, user, or application

**8.8.10.6 Management and Monitoring -** Equipment shall support VWeb-based GUI, CLI, SSH, SNMPv2/v3, REST API, cloud-based or on-premises network management, real-time analytics & reporting (RF health, AP status, client connections), Syslog, NetFlow, sFlow support for traffic analysis, Zero-Touch Provisioning (ZTP) & remote firmware upgrades

**8.8.11 Access Point Indoor**

**8.8.11.1 General requirements** - Equipment shall support enterprise-grade Wi-Fi for high-density environments, Dual-band (2.4GHz & 5GHz) or Tri-band (2.4GHz, 5GHz, 6GHz for Wi-Fi 6E, and above), backward compatibility with legacy Wi-Fi standards, 802.3af/at/bt Power over Ethernet (PoE) support for flexible deployments, Standalone, controller-based, and cloud-managed operation and Plenum-rated (UL 2043) for safe ceiling mounting

**8.8.11.2 Wireless Specifications** - Equipment shall support 2x2, 4x4, or 8x8 MIMO and above for increased throughput, OFDMA and MU-MIMO for multi-user efficiency, Channel width support such as 20/40/80MHz (Wi-Fi 5, 802.11ac), 20/40/80/160MHz (Wi-Fi 6, 802.11ax), 6GHz support with 320MHz channels (Wi-Fi 6E/7) and above; transmit power control and dynamic channel selection; aggregate data rate of 3 Gbps or higher, 1024-QAM modulation for high-efficiency transmission, at least 250 concurrent clients per AP; security features namely WPA3, WPA2-Enterprise, WPA2-PSK, 802.1X authentication with RADIUS/TACACS+ integration, MAC address filtering and rogue AP detection, Guest network isolation and captive portal support and integrated firewall and application-based QoS for application-based traffic shaping.

**8.8.11.3 Network and Management Features** - Equipment shall support 1x or 2x 1GbE/2.5GbE/10GbE uplink ports for backhaul connectivity, VLAN tagging (802.1Q) and multiple SSID support (min. 8 SSIDs per AP), Zero-Touch Provisioning (ZTP), local and cloud-based management options, SNMPv2/v3, syslog, and real-time analytics, AI-driven RF optimization for interference mitigation, Location-based services (LBS) and Bluetooth Low Energy (BLE) support, Seamless roaming with 802.11k, 802.11v, 802.11r support and IoT readiness (Zigbee, Thread, BLE 5.0).

**8.8.11.4 Compliance and Certifications** - Equipment shall conform to industry standards and certifications namely Wi-Fi Alliance Certified (Wi-Fi 6, Wi-Fi 6E, or Wi-Fi 7 ready and

above), FCC, CE, RoHS and UL 2043 (for plenum-rated deployments). The equipment shall have ceiling/wall mounting kit included, support PoE (802.3af/at/bt) or DC power input and provide remote and on-site configuration assistance.

**8.8.11 Access Point Outdoor**

**8.8.11.1 General requirements** - Equipment shall support enterprise-grade Wi-Fi for high-density environments, Dual-band (2.4GHz & 5GHz) or Tri-band (2.4GHz, 5GHz, 6GHz for Wi-Fi 6E, and above), backward compatibility with legacy Wi-Fi standards, weatherproof and ruggedized hardware for extreme temperatures and conditions, 802.3af/at/bt Power over Ethernet (PoE) support for flexible deployments and standalone, controller-based, and cloud-managed operation

**8.8.11.2 Environmental Specifications** - Equipment shall support IP67 or IP68-rated enclosure for water and dust resistance, operating temperature of between -40°C to +65°C (-40°F to 149°F), Wind resistance of 165+ mph, lightning and surge protection (EN 61000-4-5 compliance) and UV-resistant housing for long-term durability.

**8.8.11.2 Wireless Specifications** - Equipment shall support 2x2, 4x4, or 8x8 MIMO and above for increased throughput, OFDMA and MU-MIMO for multi-user efficiency, Channel width support such as 20/40/80MHz (Wi-Fi 5, 802.11ac), 20/40/80/160MHz (Wi-Fi 6, 802.11ax), 6GHz support with 320MHz channels (Wi-Fi 6E/7) and above; transmit power control and dynamic channel selection; aggregate data rate of 3 Gbps or higher, 1024-QAM modulation for high-efficiency transmission, at least 250 concurrent clients per AP; security features namely WPA3, WPA2-Enterprise, WPA2-PSK encryption, 802.1X authentication with RADIUS/TACACS+ integration, MAC address filtering and rogue AP detection, Guest network isolation and captive portal support and integrated firewall and application-based QoS for application-based traffic shaping.

**8.8.11.3 Network and Management Features** - Equipment shall support 1x or 2x 1GbE/2.5GbE/10GbE uplink ports for backhaul connectivity, VLAN tagging (802.1Q) and multiple SSID support (min. 8 SSIDs per AP), Zero-Touch Provisioning (ZTP), local and cloud-based management options, SNMPv2/v3, syslog, and real-time analytics, AI-driven RF optimization for interference mitigation, Seamless roaming with 802.11k, 802.11v, 802.11r support, Integrated GPS for location tracking (optional), Bluetooth Low Energy (BLE) support for IoT applications, external antenna support for directional coverage (optional) and IoT readiness (Zigbee, Thread, LoRaWAN support optional).

**8.8.11.4 Compliance and Certifications** - Equipment shall conform to industry standards and certifications namely Wi-Fi Alliance Certified (Wi-Fi 6, Wi-Fi 6E, or Wi-Fi 7 ready and above), FCC, CE, RoHS, UL 2043 (for plenum-rated deployments) and WEEE, REACH, EN 300 328, EN 301 893. The equipment supply shall include Pole/wall mounting kit, support for PoE (802.3af/at/bt) or DC power input and enable remote and on-site configuration assistance.

**8.8.12 Energy Efficiency**

**8.8.12.1 Energy Consumption hotspots** - The following are targeted area in optical networks for energy efficiency: optical transceivers, amplifiers, switching/routing equipment, cooling systems and passive components (efficient designs can lead to more loss requiring more amplification)

**8.8.12.2 Energy Consumption Improvement Strategies**

1. **Advanced Modulation Format:** Use coherent transmission to transmit more data per wavelength reducing the need for additional hardware
2. **Dynamic Power Scaling:** Implement adaptive link rates and sleep modes for idle components
3. **Network Architecture Optimization:** Deploy Passive Optical Networks (PONs) in access networks to minimize active components and edge computing to reduce long-haul data transmission data.
4. **Energy-Aware Routing:** Route traffic through the shortest or least congested paths to minimize energy-intensive amplification

5. **Hollow-Core Fibers:** Reduce attenuation by 30% compared to traditional silica fibers, cutting amplief requirements
6. **Renewable Energy Integration:** Power remote amplifiers and data centres with solar, wind or hydrogen fuel cells
7. **Silicon photonics:** Integrate optical components with silicon chips for lower power consumption and higher integration
8. **AI/ML- Driven Optimization:** Use machine learning to predict traffic patterns and dynamically adjust power usage
9. **Software-Defined Networking (SDN):** Centralize control to optimize resource allocation and reduce redundant hardware
10. **Quantum-Dot Amplifiers:** Emerging technologies with higher efficiencies than EDFAs
11. **Liquid-Cooling:** Replace air cooling with direct-to-chip liquid systems for data centres

**8.8.12.3 Metrics for Measuring Energy Efficiency**

12. **EPB (Energy per Bit):** Energy to transmit one bit of data
13. **PUE(Power Usage Effectiveness):** Ratio of total data centre energy to TI equipment energy
14. **NEI (Network Efficiency Intensity):** Energy consumed per unit of data traffic

## 8.9 Security

Information Security & Cybersecurity measures will be adhered to and ensure protective security considerations are inbuilt to all equipment and Accessories to determine their suitability for use in National Fiber Optic Infrastructure (NOFBI) Government facilities.

8.9.1 Security controls shall be implemented in line with the GoK information security standards

8.9.2 Identification: All authorized users of the NE shall be uniquely identified to support individual accountability.

The requirements for Identification are:

8.9.2.1 Within a specific NE, the NE shall enforce unambiguous User-IDs to identify its users.

8.9.2.2 All NE interfaces and ports that accept user command inputs shall require unambiguous User-IDs before performing any actions.

8.9.2.3 The NE shall internally maintain the identity of all current active users.

8.9.2.4 The NE shall restrict a User-ID to only one active session.

8.9.2.5 All operations-related processes running on the NE shall be associated with the User-ID of the invoking user.

8.9.2.6 If a user-ID has not been used for a period of 3 months, the NE shall be capable of disabling that User-ID.

8.9.2.7 In addition, the security administrator shall have a choice of automatic or manual disabling of these User-IDs.

8.9.2.8 The NE shall log all activities carried out by the user during each session. All logs must include timestamps and activity or system accessed.

8.9.3 All building sites and equipment (and all information and software contained therein) shall be protected from theft, vandalism, natural disaster, man-made catastrophes, and accidental damage (e.g., from electrical surges, extreme temperatures, and spilled coffee).

8.9.4 The fiber network shall be appropriately segmented to ensure security and performance. The segmentation shall allow for the main backbone network running from point to point and the access network, typically used for last mile connections

**8.10 Aerial Cable**

**8.10.1 General Requirements**

All aerial fiber optic cables deployed under the National Optic Fiber Backbone Infrastructure (NOFBI) or last-mile projects shall conform to IEC 60794-4-20, which defines performance and construction standards for aerial optical cables, particularly All-Dielectric Self-Supporting (ADSS) cables. The choice of aerial deployment shall be guided by technical feasibility, terrain constraints, underground infrastructure limitations, and overall cost-effectiveness.

**NOTE**: Aerial cable shall not be deployed for backbone network infrastructure except for OPGW cable installation.

**8.10.2 Span Between Poles**

**8.10.2.1** The standard span between poles in a last mile and metro shall be 50 meters , in accordance with established industry practices and engineering design guidelines outlined in **IEEE Std 1222-2011** and utility pole deployment norms, ensuring safe cable sag and mechanical stability under typical environmental conditions.
**8.10.2.1** Shorter spans may be adopted in areas with high wind loads or challenging terrain. All spans shall be calculated considering cable sag, wind load, pole strength, and clearance requirements.

**8.10.3 Installation Height and Positioning**
a) **Government-Owned Poles**
When using Government owned poles, aerial fiber optic cables shall be installed at a minimum height of 6.5 meters above ground level on 8-meter poles, positioned just below the top cross-arm to ensure adequate clearance from pedestrian walkways, access roads, and other ground-level infrastructure. For 12-meter poles, the cables shall be mounted at approximately 9.5 meters, providing consistent alignment across longer spans while complying with all clearance and safety requirements. Regardless of pole height, the lowest point of any cable sag must never be less than 5.5 meters above ground level.

b) **Third party-Owned Poles**
Where deployment is on third party owned poles, the standard installation practice shall be to position the fiber cable:

a. Between the high-voltage (HV) and low-voltage (LV) lines, maintaining safe clearance as specified by the third party's joint-use policy
b. The cable shall be fixed using approved aerial fiber brackets and suspension clamps, ensuring dielectric separation and avoiding any contact with electrical conductors

All installations shall be carried out under supervision and approval of the third party and follow Energy and Petroleum Regulatory Authority (EPRA) safety clearances.

**8.10.4 Environmental and Climatic Adaptability**
Aerial cables installed in arid, semi-arid, or high-temperature zones shall withstand ambient temperatures exceeding +80°C. The outer sheathing and internal strength members must be:

a. UV-resistant
b. Moisture-resistant
c. Reinforced to handle prolonged exposure to sunlight, wind pressure, and dust accumulation
d. This ensures long-term signal integrity and mechanical stability.

**8.10.5 Mechanical and Physical Standards**
All aerial cables shall demonstrate the following minimum mechanical characteristics during testing and deployment:

a. High tensile strength to support long spans (short: 50 m, medium: 80 m, long: 120 m)

b. Resistance to wind-induced vibrations, ice-loading, and storm conditions
c. Non-metallic, all-dielectric construction for storm-prone and electrically sensitive areas
d. Compliance with sag and tension parameters based on pole spacing and terrain

**8.10.6 Cable Construction and Types**

a) **All-Dielectric Self-Supporting (ADSS) Cable**
ADSS cables shall be used for both backbone and last-mile aerial fiber routes, particularly in utility corridors and government-owned infrastructure. The cable must:

a. Follow Figure-8 or integrated messenger wire design for self-support
b. Be jelly-filled to prevent moisture ingress
c. Be wrapped in water-blocking tape
d. Have dielectric strength members to avoid electrical conduction near power lines

b) **Optical Ground Wire (OPGW) Cable**
OPGW cables shall only be used in conjunction with high-voltage transmission infrastructure, where the fiber is installed as part of the ground wire (shield wire) on electrical towers. OPGW shall conform to:

a. **IEC 60794-4-10 and IEEE 1138** for composite ground wire construction
b. Use of stainless steel or aluminum-clad steel tubes housing G.652.D fibers
c. Integration with substation termination points and grounding systems

OPGW shall not be used for low- or medium-voltage pole lines due to electrical grounding requirements and safety protocols.

**c) Last Mile Drop Cable**
Last mile drop cables shall be used to connect the distribution point (e.g., a pole or distribution cabinet) to the end user premises. These cables shall be optimized for flexibility, short-span performance, and ease of termination. Drop cables shall meet the following requirements:

- The drop cable shall be constructed using **G.657.A1 or G.657.A2 bend-insensitive fiber**, suitable for tight bends within buildings and risers
- The drop cable shall have a **flat twin (figure-8) or round design**, with integrated strength members (e.g., FRP rods or aramid yarn) for mechanical reinforcement
- The drop cable shall be **UV-resistant and flame-retardant**, suitable for both indoor and outdoor use
- The drop cable shall support spans of up to **50 meters** without intermediate support, or as specified for aerial last-mile applications
- The drop cable shall be compliant with **IEC 60794-2-20** for indoor/outdoor drop cables and **IEC 60332-1** for flame propagation performance
- The drop cable shall allow for **tool-less or mechanical connector termination**, especially in FTTH and MDUs (multi-dwelling units)

Proper slack management and routing guidelines must be followed to prevent over-bending, kinking, or excess tension. Drop cables shall be clearly labeled and documented as part of the link's optical path.

**8.10.7 Standards Compliance and Testing**
All aerial cables shall be tested in accordance with:

a. EIA/TIA-455 procedures (bend, tensile, crush, temperature cycling)
b. IEC 60793-2-50, Category B1.3 for optical fiber performance
c. ITU-T G.652/G654.E/G.655 as necessary for attenuation and dispersion
d. IEC 60794-1-2 for mechanical tests of cable elements

**8.10.8 Attenuation Requirements**
Aerial cables shall meet the following optical loss specifications:

a. Typical attenuation: ≤ 0.36 dB/km at 1310 nm, ≤ 0.23 dB/km at 1550 nm
b. Maximum attenuation: ≤ 0.4 dB/km across all operational wavelengths

**8.10.9 Documentation and Certification**
All vendors and contractors shall submit:

a. OTDR traces for each reel
b. Factory test reports
c. IEC or ISO conformity certificates
d. Compliance to IEEE/IEC standards (for ADSS or OPGW respectively)

**8.10.10 Use Cases and Application Guidelines**
Aerial cable deployment is suitable in the following scenarios:

a. Terrain where trenching is not feasible due to rock or shallow water tables
b. Corridors with pre-existing poles (Third party or ICTA)
c. Rural and peri-urban areas with limited right-of-way access

All installation work must be overseen by a licensed fiber optic engineer, and documented in as-built records for future maintenance and expansion.

## 8.11 Design Process

### 8.11.1 Definition

The design process, within the framework of the National Optic Fiber Backbone Infrastructure (NOFBI) and last mile connectivity, refers to the systematic planning, analysis, and documentation of all technical, structural, and operational elements necessary for the deployment of fiber optic infrastructure. It ensures that all networks are designed in a standardized manner, promoting interoperability, scalability, and compliance with both national and international best practices.

### 8.11.2 Purpose

The primary objective of the design process is to establish a uniform methodology that guides the planning and execution of fiber optic deployments under the ICT Authority's mandate. This ensures quality assurance, cost-efficiency, and alignment with Kenya’s broader digital infrastructure development goals. A well-structured design phase helps identify and mitigate potential risks, accommodate future expansions, and integrate seamlessly with existing infrastructure.

### 8.11.3 Core Components of the Design Process

The following steps shall constitute the standard design process for backbone and last-mile fiber deployments:

**8.11.3.1 Preliminary Site Assessment (Site survey)**-A thorough field survey shall be conducted to determine the most optimal route for fiber laying. This includes mapping of terrain, assessing environmental conditions, evaluating existing civil infrastructure (such as roads, ducts, and utility corridors), and identifying wayleaves or rights of way requirements.

**8.11.3.2 Capacity and Route Planning**-Based on the forecasted bandwidth demand and service area population, the designer shall specify the core and distribution fiber count, termination points, and the appropriate topology (ring, star, mesh). The route design should aim for redundancy, fault tolerance, and future upgradability.

**8.11.3.3 Infrastructure Layout and Documentation**-The detailed design shall include trenching plans, duct and pole placements, manhole and handhole positions, fiber link budgets, splice points, and network elements (e.g., ODFs, FDHs). All components must be accurately documented using GIS mapping and structured drawings.

**8.11.3.4 Compliance with Technical Standards**-The design shall adhere to ICT Authority and Communications Authority of Kenya (CAK) technical specifications including minimum bend radius, fiber attenuation limits, safety codes, and construction guidelines. International standards such as ITU-T G.652 or G.657 and IEC standards for fiber components should be followed.

**8.11.3.5 Stakeholder Engagement and Approval**-Relevant stakeholders such as county governments, utilities, and affected communities must be consulted. Wayleave applications, environmental and social impact assessments (ESIA), and associated regulatory approvals must be completed before final sign-off.

**8.11.4 Deliverables of the Design Phase**

The output of this process shall include but not be limited to:

a. Detailed engineering drawings and route maps (Auto-cad drawings, Pdf, KMZ and KML files)
b. Fiber link budget calculations.
c. Bill of quantities (BoQ) and materials specification.
d. Risk assessment and mitigation plan.
e. Construction and implementation schedule.
f. Compliance checklist.
g. Fiber distribution diagrams

**8.11.5 Quality Assurance**

The design documents must undergo a technical review and approval process by ICT Authority or its designated reviewers before implementation begins. Any deviations from approved standards must be formally justified and documented.

**8.12 Fiber Test Process**

**8.12.1 Definition**

The fiber test process refers to the systematic validation and verification of optical fiber installations to ensure they meet required performance, safety, and reliability standards. In the context of the National Optic Fiber Backbone and Last Mile Infrastructure, this process ensures that deployed fibers

are compliant with technical specifications and are capable of supporting high-quality, uninterrupted data transmission. All testing must conform to internationally recognized standards, specifically ITU-T G.650.3, which outlines test methodologies for installed single-mode optical fiber links.

### 8.12.2 Purpose

The primary objective of fiber testing is to ensure the integrity, continuity, and optimal performance of the fiber optic network before it is commissioned for operational use. Testing verifies that installation practices have not introduced defects or impairments such as excessive splice loss, connector contamination, macro-bending, or signal attenuation that may degrade performance. A rigorous testing process is critical to ensure long-term reliability and maintain service-level agreements.

### 8.12.3 Scope and Applicability

The test process applies to all segments of fiber installations under the ICT Authority's projects, including:

a. Core backbone routes
b. Distribution and access networks
c. Drop and last-mile connections
d. It applies to both newly installed cables and reworked or repaired sections.

### 8.12.4 Key Test Parameters and Standards

In alignment with **ITU-T G.650.3**, the following parameters shall be evaluated:

a. **Optical Time Domain Reflectometer (OTDR) Testing**-Used to measure fiber length, splice loss, connector loss, and reflectance. It also helps detect faults such as breaks or macro-bends.
b. **Insertion Loss (IL) Testing**-Measures the total signal loss along a fiber span. The acceptable threshold shall not exceed the specified link budget and must conform to project design specifications.
**c.** **Optical Return Loss (ORL)-**Fiber shall be tested to Evaluate the amount of reflected light in the link, which can impact signal integrity, especially in high-speed systems.
**d.** **Continuity and Polarity Tests**-Fiber shall be tested to confirm correct fiber routing and polarity between endpoints, particularly in multi-fiber links.
**e.** **End-Face Inspection and Cleaning**-All connectors shall be visually inspected using a fiber scope and cleaned according to **IEC 61300-3-35** standards before mating.

### 8.12.5 Test Procedure Requirements

All tests shall be performed using calibrated, industry-grade equipment and by trained personnel as per ITU-T G.650.3 standard. The testing sequence must follow these steps:

a. Pre-test inspection: Visual inspection of cable reels, fibers, and enclosures.
b. Continuity testing to confirm uninterrupted fiber paths.
c. OTDR testing from both ends of the fiber link.
d. Insertion loss measurement using a light source and power meter.
e. Documentation of test results for each fiber core.

### 8.12.6 Acceptance Criteria

The following values shall apply unless otherwise specified in project documentation:

a. Maximum splice loss: ≤ 0.1 dB per splice
b. Maximum connector loss: ≤ 0.3 dB

c. Total link loss: As per link budget from design specifications
d. ORL: ≥ 35 dB for most access links

**8.12.7 Test Documentation and Reporting**

Test results shall be clearly documented in a standardized format and submitted to the ICT Authority for review and archival. The report must include:

a. OTDR traces (PDF and SOR formats)
b. Insertion loss test data
c. ORL test data (where applicable)
d. Fiber end-face inspection images
e. Test equipment serial numbers and calibration certificates
f. Tester name and certification

**8.12.8 Quality Assurance**

All test data shall be reviewed for completeness and compliance before handover. Random audits or re-tests may be conducted by ICT Authority or its designated quality assurance teams. Non-compliant fibers must be repaired and re-tested until standards are met.

**8.13 Civil Works**

Trenching for the installation of fiber optic cable shall be carried out in accordance with standard civil engineering practices, while adapting to local terrain and soil conditions prevalent across Kenya. All trenches shall be excavated to a uniform depth of 1500 mm, with a minimum bottom and top width of 300 mm, and vertical walls maintained where soil stability permits. Special consideration shall be given to regional variability, including black cotton soils, loose sandy soils, rocky escarpments, and areas with shallow water tables.

**8.13.1 Trenching in Soft or Unstable Soils**-In areas with soft, unstable, or water-retentive soils—such as clay, marshland, black cotton soil, or sand—reinforcement measures shall be implemented to prevent trench collapse, long-term cable settlement, and waterlogging. The following practical procedures shall apply:

**a. Sub-base Stabilization-**A 150 mm layer of compacted bedding material (murram, quarry dust, or river sand) mixed with 5–8% cement or lime shall be laid at the trench base. In rural and peri-urban areas where cement stabilization may not be cost-effective, well-compacted dry murram may be permitted with approval from the supervising engineer.

**b. Geotextile Use (Optional in Critical Zones)-**In swampy or black cotton soils where high moisture content leads to structural instability, a geotextile membrane shall be installed beneath the bedding layer. Where geotextiles are unavailable, double-layered sacks or woven mesh shall be temporarily approved as substitutes—subject to site conditions and engineer verification.

**c. Trench Wall Reinforcement-**Where soils are loose or collapsing, especially in rainy seasons, wooden shoring, metal trench boxes, or even sandbag support may be used during duct placement. For short trench sections, controlled trenching and immediate duct placement and backfilling is encouraged to minimize wall erosion.

**d. Backfilling and Compaction-**After duct installation, backfilling shall be done in 150–200 mm layers, each compacted manually or mechanically. Locally available backfill material such as sieved excavated soil or murram may be used if free from organic matter, stones, or debris.

**e. Gabion Installation in Erosion-Prone Zones-**In areas susceptible to **soil erosion**, such as slopes, culvert crossings, riverbanks, or steep escarpments, **gabion boxes** (wire mesh cages filled with stones) shall be installed alongside or above the trench to provide mechanical protection, control water flow, and prevent washout of the backfilled trench. The gabions shall be securely anchored and aligned to the slope or drainage path to stabilize the surrounding area and maintain long-term trench integrity. The use of gabions must be approved by the supervising engineer and included in the as-built documentation

**f. Warning Tape Installation-**A fiber optic warning tape shall be placed at 750 mm depth above the duct, aligned along the route, to serve as a visual alert during future excavation.

**g. Top Layer Protection-**The uppermost 300 mm layer shall consist of compacted treated backfill, preferably stabilized with cement or lime in unstable soils. In urban settings or utility crossings, precast slabs, bricks, or cable protection tiles may be installed above the duct for additional protection.

**8.13.2 Trenching on hard rock**

Where fiber optic cable routes traverse hard rock terrain—including exposed bedrock, rocky escarpments, or volcanic formations—special trenching procedures shall be adopted to ensure structural integrity, adequate burial depth, and protection of the fiber infrastructure. The following specifications shall apply:

**a. Trench Dimensions in Hard Rock**

Trenches excavated in hard rock shall achieve a minimum depth of **800 mm** and a minimum width of **300 mm**. Where it is not feasible to attain standard trench depth due to solid rock strata, the trench depth may be reduced with prior written approval from the supervising engineer, provided that additional protection such as concrete encasement is implemented.

**b. Excavation Methodology**

Mechanical excavation shall be undertaken using rock trenchers, pneumatic breakers, jackhammers, or excavators fitted with hydraulic hammers suitable for rock cutting. Blasting is discouraged and may only be used under exceptional circumstances, subject to applicable safety regulations and authorization from local authorities.

**c. Bedding Layer**

A **150 mm thick layer of compacted fine bedding material** (such as quarry dust, murram, or river sand) shall be laid at the base of the trench. The bedding material shall be free of sharp stones, roots, or organic matter and shall serve to cushion and support the duct or cable.

**d. Concrete Envelop**

Where trench depth is less than the standard 1500 mm due to solid rock, or where the route lies within high-risk zones such as road crossings, pedestrian pathways, or areas prone to vandalism, the duct shall be encased in **plain concrete with a minimum compressive strength of 25 MPa**. The concrete envelope shall provide a minimum cover of **75 mm** on all sides of the duct as per the Fiber Optic Association guidelines. See annex 4 for specifications for concrete

Concrete encasement shall also be mandated in the following conditions:

a) Along urban road reserves or where the trench overlaps with paved walkways
b) In locations subject to high dynamic loads such as vehicle crossings
c) Where cable route passes through shallow rock cuts that restrict standard backfilling

**e. Concrete Encasement Dimensions**

All ducts shall be encased in concrete with a minimum cover of 75 mm on all sides of the duct (top, bottom, and sides). The concrete shall be poured in layers and compacted using mechanical vibrators to eliminate voids and ensure full enclosure

**f. Curing Process**

The concrete shall be cured for at least seven (7) days. In hot or arid regions, water shall be sprinkled during early mornings and late evenings. The concrete shall be covered using gunny bags or plastic sheeting and overlaid with 50 mm of moist sand to retain moisture and prevent rapid drying.

**g. Documentation and Supervision**

All trenching works in hard rock areas shall be supervised by the site engineer and documented with photographic evidence, trench profile diagrams, and GPS coordinates. Deviations from standard trenching depth due to rock shall be justified in the as-built report and verified by ICT Authority inspection teams.

### 8.13.3 Reinstating Cabros on Road Reserves and Road Cuttings in Urban/Rural Areas

After completion of trenching and cable installation within road reserves or urban road cuttings, the surface restoration shall ensure durability, safety, and aesthetic conformity with the surrounding infrastructure. The following procedures shall apply:

a. **Cabro Removal and Storage:** Existing cabro blocks along the trench route shall be carefully removed and stacked without damage to allow for reuse.
b. **Sub-base Preparation:** Before reinstating cabros, the trench surface shall be properly compacted and leveled using suitable bedding material (murram or crushed aggregate) to provide a stable base and prevent future settlement.

c. **Cabro Reinstatement:** Original cabro blocks shall be reinstated in their original pattern where possible, ensuring tight and even placement. In cases where damaged or missing blocks are identified, matching replacement cabros shall be used to maintain uniformity.
d. **Jointing and Bedding:** Joints between cabros shall be filled with fine sand or mortar as per the local municipal requirements to enhance interlock and prevent water ingress.
e. **Compaction and Finishing:** After laying the cabros, the surface shall be compacted using mechanical plate compactors to ensure evenness and structural integrity. Final surface inspection shall confirm alignment, levelness, and stability.
f. **Traffic and Safety:** Reinstated areas shall be clearly marked with road signage and warning tapes and safeguarded during curing or settlement periods to protect pedestrians and vehicles.
g. **Documentation:** The reinstatement process shall be documented and verified by the supervising engineer, including photographs and as-built drawings indicating exact locations and extent of works.
h. All road surface and cabro reinstatement works, following fiber optic trenching, shall be completed within 7 to 10 working days, in accordance with industry best practices and subject to approval by the relevant road authority. Temporary reinstatement must be done within 24 hours to ensure public safety and traffic continuity

**8.13.3 Quality Assurance (QA) and Supervision-**Field teams shall assess trenching difficulty per location and consult the supervising engineer for site-specific reinforcement adaptations. The supervising engineer shall conduct trench inspections and compaction checks to ensure compliance before cable laying begins.
See annex 3 for detailed trench specification

**ANNEXES**

Annex 1: Standard physical requirement of the ducts
**(1) Backbone Network Physical Standards**

The duct shall conform with ISO/IEC TR 11801-9901 and ETSI EN 50411-2-8, ITU-T L.110/L.111 Series.

| **Description** | **Spec** |
|---|---|
| Conduit Type | HDPE |
| Inner Layer | Silicone with cream inner side |
| Color | Owner |
| Labeling | Owner- yyyy= mm/yyyy (Month & Year of manufacture) =Spacing of the labeling will be 1.0m. The year will be changed to the right year of manufacture) |
| Outside diameter (mm) | 32 |

| | |
|---|---|
| Inside diameter (mm) | 26 |
| Standard straight length (m) | n/a |
| Standard length coils (m) | Min 50 |
| Min. bending radius (mm) 6m length | n/a |
| Material used | Must be anti-rodent material |
| Minimum number of ducts to be installed | 2 |
| Min. bending radius (mm) coils | 150 |
| | |

(2) **Metro Network Physical Standards**

| **Description** | **Spec** |
|---|---|
| Conduit Type | Micro ducts 7 way minimum |
| Inner Layer | Silicone with cream inner side |
| Color | Owners Color |
| Labeling | Owner- yyyy= mm/yyyy (Month & Year of manufacture) =Spacing of the labeling will be 1.0m. The year will be changed to the right year of manufacture) |
| Outside diameter (mm) | 14 |
| Inside diameter (mm) | 10 |
| Standard straight length (m) | n/a |
| Standard length coils (m) | Min 50 |

| | |
|---|---|
| Min. bending radius (mm) 6m length | n/a |
| Min number to be installed once | 2 |
| Material used | Must be anti-rodent material |
| Min. bending radius (mm) coils | 150 |

(3) **Last Mile Network Physical Standards**

Last mile network shall be characterized into:

- Fiber to the Building (FTTB) – Minimum 7 Way from the manhole to the building and structured cable
- Fiber to the Homes (FTTH) – Minimum 7 Way
- Fiber to the Site - Minimum 4 Way

All last mile network shall use micro ducts in the implementation of the network with below physical characteristics

| **Description** | **Specification** |
|---|---|
| Conduit Type | Micro ducts 7 way minimum |
| Inner Layer | Silicone with cream inner side |
| Color | Owners Color |
| Labeling | Owner- yyyy= mm/yyyy (Month & Year of manufacture) =Spacing of the labeling will be 1.0m. The year will be changed to the right year of manufacture) |
| Outside diameter (mm) | 14 |
| Inside diameter (mm) | 10 |
| Standard straight length (m) | n/a |
| Standard length coils (m) | Min 50 |

| | |
|---|---|
| Min. bending radius (mm) 6m length | n/a |
| Min number of ducts to be installed | 2 |
| Material used | Must be anti-rodent material |
| Min. bending radius (mm) coils | 150 |

**4) Road crossing Physical Standards**

Road crossing for all the new roads shall be constructed during road building using Concrete service ducts at intervals of 500m

The road crossing for existing ducts shall use below physical characteristics

| **Description** | **Spec** |
|---|---|
| Conduit Type | HDPE |
| Inner Layer | Silicone with cream inner side |
| Color | Owners Color |
| Labeling | Owner- yyyy= mm/yyyy (Month & Year of manufacture) =Spacing of the labeling will be 1.0m. The year will be changed to the right year of manufacture) |
| Outside diameter (mm) | Class A road- 160mm<br>Class B, C, D roads- 110 |
| Inside diameter (mm) | Class A road –147mm<br>Class B, C, D -100mm |
| Standard straight length (m) | n/a |
| Standard length coils (m) | Min 50 |
| Min. bending radius (mm) 6m length | n/a |
| Material used | Must be anti-rodent material |

| | |
|---|---|
| Minimum Number for any road crossing | 2 |
| Min. bending radius (mm) coils | 150 |

Annex 2: OFC Duct Technical Requirements

| Item | Description | Spec | Units | Method |
|---|---|---|---|---|
| **1.** | Density | 0.95 | $g/cm^3$ | DIN 53 479 |
| **2.** | Tensile strength at break | 23 – 30 | N/mm2 | DIN 53 455 |
| **3.** | Ball indentation hardness | 30 – 65 | N/mm2 | DIN 53 456 |
| **4.** | Notched bar impact strength | > 5 | mJ/mm2 | DIN 53 453 |
| **5.** | Thermal conductivity | 0.40 – 0.46 | W/m K | DIN 52 612 |
| **6.** | Coefficient of elongation | $1.5–2.0 \times 10^{-4}$ | K-1 | DIN 52 328 |
| **7.** | Dielectric strength | 800 – 900 | kV/cm | DIN 53 481 |
| **8.** | Specific insulation resistance | $10^{16}$ | Ohm. cm | DIN 53 482 |

Annex 3: Trenching of all soil types

| Item | Description | Spec |
|---|---|---|
| **1** | Trenching Depth for all the soil type | 1500mm |
| **2** | Minimum trench width at 1500mm (bottom) | 300mm |
| **3** | Minimum trench width at 0 depth (Top) | 300mm |
| **4** | Compacted treated Bedding at bottom of trench | 150mm |
| **5** | Warning Tape depth | 750mm |
| **6** | Depth of compacted treated backfill at top of trench | 300mm |

Annex 4: Trenching on Hard rock

Concrete mix specification and depth

| Item | Description | Spec |
|---|---|---|
| **1** | Mix Ratio | 1:2:4 (cement : sand : gravel)- |

| | | |
|---|---|---|
| | | Class 2025 |
| **2** | Water-Cement Ratio | Between 0.45 and 0.60 by weight |
| **3** | Minimum Compressive Strength | 25 MPa after 28 days |
| **4** | Minimum trench depth | 800mm |
| **5** | Minimum trench width | 300mm |

Annex 5: Optical Fiber Characteristics

| No | ITEM |
|---|---|
| **1** | **Introduction** |
| | Optical fiber cables are categorized into six main types based on their characteristics as defined by the International Telecommunications Union standards ITU-T G. series (ITU-T G.652 - G.657). |
| | The classification and standards define the various cable types to reflect their properties as here below summarized and the ideal applications for each. |
| | 1) G.652 - Characteristics of a single-mode optical fiber cable. |
| | 2) G.653 - Characteristics of a dispersion-shifted, single-mode optical fiber cable. |
| | 3) G.654 - Characteristics of a cut-off shifted, single-mode optical fiber cable. |
| | 4) G.655 - Characteristics of a non-zero dispersion-shifted single-mode optical fiber cable. |
| | 5) G.656 - Characteristics of a fiber and cable with non-zero dispersion for wideband optical transport. |
| | 6) G.657 - Characteristics of a bending-loss insensitive single-mode optical fiber and cable for the access network. |
| **2** | **Backbone deployments** |
| | Optical fiber used in the cable manufacturing fully comply with ITU-T-Rec G 652 D. For detailed characteristics. |
| | More specific for general fiber installations |
| | Optical fiber used in the cable manufacturing fully comply with ITU-T-Rec G 655 D. For detailed characteristics. |

| | |
|---|---|
| | More specific for backbone and high capacity long haul links with DWDM equipment |
| | Optical fiber used in the cable manufacturing fully comply with ITU-T-Rec G 656 D. For detailed characteristics. |
| | More specific for backbone and high capacity long haul links with DWDM equipment |
| | Optical fiber used in the cable manufacturing fully comply with ITU-T-Rec G 657 D. For detailed characteristics. |
| | More specific for last mile installations with limited bending areas and thus small bending radius appropriate |

Annex 6: Pre Installation for cable Drum

| No | Item |
|---|---|
| 1 | Check that the cable specified, has been procured |
| 2 | The cable drum shall be inspected for signs of excessive weathering and/or damage |
| 3 | Drums shall be transported or stored with their battens intact |
| 4 | Never accept delivery of a cable should the drum is damaged |
| 5 | Plastic foil wrap shall remain in place until cable placement |
| 6 | To remove plastic foil wrap on a cable, do not use sharp tools |
| 7 | Ensure that all cable drum bolts are all tightened |
| 8 | Verify that nails, bolts or screws on the inside surface of drum flanges are counter-sunk to avoid damage to the cable during placement. |
| 9 | Place the cable drum in line with the intended direction of deployment, to prevent reel flange-cable rubbing |
| 10 | Cable end shall always be sealed – using pre-formed or heat shrinkable end caps |
| 11 | Using tape for sealing cable ends is considered unsuitable |
| 12 | Always roll the drum following the direction of the arrow |
| 13 | Drums shall be chocked to prevent them from moving |
| 14 | **Branding** |
| | The branding of the cables, ducts, poles, and any other accessories should meet the following minimum requirements. |
| | I. All the text shall be electronically printed |
| | II. The printed text on the fiber cables shall have the organization name, logo, year of manufacture, number of cores and the physical location of the route reading From….. To…... |

| | | |
|---|---|---|
| | III. | The printed text on the ducts shall have the organization name, logo, year of manufacture and the physical location of the route reading From….. To…... |
| | IV. | The text shall be printed in intervals of 1meter spacing for the cables and ducts |
| | V. | The printed text shall be legible, which typically means they should be printed on a high quality to ensure the text is easy to read |
| | VI. | The text should be consistent |
| | VII. | The text should be able to last for a long period of time, therefore durability is key as the ducts, cables and other accessories last for many years. |
| | VIII. | The text shall be permanently placed on the products. |
| **15** | **Label** | |
| | a. Plastic cable labels shall be mechanically printed and shall be attached to all fiber optic cables using black UV rated cable ties or stainless-steel cable ties within six inches of the splice closure and 6 “from all ducts and sleeves. | |
| | b. Provide electronically printed, waterproof, self-adhesive, laminated labels installable on the external surface of the outside panel of all FDU’s and closures. | |

Annex 7: OTDR Pre- test

| **No** | **Item** |
|---|---|
| 1 | All fiber should be tested before installation begins by use of a minimum OTDR or Scalable OTDR based in the technology. |
| 2 | Testing shall be done on all fibers in one direction at 1550nm or 1310nm, using a pulse of 30ns |
| 3 | Traces will be stored and soft/electronic copy submitted to the client |
| 4 | Should a cable be installed without OTDR pre-test – a supplier can claim that the installer assumed liability upon installation. |

Annex 8: Technical details of fiber optic cable 8,24,48,72 96 & 144 fibre (g652d) dry core, multi loose tube design, single sheath, glass yarn armoured ofc suitable for duct installation

| **NO.** | **ITEM** |
|---|---|
| **1** | **INTRODUCTION** |
| | Glass Yarn armored, Rodent protected, in full compliance with ITU-T G 652 D. |

| | |
|---|---|
| 2 | **CABLE DESIGN:** |
| | a. Single mode and Multimode fiber in full compliance with ITU-T G 652 D |
| | b. Water blocking yarns used helically over PE up coated FRP Rod[ |
| | c. Loose buffer tubes fully filled Thixotropic Jelly |
| | d. Loose buffer tubes S-Z Stranded |
| | e. Water Blocking tape wrapping over S-Z core |
| | f. Glass yarn used as peripheral strength member |
| | g. UV Stabilized HDPE Outer sheath, black |
| **3** | **MECHANICAL CHARACTERISTICS** |
| | 1. Ø Temperature Range (IEC6079-1-2-F1) |
| | 2. Ø Operation -30° to +70°C |
| | 3. Ø Transport and Storage -40° to +70°C |
| | 4. Ø Cable Bending Radius (IEC 60794-1-2-E11) |
| **4** | **OPTICAL CHARACTERISTICS:** |
| | Optical fiber used in the cable manufacturing fully comply to ITU-T-Rec G 652 D. For detailed characteristic. |
| | i. at 1310 nm < 0.35 dB/Km |
| | ii. at 1550 nm < 0.22 dB/Km |

| | |
|---|---|
| | iii. at 1625 nm < 0.26 dB/Km |
| 5 | **COLOR CODING** |

| | | | |
|---|---|---|---|
| | Color of Fibers in a Tube : | | Blue, Orange, Green, Brown, Slate, White |
| | | | Red, Black, Yellow, Violet, Pink & Natural/Aqua |
| Color of Loose Tubes: | | | Blue, Orange, Green, Brown, Slate, White, Red, Black |
| | | | Yellow, Violet, Pink & Aqua |

| | |
|---|---|
| **6** | **Note :** |
| | a. For 144 F Cable: 12 loose tubes each having 12 fibers |
| | b. For 96 F Cable: 8 loose tubes each having 12 fibers |
| | c. For 72 F Cable: 6 loose tubes each having 12 fibers |
| | d. For 48 F Cable: 4 loose tubes each having 12 fibers & 2No. Filler |
| | e. For 24 F Cable: 6 loose tubes each having 4 fibers |
| | f. For 8 F Cable: 2 loose tubes each having 8 fibers & 4No Filler |
| **7** | **CABLE SHEATH MARKING:** |

| | |
|---|---|
| | Below mentioned details are generally marked on the cable sheath. |
| | Telephone Symbol, Laser Symbol, Number of Fibers, Type of Fiber (G 652 D) SM, Month & Year of Manufacturer, Manufacturer, Customer Name, Sequential Meter Marking |
| 8 | **CABLE DRUM PACKING:** |
| | Generally the cable drum flange will be marked with following: |
| | a. Arrow showing the direction, the drum can be rolled. |
| | b. Country of origin. |
| | c. The manufacturer's name. |
| | d. Number of fibers. |
| | e. Nominal cable length in meters |
| | f. Net and gross weight. |
| | g. Customer's name |
| | h. Both ends of the cable shall be sealed to prevent the ingress of moisture during transportation and storage, physical damage. |
| 9 | **GENERAL CHARACTERISTICS** |
| | a. All accompanying documentation and brochures shall be in English language |
| | **b. OPTIC FIBER CABLE (G.652.D)** |
| | c. STANDARDS COMPLIANCE |
| | d. The cables should be tested and proven to conform to the TIA/EIA 568B.3 and ISO/IEC 11801:2002, IEC 60794-3-12 ,IEC 60794-3-21, IEC 60794-3-21, EN 60794-3-21:2006 requirements for optical fiber cable performance |
| | e. Should support and exceed all of the performance requirements for current and proposed applications such as 100BASE-F, 155/622 Mbps ATM Gigabit Ethernet 10 Gigabit Ethernet. |
| 10 | **SPECIFICATIONS** |
| | a. The optical fiber cable shall comprise of [**4, 6, 12, 24, 36, 48, 96, 144**] fibers. |
| | b. Fiber color sequence is compiled with TIA-598. |
| | c. The filler elements are manufactured with PE to the same outside diameter as the loose tubes. |
| | d. The elements are SZ stranded around a non -metallic central strength member (FRP with coating if required) and the formation retained with polyester water blocking tapes binders. |
| | e. To prevent the ingress of water, the cable core should be jelly filled. Over this core is applied a polyester tape. |
| | f. This sheath should be black HDPE in a figure 8 formation with the upper part carrying a 7X1.2mm (for 4-72Fiber), 7X1.3mm (for 96Fiber), 7X1.6 mm (for 144Fiber) stranded zinc-coated steel strand bearer. |

<table>
<tr><td></td><td colspan="2">g. The nominal radial thickness of the sheath around the cable core is 1.5mm, and around the bearer the nominal radial thickness is 1.0mm. The web dimensions are 2.0mm wide X 2.0mm high.</td></tr>
<tr><td rowspan="6">11</td><td colspan="2">PERFORMANCE SPECIFICATIONS</td></tr>
<tr><td colspan="2">● The Fiber Aerial Figure 8 Cable should be designed and tested in accordance with TIA-568-B.3 and ISO 11801, ITU G.652D.</td></tr>
<tr><td colspan="2">● The Performance specifications should be measured in accordance with the Fiber Optic Test Procedures (EIA/TIA-455 documents) and the test procedures of IEC 60793-2-50,B1.3 , IEC 60794.</td></tr>
<tr><td colspan="2">● The vendor shall provide documentary evidence/certification of prove of conformity to the above performance</td></tr>
<tr><td>Description</td><td>Single Mode (1310/1550)</td></tr>
<tr><td>Typical Attenuation</td><td>≤ 0.36/0.36/0.23 dB/km</td></tr>
<tr><td></td><td>Maximum Attenuation</td><td>0.4/0.4/0.4 dB/km</td></tr>
</table>