GUIDELINES

FOR

NETWORK REDUNDANCY, RESILIENCE AND DIVERSITY

ON

INFORMATION AND COMMUNICATION

NETWORKS

IN

KENYA

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1. Introduction

The Communications Authority of Kenya (hereinafter referred to as the Authority) was established under the Kenya Communications Act, 1998, as Amended (hereinafter referred to as The Act), to licence and regulate telecommunications, radio communications, postal and broadcasting services in Kenya. The Authority is also responsible for ensuring consumers enjoy quality communications services at all times.

These Network Redundancy, Resilience and Diversity (NRRD) Guidelines are issued pursuant to Section 23 and 27 of the Act.

1.1. Purpose of the Network Redundancy, Resilience and Diversity (NRRD) Guidelines

The Network Redundancy, Resilience and Diversity (NRRD) Guidelines are intended to develop regulatory interventions and appropriate procedures for use by network operators in support of sustained reliable and available Information and Communications Technology (ICT) networks in Kenya.

The NRRD guidelines will monitor the following network aspects:

i) Redundancy to improve the availability and fault tolerance of a system or service by duplicating one or more components of the system.
ii) Resilience to enable a network to provide and maintain an acceptable level of service in the face of various faults and challenges to normal operation by providing a set of defences against failure and reducing the impact of an adverse event on network service delivery.
iii) Diversity to ensure that alternatives are available when challenges impact particular elements or processes. This will prevent network degradation from normal operational parameters.

1.2. Scope of the Network Redundancy, Resilience and Diversity (NRRD) Guidelines

These NRRD Guidelines apply to the following networks:

i) Mobile Network Operators (MNO);
ii) Internet Service Provider (ISP) Networks;
iii) Fixed Wireless Access (FWA) Networks;
iv) International Gateway (IGW) Networks;
v) Submarine Cable Networks (SCN);
vi) Internet Exchange Point (INX), and
vii) Fixed Network Operators (FNO).

2. Definitions and Abbreviations

2.1. Definitions

In these Guidelines, unless otherwise stated the following definitions apply:

"Authority" means the Communications Authority of Kenya;

"Diversity" is a technique used so that the same fate is unlikely to be shared by parts of the system undergoing correlated failures.

Diversity is closely related to redundancy, but has the key goal to avoid fate sharing. It consists of providing alternatives so that even when challenges impact particular elements or processes, other alternatives prevent degradation from normal operational parameters. These diverse alternatives can either be simultaneously operational or available "as needed" to remediate failures as they occur;

"Metric" is a system of related measuring that enables quantification of some characteristic of a system, component or process. A metric is composed of two or more measures;

"Redundancy" means improving the availability and fault tolerance of a system or service by duplicating one or more components of the system.

Redundancy is a technique to compensate for random uncorrelated failure of components. In the event that a fault occurs and results in an error, redundant components are able to operate and prevent a service failure;

"Resilience" means the ability of the network to provide and maintain an acceptable level of service in the face of various faults and challenges to normal operation.

Resilience is provided by having a set of defences that reduce the probability of a fault leading to a failure and reduce the impact of an adverse event on network service delivery, and

"Target" means an aspirational standard for a given metric and network type developed with reference to best practices, industry and other standards and guidelines which are intended to act as a reference against which to compare the reportable achievements of network operators with regard to NRRD.

2.2. Abbreviations

In these Guidelines, unless otherwise stated the following abbreviations apply:

AAA	Authentication, Authorization and Accounting	MSC	Mobile Switching Centre
ASN	Access Service Network Gateway	MUX/ DMUX	Multiplexer/ Demultiplexer
BSC	Base Station Controller	NMS	Network Management System
BSF	Backhaul From Interconnect to SCLS	NPE	Network Protection Equipment
BTS	Base Transceiver Station	NTP	Network Time Protocol
CS	Circuit Switched	OCS	Online Charging System
CS MGW	Circuit Switched Media Gateway	PCRF	Policy and Charging Rules Function
CSP	Content Service Provider	PDN-GW	Packet Data Network Gateway
DHCP	Dynamic Host Configuration Protocol Servers	PE	Provider Edge Routers
DNS	Dynamic Name Server	PFE	Power Feed Equipment
eNodeB	Evolved Nodeb	PoP	Point of Presence
FNO	Fixed Network Operator	PS	Packet Switched
FWA	Fixed Wireless Access	PSTN	Public Switched Telephone Network
GGSN	Gateway Gprs Support Node	PSU	SCLS Power Supply Unit
GMSC	Gateway Mobile Services Switching Centre	RNC	Radio Network Controller
GPRS	General Packet Radio Service	S-GW	Serving Gateway
HLR-AuC	Home Location Register – Authentication Centre	SBC	Session Border Controller
HSP	Hosting Service Provider	SCLS	Submarine Cable Landing Station
HSS	Home Subscriber Server	SCN	Submarine Cable Networks
ICT	Information and Communications Technology	SGSN	Serving GPRS Support Node
IGW	Internet Gateway Network	SIP	Session Initiation Protocol Servers
IMS	IP Multimedia Sub System	SLTE	Submarine Line Terminating Equipment
IXP	Internet Exchange Point	SMTP	Simple Mail Transfer Protocol
IPS	Intrusion Prevention System	STP	Signal Transfer Point
ISP	Internet Service Provider	TDM	Time Division Multiplexing Switches (Exchange)
ITP	Internet Transfer Point	UPS	Uninterruptable Power Supply
MME	Mobile Management Entity	www	World Wide Web
MNO	Mobile Network Operator		

3. NRRD Parameters

In order to determine the levels of NRRD of ICT networks in Kenya, the Authority has identified the metrics shown in Table 1 below against which licensed networks will be monitored.

Table 1: NRRD Metrics Identified for Kenya

Metric Name	Description and Objective
a) Service Availability	Service Availability is defined as the ability of a service to perform its required function at a stated instant or over a stated period of time. **Calculation Method:** $$\textbf{Service availability (Monitoring Period (M))}\ \% = \left[1 - \frac{\sum_i^N \textbf{service downtime}(i)}{\textbf{Monitoring Period (M)}}\right] * 100$$ Where: N = number of times the service is down (service unavailable or below QoS/SLA thresholds), Downtime and Monitoring period in seconds $$\textbf{Cumulative Service availability (for K number of Monitoring Periods)}\ (\%) = \left[1 - \frac{\sum_1^K \sum_i^N \textbf{service downtime}(i)}{\sum_1^K \textbf{Monitoring period (M)}}\right] * 100$$ Where: K = the number of monitoring periods.
b) Network Element Availability	Network Element availability is defined as the ability of a network element to perform its required function at a stated instant or over a stated period of time. Note 1: • If there are redundant nodes deployed in active-standby model, then availability should be considered for the combined system. • If the redundant nodes are deployed in load-sharing mode and dimensioning is applied in such a way that where there is failure of one node, all the traffic is automatically moved to the second available node, then availability should be considered for the combined system. • If the redundancy nodes require manual switchover and there is a potential loss of service during the switching period, then availability should be considered for individual nodes. **Calculation Method: Shall be calculated separately for each network element type**

Metric Name	Description and Objective
	$$\textbf{Network Element X availability}\left(\textbf{Monitoiring Period}\ (\boldsymbol{M})\right)\% = \left[1 - \frac{\sum_i^N \textbf{Network Element}\ (\boldsymbol{X})\textbf{downtime}(\boldsymbol{i})}{\textbf{Monitoring Period}\ (\boldsymbol{M})}\right] * \mathbf{100}$$ Where**:** ***N*** **=** number of times a network element type is <u>down resulting in loss of service,</u> See Note 1 above. ***X*** **=** Represents a specific network element type. In a network, where there is a population of a network element type, the downtime of each element shall contribute to the overall downtime, e.g. failure of any transport links between core network and various elements up to the access nodes shall contribute to the overall downtime, where appropriate) Downtime and Monitoring period in seconds $$\textbf{Cumulative Network Element X availability}\ (\textbf{for K number of Monitoring Periods})\ (\%) = \left[1 - \frac{\sum_1^K \sum_i^N \textbf{Network Element}\ (\boldsymbol{X})\ \textbf{downtime}(\boldsymbol{i})}{\sum_1^K \textbf{Monitoring period}\ (\boldsymbol{M})}\right] * \mathbf{100}$$ Where: ***K*** **=** the number of monitoring periods.
c) Link Availability	Link Availability is defined as the period for which a link or links between two network elements or locations are available. See Note 1 above **<u>Calculation Method:</u> Shall be calculated separately for each external network it is connected to** $$\textbf{External Transport Link availability to Network Z}\ (\textbf{Monitoring Period M})\% = \left[1 - \frac{\sum_i^N \textbf{External Transport Link Availability to Network Z downtime}(\boldsymbol{i})}{\textbf{Monitoring Period}}\right] * \mathbf{100}$$ $$\textbf{Cumulative External Transport Link availability to Network}\ (\boldsymbol{Z})\ (\textbf{for K number of Monitoring Periods})\ (\%) = \left[1 - \frac{\sum_1^K \sum_i^N \textbf{External Transport Link Availability to Network Z downtime}(\boldsymbol{i})}{\sum_1^K \textbf{Monitoring period}\ (\boldsymbol{M})}\right] * \mathbf{100}$$ Where: ***K*** **=** the number of monitoring periods.

Availability Measures used in these NRRD Guidelines are outlined at Annex 1 below.

4. NRRD Guidelines for Mobile Network Operators (MNO)

The Authority shall monitor the following as the minimum thresholds of the NRRD metrics for mobile networks:

4.1. Service Availability

The Authority shall evaluate Service Availability at the Radio Access Nodes of the mobile network system and will require licensees to achieve **99.900% availability**.

Service Availability shall be calculated using the equation in Table 1a).

4.2. Network Element Availability

The Authority shall evaluate Network Element Availability for Critical Elements and for Major Elements in a mobile network.

Network Element Availability shall be calculated using the equation in Table 1b).

a) Monitoring of Availability of Critical Network Elements

Licensees will be required to achieve **99.999% availability** for Critical Network Elements aggregated per-element basis. The Authority identifies the following as Critical Network Elements:

i) Signal Transfer Point /IP Transfer Point (STP / ITP);
ii) Mobile Switching Centre (MSC);
iii) MSC-Servers;
iv) Circuit Switched Media Gateway (CS MGW);
v) Serving GPRS Support Node (SGSN);
vi) Gateway GPRS Support Node (GGSN);
vii) Mobile Management Entity (MME);
viii) Serving Gateway (S-GW);
ix) Packet Data Network Gateway (PDN-GW);
x) Home Location Register –Authentication Centre (HLR-AuC);
xi) Home Subscriber Server (HSS);
xii) Core Network Power Supply;
xiii) Gateway Mobile Services Switching Centre (GMSC);
xiv) GMSC-Server;
xv) Policy and Charging Rules Function (PCRF), and
xvi) Online Charging System (OCS).

b) Monitoring of Availability of Major Network Elements

Licensees will be required to achieve **99.990% availability** for Major Network Elements aggregated per-element basis. The Authority identifies the following as Major Network Elements:

i) Base Transceiver Station (BTS), and
ii) Radio Network Controller (RNC).

4.3. Link Availability

The Authority shall evaluate Link Availability aggregated, per-connection-type basis and will require licensees to achieve **99.990% availability**.

The Link Availability metric will be measured for the following Network connections in the mobile network:

i) Links between the MNO and other MNOs;
ii) Links between the MNO and other Public switched telephone network (PSTN) Operators;
iii) Links between the MNO and Fixed Wireless Access (FWA) Operators;
iv) Links between the MNO and Internet Service Provider (ISP)/Internet Exchange (INX);
v) Links between the MNO and International Gateway (IGW) Operators, and
vi) Links between the MNO and Roaming Links.

Link Availability shall be calculated using the equation in Table 1c).

5. NRRD Guidelines for Internet Service Providers (ISP)

The Authority shall monitor the following as the minimum thresholds of the NRRD metrics for Internet Service Provider (ISP) Networks.

5.1. Service Availability

The Authority shall evaluate Service Availability measured at the Access Nodes of the internet service provider and will require licensees to achieve **99.900% availability**.

Service Availability shall be calculated using the equation in Table 1a).

5.2. Network Element Availability

The Authority shall evaluate Network Element Availability for Critical Elements and for Major Elements in an Internet Service Provider (ISP) Network.

Network Element Availability shall be calculated using the equation in Table 1b):

a) Monitoring of Availability of Critical Network Elements

Licensees will be required to achieve **99.990% availability** for Critical Network Elements aggregated per-element basis. The Authority identifies the following as Critical Network Elements:

i) Provider (P) / Provider Edge (PE)/Aggregation/Access Routers;
ii) Switches;
iii) AAA and
iv) DHCP servers.

b) Monitoring of Availability of Major Network Elements

Licensees will be required to achieve **99.900% availability** for Major Network Elements. The Authority identifies the following as Major Network Elements:

i) World Wide Web (www) server;
ii) Policy server;
iii) Links between Aggregation Point and Provider Edge (PE)/ Access routers;
iv) Links within the P core network, and
v) Links between Provider (P) and Provider Edge (PE) routers.

5.3. Link Availability

The Authority shall evaluate Link Availability aggregated, per-connection-type basis and will require licensees to achieve **99.900% availability**.

The Link Availability metric will be measured for the following transport links in an Internet Service Provider Network:

i) Links between ISP and ISP networks, and
ii) Links between the ISP network and the Internet Exchange Point (INX).

Link Availability shall be calculated using the equation in Table 1c).

6. NRRD Guidelines for Fixed Wireless Access Network

The Authority shall monitor the following as the minimum thresholds of the NRRD metrics for Fixed Wireless Access Network Operators.

6.1. Service Availability

The Authority shall evaluate Service Availability for a given group of customers measured at the Radio Access Nodes of the fixed wireless network operator and will require licensees to achieve **99.000% availability**.

Service Availability shall be calculated using the equation in Table 1a).

6.2. Network Element Availability

The Authority shall evaluate Network Element Availability for Critical Elements and for Major Elements in a Fixed Wireless Access Network.

Network Element Availability shall be calculated using the equation in Table 1b).

a) Monitoring of Availability of Critical Network Elements

Licensees will be required to achieve **99.990% availability** for Critical Network Elements aggregated per-element basis. The Authority identifies the following as critical network elements:

i) Voice Gateways, and
ii) AAA Servers

b) Monitoring of Availability of Major Network Elements

Licensees will be required to achieve **99.900% availability** for Major Network Elements aggregated per-element basis. The Authority identifies the following as major network elements:

i) Domain Name System (DNS) Servers;
ii) Dynamic Host Configuration Protocol (DHCP) Servers, and
iii) Access Service Network (ASN)-Gateway.

6.3. Link Availability.

The Authority shall evaluate Link Availability aggregated, per-connection-type basis and will require licensees to achieve **99.900% availability**.

The Link Availability metric will be measured for the following transport links in the Fixed Wireless Access Network:

i) Links between the Fixed Wireless Network and Other Fixed Wireless Networks;
ii) Links between the Fixed Wireless Network and other Public Switched Telephone Network (PSTN) Operators;
iii) Links between the Fixed Wireless Network and Mobile Network Operators (MNOs);
iv) Links between the Fixed Wireless Network and Internet Service Provider (ISP)/Internet Exchange (INX);
v) Links between the Fixed Wireless Network and International Gateway (IGW) Operators, and
vi) Links between the ISP and SCN operators.

Link Availability shall be calculated using the equation in Table 1c).

7. NRRD Guidelines for Internet Gateway (IGW) Operators

The Authority shall monitor the following as the minimum thresholds of the NRRD metrics for Internet Gateway Network (IGW) Operators.

7.1. Service Availability

The Authority shall evaluate Service Availability on traffic destinations and will require licensees to achieve the following availability measures:

i) Voice calls to specific and major traffic destination (for example, top 10) destinations shall be reachable 99.990% of time, and
ii) Voice calls to non-major destinations shall be reachable 99.900% of time.

Service Availability shall be calculated using the equation in Table 1a).

7.2. Network Element Availability

The Authority shall evaluate network element availability for critical elements in an Internet Gateway Network.

Network Element Availability shall be calculated using the equation in Table 1b).

Licensees will be required to achieve **99.900% availability** for Critical Network Elements aggregated per-element basis. The Authority identifies the following as Critical Network Elements:

i) Time Division Multiplexing (TDM) Switches (Exchange);
ii) Signal Transfer point (STP)-Internet Transfer point (ITP) mated pairs;
iii) Session Border Controller (SBC);
iv) Gateway power supply;
v) Firewalls, and
vi) Session Initiation Protocol (SIP) servers.

7.3. Link Availability

The Authority shall evaluate Link Availability aggregated, per-connection-type basis and will require licensees to achieve **99.990% availability**.

The Link Availability metric will be measured for the following transport links in an Internet Gateway Network:

i) Links between the Internet Gateway Network (IGW) and Interconnect points of Submarine Cable Networks;
ii) Links between the Internet Gateway Network (IGW) and National Operators;
iii) Links between the Internet Gateway Network (IGW) and International PoPs and Exchanges, and
iv) Link between the Internet Gateway Network (IGW) and ISP/INX for carrying VoIP calls.

Link Availability shall be calculated using the equation in Table 1c).

8. NRRD Guidelines for Submarine Cable Network (SCN) Operators

The Authority shall monitor the following as the minimum thresholds of the NRRD metrics for Submarine Cable Network Operators.

8.1. Service Availability

The Authority shall evaluate Service Availability to and from International destinations and will require licensees to achieve **99.990%** connectivity to and from international destinations.

Service Availability shall be calculated using the equation in Table 1a).

8.2. Network Element Availability

The Authority shall evaluate Network Element Availability for Critical Elements and for Major Elements in a Submarine Cable System.

Network Element Availability shall be calculated using the equation in Table 1b).

a) Monitoring of Availability of Critical Network Elements-Dry Section

Licensees will be required to achieve **99.999% availability** for Critical Network Elements (Dry Section) aggregated per-element basis. The Authority identifies the following as critical network elements (Dry Section):

i) Network Protection Equipment (NPE);
ii) Submarine Line Terminating Equipment (SLTE);
iii) Power Feed Equipment (PFE);
iv) SCLS Power Supply Unit (PSU), and
v) Interconnect PoP.

b) Monitoring of Availability of Critical Network Elements-Wet Section

Licensees will be required to achieve **99.9990% availability** for Critical Network Elements (Wet Section) aggregated per-element basis. The Authority identifies the following as critical network elements (Wet Section):

i) Repeaters, and
ii) Branching Units.

8.3. Link Availability

The Authority shall evaluate Link Availability between the interconnect point where all other service providers connected to the dry section of SCN and will require licensees to achieve **99.9990% availability** on a licensee-wide, aggregated per-connection-type basis.

Link Availability shall be calculated using the equation in Table 1c).

9. NRRD Guidelines for Internet Exchange Point (IXP) Operators

The Authority shall monitor the following as the minimum thresholds of the NRRD metrics for Internet Exchange Point (IXP) Operators.

9.1. Service Availability

The Authority shall evaluate Service Availability of Internet Data Traffic and will require licensee's customers to be able to receive acceptable level of service for **99.990%** of time.

Service Availability shall be calculated using the equation in Table 1a).

9.2. Network Element Availability

The Authority shall evaluate Network Element Availability for Critical and Major Elements in an Internet Exchange Network.

Network Element Availability shall be calculated using the equation in Table 1b).

a) Monitoring of Availability of Critical Network Elements

Licensees will be required to achieve **99.999% availability** for Critical Network Elements aggregated per-element basis. The Authority identifies the following as Critical Network Elements:

i) High speed Switching Fabric;
ii) Authentication, authorization, and accounting (AAA);
iii) Firewall;
iv) IXP Route server;
v) Multiplexer/Demultiplexer (MUX/DMUX);
vi) Dynamic Name Server (DNS);
vii) Exchange Power Supply;
viii) Switching Fabrics;
ix) Caching servers, and
x) Routers.

b) Monitoring of Availability of Major Network Elements

Licensees will be required to achieve **99.900% availability** for Major Network Elements aggregated per-element basis. The Authority identifies the following as Major Network Elements:

i) World Wide Web Server, and
ii) Network Time Protocol (NTP).

9.3. Link Availability

The Authority shall evaluate Link Availability aggregated, per-connection-type basis and will require licensees to achieve **99.999% availability**.

Link Availability shall be calculated using the equation in Table 1c).

The Link Availability metric will be measured for the following links in an Internet Exchange Point Operator:

i) Link between ISP/CSP/HSP and Switching Fabric;
ii) Link between Aggregation Point and MUX/DMUX, and
iii) Link between MUX/DMUX and Interconnect partners. e.g. Submarine Cable Network (SCN) or satellite operators.

10. NRRD Guidelines for Fixed Networks

The Authority shall monitor the following as the minimum thresholds of the NRRD metrics for Fixed Network Operators.

10.1. Service Availability

The Authority shall evaluate Service Availability at the Access Nodes of the fixed network operator. Access nodes are either interconnect points (other network operators) or interface points to provide services to public/private users (cabinets). Licensees will be required to achieve **99.900% availability.**

Service Availability shall be calculated using equation in Table 1a).

10.2. Network Element Availability

The Authority shall evaluate Network Element Availability for Critical Elements and for Major Elements in a Fixed Network.

Network Element Availability shall be calculated using the equation in Table 1b).

a) Monitoring of Availability of Critical Network Elements

Licensees will be required to achieve **99.999% availability** for Critical Network Elements aggregated per-element basis. The Authority identifies the following as Critical Network Elements:

i) Local Exchange;
ii) Tandem or Trunk Exchange;
iii) Toll Exchange, and
iv) STP.

b) Monitoring of Availability of Major Network Elements

Licensees will be required to achieve **99.900% availability** for Major Network Elements aggregated per-element basis. The Authority identifies the following as Major Network Elements:

i) Cabinets, and
ii) Billing System.

10.3. Link Availability

The Authority shall evaluate Link Availability aggregated, per-connection-type basis and will require licensees to achieve **99.900% availability**.

The Link Availability metric will be measured for the following transport links in the Fixed Network:

i) Links between the Fixed Network Operator (FNO) and Mobile Network Operator (MNO);
ii) Links between Fixed Network Operator (FNO) and other FNOs;
iii) Links between Fixed Network Operator (FNO) and FWA operator;
iv) Links between Fixed Network Operator (FNO) and ISP / IXP;
v) Links between Fixed Network Operator (FNO) and IGW, and
vi) Links between Fixed Network Operator (FNO) and SCN.

Link Availability shall be calculated using the equation in Table 1c).

11. Submission of Quarterly Reports

Licensee shall submit quarterly reports in the format provided at Annex 2 below or as prescribed by the Authority from time to time.

12. Promulgation of the NRRD Guidelines

12.1. Effective Date of the NRRD Guidelines

These NRRD Guidelines shall become effective from the date they are signed by the Director General.

12.2. Review of the NRRD Guidelines

The Authority may review these NRRD Guidelines from time to time in consultation with stakeholders.

Issued by the Communications Authority of Kenya

_____ _____

Director General **Date**
Communications Authority of Kenya

ANNEX 1: AVAILABILITY MEASURES

Availability Measures	
Uptime %	**Downtime / Unavailability in time**
99.999 (Five Nines)	Yearly: 5 minutes 15.36 seconds Monthly: 26.2 seconds Weekly: 6 seconds
99.99 (Four Nines)	Yearly: 52 minutes 35.7 seconds Monthly: 4 minutes 23 seconds Weekly: 1 minute 0.5 second
99.9 (Three Nines)	Yearly: 8 hours, 45 minutes, 57 seconds Monthly: 43 minutes 49.7 seconds Weekly: 10 minutes 4.8 seconds
99.0 (Two Nines)	Yearly: 3 days, 15 hours, 39 minutes, 29.5 seconds Monthly: 7 hours, 18 minutes, 17.5 seconds Weekly: 1 hour, 40 minutes, 48 seconds.
98.0	Yearly: 7 days, 7 hours, 18 minutes, 59 seconds Monthly: 14 hours, 36 minutes, 34.9 seconds Weekly: 3 hours, 21 minutes, 36 seconds
95.0	Yearly: 18 days, 6 hours, 17 minutes, 27 seconds Monthly: 1 day, 12 hours, 31 minutes, 27 seconds Weekly: 8 hours, 24 minutes

ANNEX 2: COMPLIANCE RETURN FORM

NETWORK REDUNDANCY, RESILIENCE AND DIVERSITY (NRRD) COMPLIANCE RETURN FORM

PURSUANT TO THE PROVISIONS OF KICA 1998 AS AMENDED, THE KENYA INFORMATION AND COMMUNICATIONS REGULATIONS AND THE LICENSE CONDITIONS

Please note that the latest version of this form must be downloaded from the Authority's website at the end of each quarter

1. GENERAL INFORMATION

1.1 Licensee Details

Name of Licensee _____

License No _____

Other Licenses held _____

1.2 Period under review (Tick against appropriate quarter)

FINANCIAL YEAR _____ (based on Government of Kenya Financial year)

Quarter 1 (1st Jul-30th Sep)	Quarter 2 (1st Oct -31stDec)	Quarter 3 (1st Jan -31st Mar)	Quarter 2 (1st Apr-30th Jun)
☐	☐	☐	☐

1.3 Address

1. Physical Address: _____

Town _____ Street/Road _____

L.R. No. _____ Floor No. _____ Room No. _____

2. Postal Address:

P. O. Box _____ Postal Code _____

Post Office Town _____

3. Phone Contact:

Tel. No. _____ Mobile No _____ Other Tel. Nos _____

1.4. Email and Web Address:

Email address: _____

Web Address: _____

Did any of the address information change during the quarter? (Tick as appropriate) Yes No

(***If Yes, attach a notification letter on the same)***

Please note that all the address information requested must be provided above whether or not there were changes during the quarter.

1.4 Contact details

Name of Head of Organization _____

Title of Head of Organization _____

Name of contact person _____

Title _____

Telephone _____

Email _____

Signature _____

1.5 Instructions

1. This form has provision for both quarterly and annual reporting.
2. Please provide information in the space provided, you may insert additional rows and pages as required.
3. Please refer to Appendix A for calculations of the required metrics. Appendix B provides worked examples on how to calculate a metric.

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REPORTING SECTION

[please complete the appropriate section/s in relation to your license category/ies]

(Information should be submitted within 15 days after the end of each Quarter)

2.0 NRRD Metrics for Mobile Network Operators (MNO)

2.1 Service Availability

Target: 99.900% availability.

2.2 Network Element Availability -

a) Availability of Critical Network Elements

Target: 99.999% availability.

	Network Element	**Availability (%)**
i).	Signal Transfer Point /IP Transfer Point (STP / ITP)	
ii).	Mobile Switching Centre (MSC)	
iii).	MSC-Servers	
iv).	Circuit Switched Media Gateway (CS MGW)	
v).	Serving GPRS Support Node (SGSN)	
vi).	Gateway GPRS Support Node (GGSN)	
vii).	Mobile Management Entity (MME)	
viii).	Serving Gateway (S-GW)	
ix).	Packet Data Network Gateway (PDN-GW)	
x).	Home Location Register –Authentication Centre (HLR-AuC)	
xi).	Home Subscriber Server (HSS)	
xii).	Core Network Power Supply	
xiii).	Gateway Mobile Services Switching Centre (GMSC)	
xiv).	GMSC-Server	
xv).	Policy and Charging Rules Function (PCRF)	
xvi).	Online Charging System (OCS)	

b) Availability of Major Network Elements

Target: **99.990% availability**.

	Network Element	**Availability (%)**
i).	Base Transceiver Station (BTS)	
ii).	Radio Network Controller (RNC)	

2.3 Link Availability

Target: 99.990% availability.

	Links	Availability (%)
i).	Links between the MNO and other MNOs	
ii).	Links between the MNO and other Public switched telephone network (PSTN) Operators;	
iii).	Links between the MNO and Fixed Wireless Access (FWA) Operators;	
iv).	Links between the MNO and Internet Service Provider (ISP)/Internet Exchange Point (IXP);	
v).	Links between the MNO and International Gateway (IGW) Operators	
vi).	Links between the MNO and Roaming Links.	

3.0 NRRD Metrics for Internet Service Providers (ISP)

3.1 Service Availability

Target: 99.900% availability.

3.2 Network Element Availability

a) Availability of Critical Network Elements

Target: 99.990% availability

	Network Element	Availability (%)
i).	Provider (P)/Provider Edge (PE)/Aggregation/Access Routers	
ii).	Switches	
iii).	AAA	
iv).	DHCP servers	

b) Availability of Major Network Elements

Target: 99.900% availability.

	Network Element	Availability (%)
i).	World Wide Web (www) server	
ii).	Policy server	
iii).	Links between Aggregation Point and Provider Edge (PE)/ Access	
iv).	Links within the P core network	
v).	Links between Provider (P) and Provider Edge (PE) routers	

3.3 Link Availability

Target: 99.900% availability.

	Links	Availability (%)
i).	Links between ISP and ISP networks	
ii).	Links between the ISP network and the Internet Exchange Point (IXP)	

4.0 NRRD Metrics for Fixed Wireless Access Network

4.1 Service Availability

Target: 99.000% availability.

4.2 Network Element Availability

a) Availability of Critical Network Elements

Target: 99.990% availability

	Network Element	Availability (%)
i).	Voice Gateways	
ii).	AAA Servers	

b) Availability of Major Network Elements

Target: 99.900% availability.

	Network Element	Availability (%)
i).	Domain Name System (DNS) Servers	
ii).	Dynamic Host Configuration Protocol (DHCP) Servers	
iii).	Access Service Network *(*ASN)-Gateway	

4.3 Link Availability

Target: 99.900% availability.

	Links	Availability (%)
i).	Links between the Fixed Wireless Network and Other Fixed Wireless Networks	
ii).	Links between the Fixed Wireless Network and other public switched telephone network (PSTN) Operators	
iii).	Links between the Fixed Wireless Network and Mobile Network Operators (MNO's)	
iv).	Links between the Fixed Wireless Network and Internet Service Provider (ISP)/Internet Exchange Point (IXP)	
v).	Links between the Fixed Wireless Network and International Gateway (IGW) Operators	
vi).	Links between the ISP and SCN operators	

5.0 NRRD Metrics for Internet Gateway Network (IGW) Operators

5.1 Service Availability

Target:

a) Voice calls to specific and major traffic destinations shall be reachable 99.990% of time and
b) Voice calls to non-major destinations shall be reachable 99.900% of time.

5.2 Network Element Availability-Availability of Critical Network Elements

Target: 99.900%

	Network Element	Availability (%)
i).	Time Division Multiplexing (TDM) Switches (Exchange);	
ii).	Signal Transfer point (STP)-Internet Transfer point (ITP) mated pairs	
iii).	Session Border Controller (SBC);	
iv).	Gateway power supply	
v).	Firewalls	
vi).	Session Initiation Protocol (SIP) servers	

5.3 Link Availability

Target: 99.990% availability.

	Links	Availability (%)
i).	Links between the Internet Gateway Network (IGW) and Interconnect points of Submarine Cable Network Interconnect Points	
ii).	Links between the Internet Gateway Network (IGW) and National Operators	
iii).	Links between the Internet Gateway Network (IGW) and International PoPs & Exchanges	
iv).	Link between the Internet Gateway Network (IGW) and ISP/IXP for carrying VoIP calls	

6.0 NRRD Metrics for Submarine Cable Network (SCN) Operators

6.1 Service Availability

Target: 99.990% availability.

6.2 Network Element Availability

a) Availability of Critical Network Elements-Dry Section

Target: 99.999% availability

	Network Element	Availability (%)
i).	Network Protection Equipment (NPE)	
ii).	Submarine Line Terminating Equipment (SLTE)	
iii).	Power Feed Equipment (PFE)	
iv).	SCLS Power Supply Unit (PSU)	
v).	Interconnect PoP	

b) Availability of Critical Network Elements-Wet Section

Target: 99.999% availability

	Network Element	Availability (%)
i).	Repeaters	
ii).	Branching Units	

6.3 Link Availability

Target: 99.999% availability.

	Links	Availability (%)
i).	Link between the interconnect point where all other service providers connect to and the dry section of SCN	

7.0 NRRD Metrics for Internet Exchange Point (IXP) Operator

7.1 Service Availability

Target: 99.990% availability.

7.2 Network Element Availability

a) Availability of Critical Network Elements

Target: 99.999% availability

	Network Element	Availability (%)
i).	High speed Switching Fabric	
ii).	Authentication, authorization, and accounting (AAA)	
iii).	Firewall	
iv).	IX Route server	
v).	Multiplexer/ Demultiplexer (MUX/DMUX);	
vi).	Dynamic Name Server (DNS)	
vii).	Exchange Power Supply	
viii).	Switching Fabrics	
ix).	Caching servers	
x).	Routers	

b) Availability of Major Network Elements

Target: 99.900% availability.

	Network Element	Availability (%)
i).	World Wide Web Server	
ii).	Network Time Protocol (NTP)	

7.3 Link Availability

Target: 99.999% availability.

	Links	Availability (%)
i).	Link between ISP/CSP/HSP & Switching Fabric	
ii).	Link between Aggregation Point and MUX/DMUX	
iii).	Link between MUX/DMUX & Interconnect partners. e.g. Submarine Cable Network (SCN) and satellite operators	

8.0 NRRD Metrics for Fixed Network Operator

8.1 Service Availability

Target: 99.900% availability.

8.2 Network Element Availability

a) Availability of Critical Network Elements

Target: 99.999% availability

	Network Element	Availability (%)
i).	Local Exchange	
ii).	Tandem or Trunk Exchange	
iii).	Toll Exchange	
iv).	STP	

b) Availability of Major Network Elements

Target: 99.900% availability.

	Network Element	Availability (%)
i).	Cabinets	
ii).	Billing System	

8.3 Link Availability

Target: 99.900% availability.

	Links	Availability (%)
i).	Links between the Fixed Network Operator (FNO) and Mobile Network Operator (MNO)	
ii).	Links between Fixed Network Operator (FNO) and other FNOs	
iii).	Links between Fixed Network Operator (FNO) and FWA operator	
iv).	Links between Fixed Network Operator (FNO) and ISP / IXP	
v).	Links between Fixed Network Operator (FNO) and IGW	
vi).	Links between Fixed Network Operator (FNO) and SCN	

APPENDIX A: AVAILABILITY MEASURES

Metric Name	Description and Objective
a) Service Availability	Service Availability is defined as the ability of a service to perform its required function at a stated instant or over a stated period of time. **Calculation Method:** $$\boldsymbol{Service\ availability\ (Monitoring\ Period\ (M))}\ \% = \left[\mathbf{1} - \frac{\sum_i^N \boldsymbol{service\ downtime(i)}}{\boldsymbol{Monitoring\ Period\ (M)}}\right] * \mathbf{100}$$ Where: ***N*** **=** number of times the service is down (service unavailable or below QoS/SLA thresholds), Downtime and Monitoring period in seconds $$\boldsymbol{Cumulative\ Service\ availability\ (for\ K\ number\ of\ Monitoring\ Periods)}\ (\%) = \left[\mathbf{1} - \frac{\sum_1^K \sum_i^N \boldsymbol{service\ downtime(i)}}{\sum_1^K \boldsymbol{Monitoring\ period\ (M)}}\right] * \mathbf{100}$$ Where: ***K*** **=** the number of monitoring periods.
b) Network Element Availability	Network Element availability is defined as the ability of a network element to perform its required function at a stated instant or over a stated period of time. Note 1: • If there are redundant nodes deployed in active-standby model, then availability should be considered for the combined system. • If the redundant nodes are deployed in load-sharing mode and dimensioning is applied in such a way that failure of one node all the traffic is automatically moved to second available node, then availability should be considered for the combined system. • If the redundancy nodes require manual switchover & there is a potential loss of service while switching period, then availability should be considered for individual nodes. **Calculation Method: Shall be calculated separately for each network element type**

Metric Name	Description and Objective
	$$\textbf{Network Element X availability}\left(\textbf{Monitoiring Period}\ (\boldsymbol{M})\right)\% = \left[1 - \frac{\sum_i^N \textbf{Network Element}\ (\boldsymbol{X})\textbf{downtime}(\boldsymbol{i})}{\textbf{Monitoring Period}\ (\boldsymbol{M})}\right] * \mathbf{100}$$ Where**:** ***N* =** number of times a network element type is <u>down resulting in loss of service,</u> See Note 1 above. ***X* =** Represents a specific network element type. In a network, where there is a population of a network element type, the downtime of each element shall contribute to the overall downtime, e.g. failure of any transport links between core network and various elements up to the access nodes shall contribute to the overall downtime, where appropriate) Downtime and Monitoring period in seconds $$\textbf{Cumulative Network Element X availability}\ (\textbf{for K number of Monitoring Periods})\ (\%) = \left[1 - \frac{\sum_1^K \sum_i^N \textbf{Network Element}\ (\boldsymbol{X})\ \textbf{downtime}(\boldsymbol{i})}{\sum_1^K \textbf{Monitoring period}\ (\boldsymbol{M})}\right] * \mathbf{100}$$ Where: ***K* =** the number of monitoring periods.
c) Link Availability	Link Availability is defined as the period for which a link or links between two network elements or locations are available. See Note 1 above **<u>Calculation Method:</u> Shall be calculated separately for each external network it is connected to** $$\textbf{External Transport Link availability to Network Z}\ (\textbf{Monitoring Period M})\% = \left[1 - \frac{\sum_i^N \textbf{External Transport Link Availability to Network Z downtime}(\boldsymbol{i})}{\textbf{Monitoring Period}}\right] * \mathbf{100}$$ $$\textbf{Cumulative External Transport Link availability to Network}\ (\boldsymbol{Z})\ (\textbf{for K number of Monitoring Periods})\ (\%) = \left[1 - \frac{\sum_1^K \sum_i^N \textbf{External Transport Link Availability to Network Z downtime}(\boldsymbol{i})}{\sum_1^K \textbf{Monitoring period}\ (\boldsymbol{M})}\right] * \mathbf{100}$$ Where: ***K* =** the number of monitoring periods.

APPENDIX B: EXAMPLES OF HOW TO CALCULATE THE METRICS

Calculation of service availability, network availability and link availability
Examples apply to service availability, network availability and link availability
Notes:

1. Monitoring periods will vary due to different days in a month over a calendar year.
2. Cumulative availability is an integration of the current and previous downtimes for each reporting period.
3. In the examples below, example 1 is the start of monitoring NRRD metrics.
4. Two calculations shall be carried out for each monitoring period: one specific to the monitoring period and one considering the previous monitoring availability (cumulative)

Examples
Monitoring period (MP) = 3 Months
MP =3*31*24*60*60 = 8035230 Seconds

Example 1: Two downtimes during the monitoring period -> MP1-DT1 and MP1-DT2
MP1-DT1 = 30 minutes = 1800 seconds
MP1-DT2 = 15 minutes = 900 seconds
MP1 Availability = {1- [(1800+900)/8035230)} * 100
MP1 Availability = 99.966%

Example 2: One downtime during the monitoring period -> MP2-DT1
MP2-DT1 = 60 minutes = 3600 seconds
MP2 Availability = {1- [(3600)/8035230)} * 100
MP2 Availability = 99.955%
Cumulative availability (over 2 the monitoring periods) -> Integrate over MP1 and MP2
Cumulative availability (6 months) = {1- [(1800+900+3600)/(8035230+8035230)} * 100
Cumulative availability (6 months) =99.960%

Example 3: No downtime during the monitoring period
MP3-DT = 0 seconds
MP3–Availability = {1- [(0)/8035230)} * 100
MP3-Availability = 100%
Cumulative availability (over the 3 monitoring periods) -> Integrate over MP1, MP2 and MP3
Cumulative availability (9 months) = {1- [(1800+900+3600+0)/(8035230+8035230+80335230)} * 100
Cumulative availability (9 months) =99.974%

8. COMMENTS/ SUGGESTIONS

Please share any challenges faced and/or make suggestions to improve the regulatory environment.

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Signed…….
Name……..
Title……
Date …….

Company Stamp above

(NB: Where nil returns are provided an explanation <u>MUST</u> be provided under the Comments/Suggestions section of this form)

THANK YOU FOR COMPLETING THIS FORM

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