National Communications Authority

NatCA

13 Regent Road, Hill Station, Freetown

ITU Workshop on Telecommunication Service Quality

Roundtable on Telecommunication Service Quality
Case of Sierra Leone

Freetown, Sierra Leone

1-2 July 2025

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Objectives

- Share relevant legal and regulatory provisions on QoS and QoE
- Bring out the shortfalls and proffer reasons for the revision of the QoS Regulations 2020
- Outline QoS and QoE measurement and monitoring methods
- Provide insights into QoS and QoE KPIs
- Enforcement mechanisms

Defining Quality of Service & Quality of Experience

What is Quality of Service (QoS)?

Quality of Service (QoS), as defined by the ITU, is totality of characteristics of a telecommunications service that bear on its ability to satisfy stated and implied needs of the user of the service.

What is Quality of Experience (QoE)?

- Initially Quality of Experience (QoE) was defined as the overall acceptability of an application or service, as perceived subjectively by the end-user (according to ITU-T Recommendation P.10/G.100).
- ITU-T has replaced the QoE definition developed in 2007 with a new definition adopted in 2016, which is currently the actual QoE definition, that is:

Quality of experience (QoE) is the degree of delight or annoyance of the user of an application or service.

Legal and Regulatory Provisions

- Section 179 (3) states that the National Communications Act 2022 by statutory instrument make rules on the following-

a) the regulation of quality of service of licensee in line with ITU standards

b) the necessary quality of service parameters and acceptable service levels

c) monitor compliance with the prescribed quality of service parameters

d) Auditing the quality of service reports submitted by licensees

- Section 179 (1) stipulates that "the authority shall receive periodic reports on the quality of service as may be specified by the Authority, stating the level of service quality it achieved in the previous quarter".
- Section 116 (4) (b) states that "together with Bank of Sierra Leone may regulate communications value-added services including non-bank-led money services initiated and terminated on communications platforms……"

Legal and Regulatory Provisions Cont.

- Section 4 (a) of the Quality of Service Regulations 2020 indicates that “subject to the Act and regulations made under the Act, each licensee shall deliver services at a performance level that meets or exceeds levels of performance as set out these Regulations”
- Section 21 (3) of the Quality of Service Regulations 2020 states that “the sanctions set out in the fifth schedule shall apply for non- compliance with quality of service provisions under these Regulations”

Quality of Service Regulations 2020

The QoS Regulations 2020 provided the foundation for measuring and monitoring KPIs for the telecommunication services:

- Mobile telephone services (2G and 3G)- KPI targets monitored and measured based on sites but not cells
- Interconnection services- International Route utilization, Network Effectiveness & Time to Repair International Route
- Wireless Broadband Services- latency, throughput, service availability etc.
- Cabled Communications Services- Service connection success rate, MTTR, latency, etc.
- Billing, Customer Service- Billing accuracy, call center response time, IVR waiting time, etc.
- Customer satisfaction- in terms of service availability, accessibility, reliability help/enquiry, etc.
- *Qos 2020 Regulations is found on:* https://www.natca.gov.sl/wp-content/uploads/2025/06/Final-Draft-QoS-Regulations-2019.pdf

Why 2025 Quality of Regulations

- Due to the emergence and rapid evolution of technologies and associated services, 2020 QoS regulations became relatively ineffective and inefficient to performance relevant regulatory

Mobile Telephone Services- No QoS 4G & 5G monitoring and measurement mandate

Monitoring and Measurement per Site- No Cell level monitoring and measurement mandate

Limited Scope of Reporting for various QoS related issues to the Authority

Drive Test Measurements: No enforceable Qos & QoE Drive Test Monitoring and Measurement Procedures

Customer Service: Weak Customer Complaints Resolution mechanisms

Limited scope in investigating measurement and record keeping procedures

Improper auditing procedure of quality of service data

Limited scope for support to Public Emergencies and National Security

QoS 2025 Regulations is found on- https://www.natca.gov.sl/wp-content/uploads/2025/06/Final-Draft-QoS-Regulations-2025.pdf

Comparing QoS 2020 and QoS 2025 Regulations

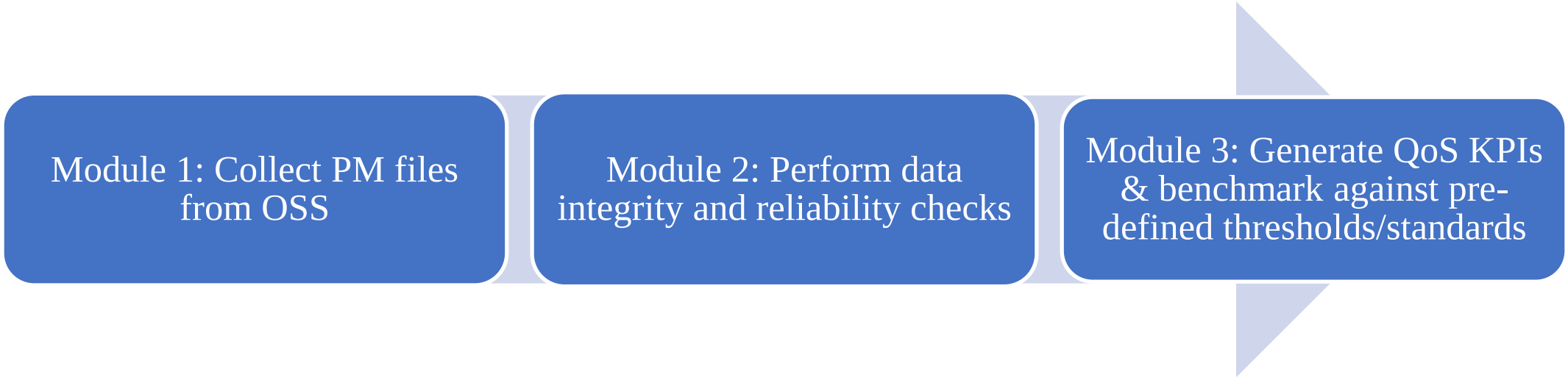
QoS 2020	QoS 2025
Mobile Telephony Network Operators – 2G & 3G services	Mobile Telephony Network Operators- 2G,3G,4G & 5G spectrum trial services
Broadband Internet Service Providers	Broadband Internet Service Providers including satellite services (Starlink)
Cabled (Copper & Fiber Optic) Network service providers	Cabled (Copper & Fiber Optic) Network service providers
	Infrastructure Service Providers
	Non-bank-led digital financial service providers – Mobile money service providers
	Over-The-Top (OTT) Licensed service providers

QoS and QoE Measurement & Monitoring Methods

- Analysis of Performance Management (PM) Files extracted from BSC & RNC and Interconnections points- Using fixed probes, mobile station probes & data collected from NMS or NOC
- Drive Tests- Using drive Test tools including hardware (mobile test phones) and software
- Consumer Perception Survey- Periodically conducting a survey to determine the degree of delight and annoyance of consumers (mostly QoE perspective)

Network Performance Measurement

- Collect Operator's Performance Management (PM) data and fed into the Authority's Network Monitoring System (NMS) hosted by SALCAN Telecom
- NMS interfaces passively with the Operator's Operations Support System (OSS) platform via a Virtual Private Network (VPN) connection
- Monthly performance measurements of eight (8) KPIs for 2G and 3G services with respective thresholds
- The modular architectural workflow of the NMS is captured below:



Current PM Measured and Monitored 2G & 3G KPIs and Thresholds

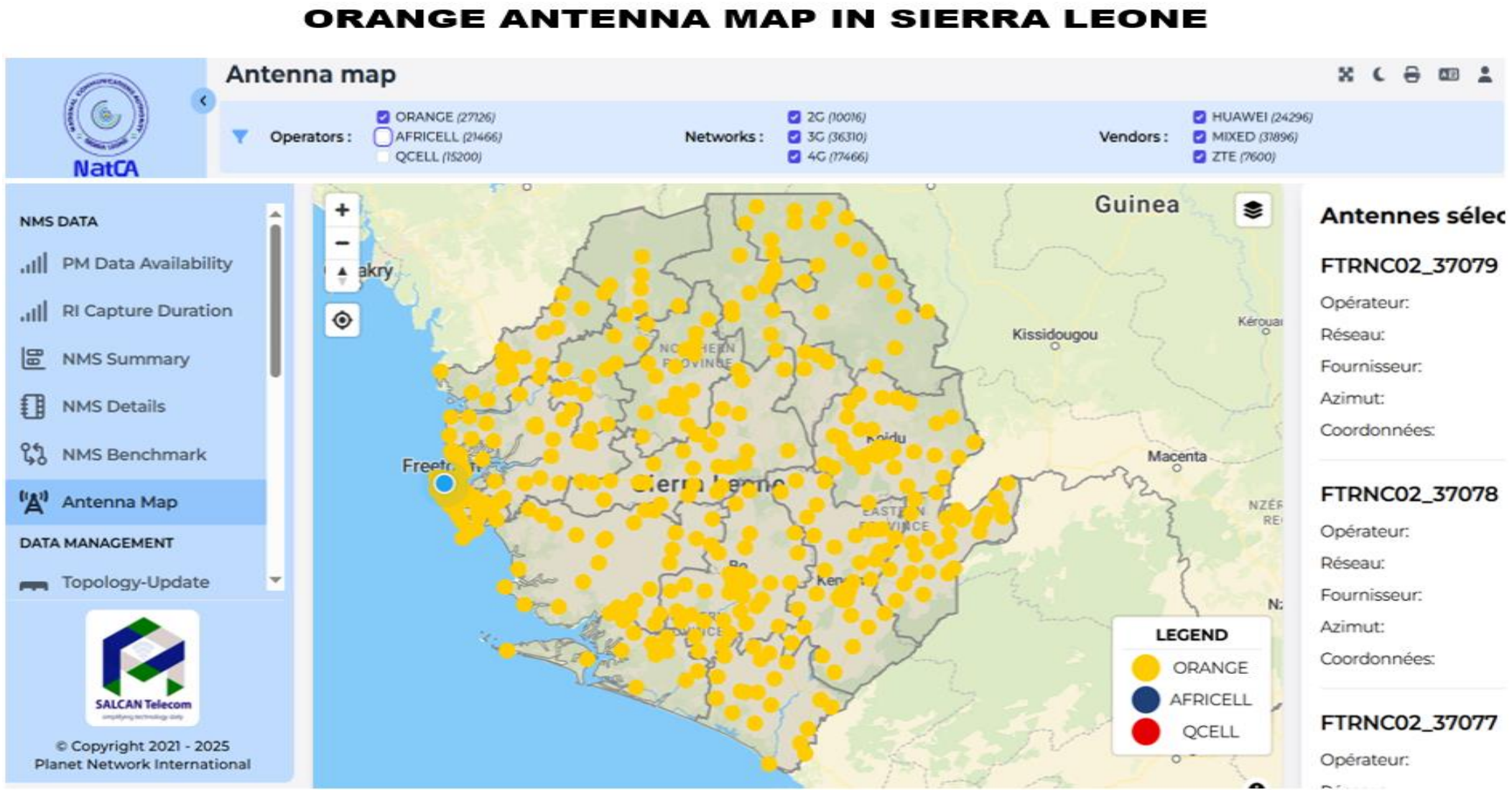
2G KPIs

KPIs	Threshold
SDCCH Congestion	< 15%
TCH Congestion	< 15%
Call Drop Rate	< 2%
Call Connection Success Rate or Call Setup Success Rate	> 95%

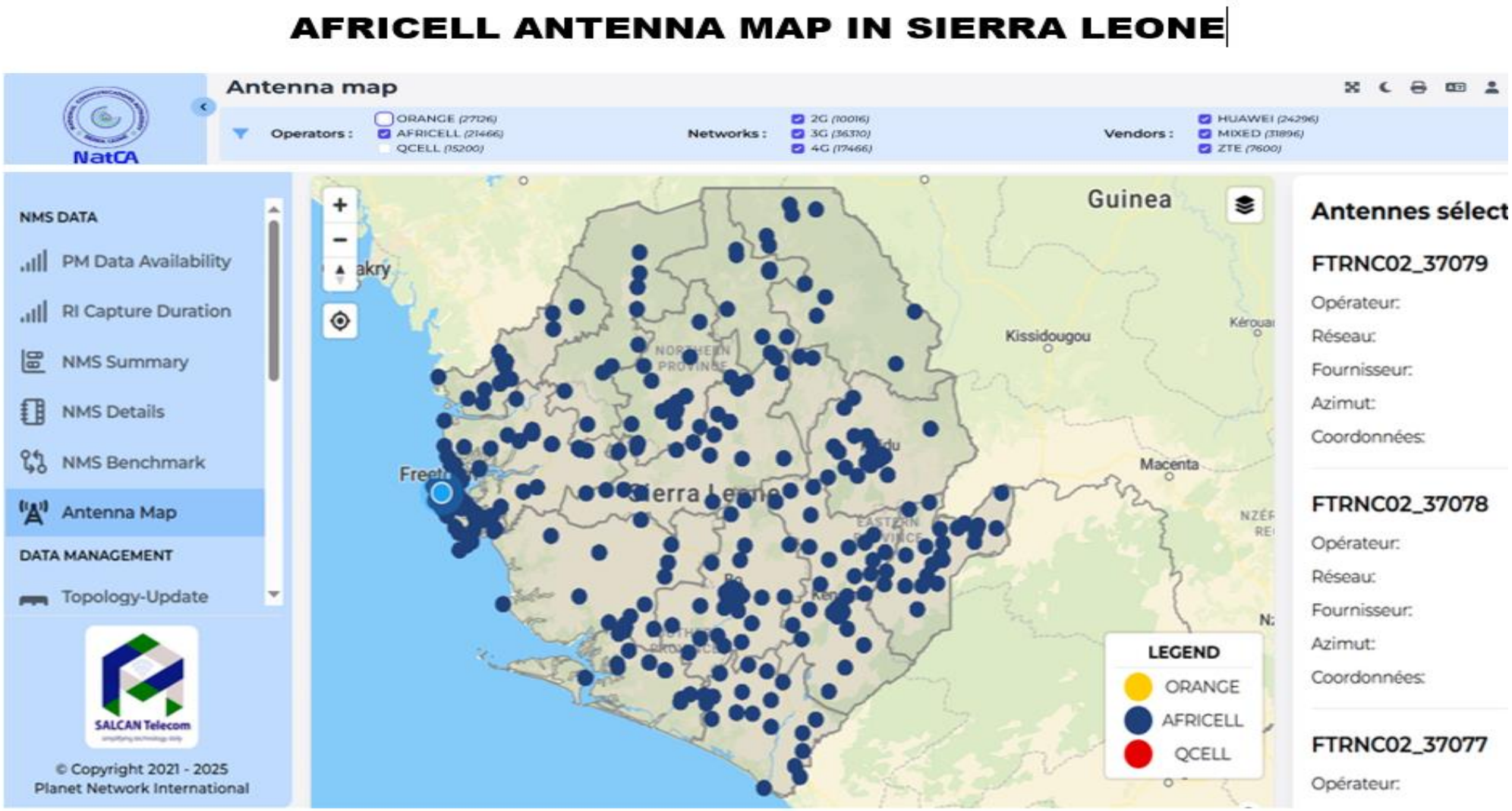
3G KPIs

KPIs	Threshold
Voice Call Drop Rate	< 2%
Voice Call Connection Success Rate	> 95%
Data Access Success Rate	> 98%
Data Drop Rate	< 2%

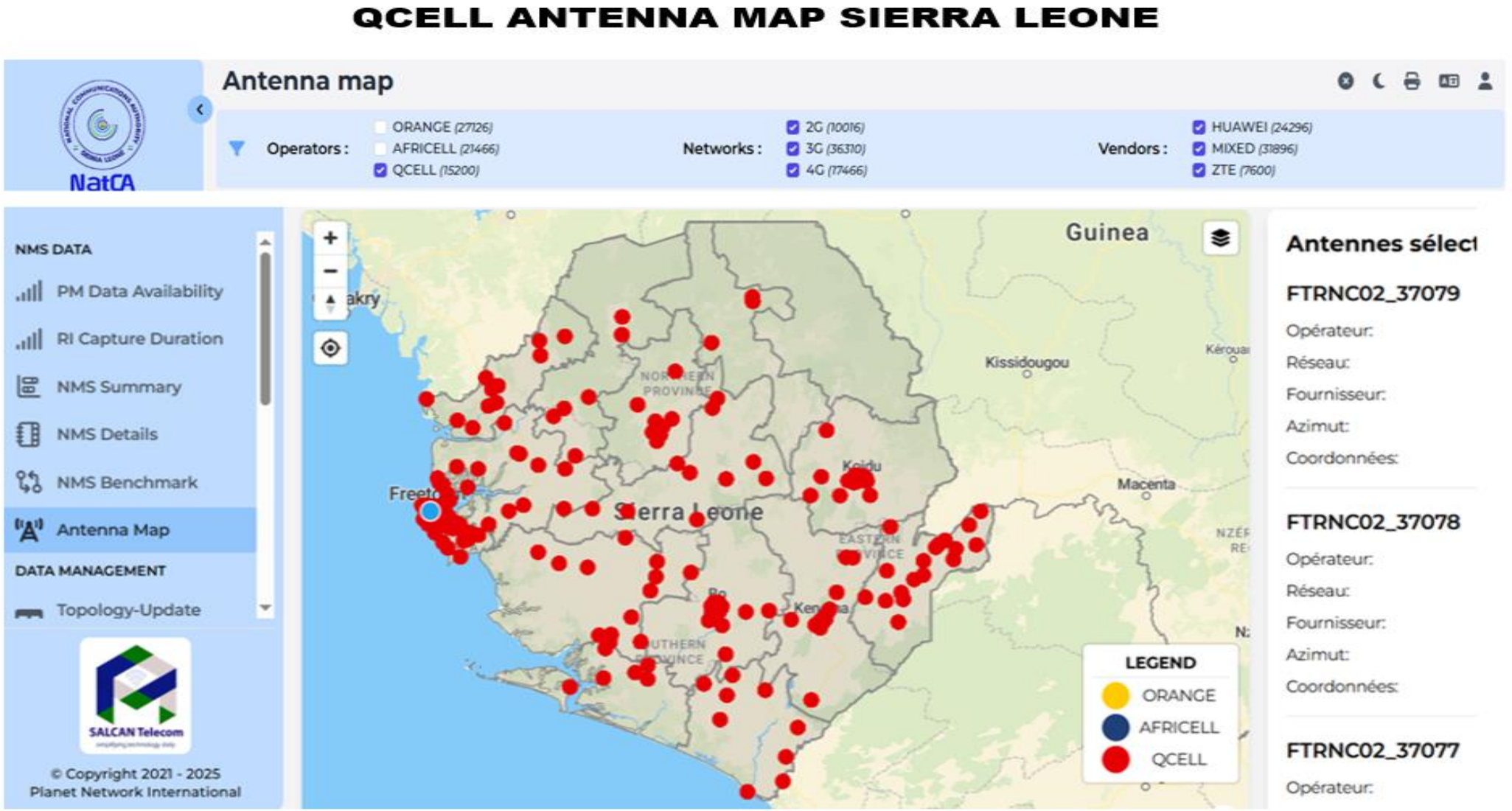
Output of NMS- Orange Antenna Map



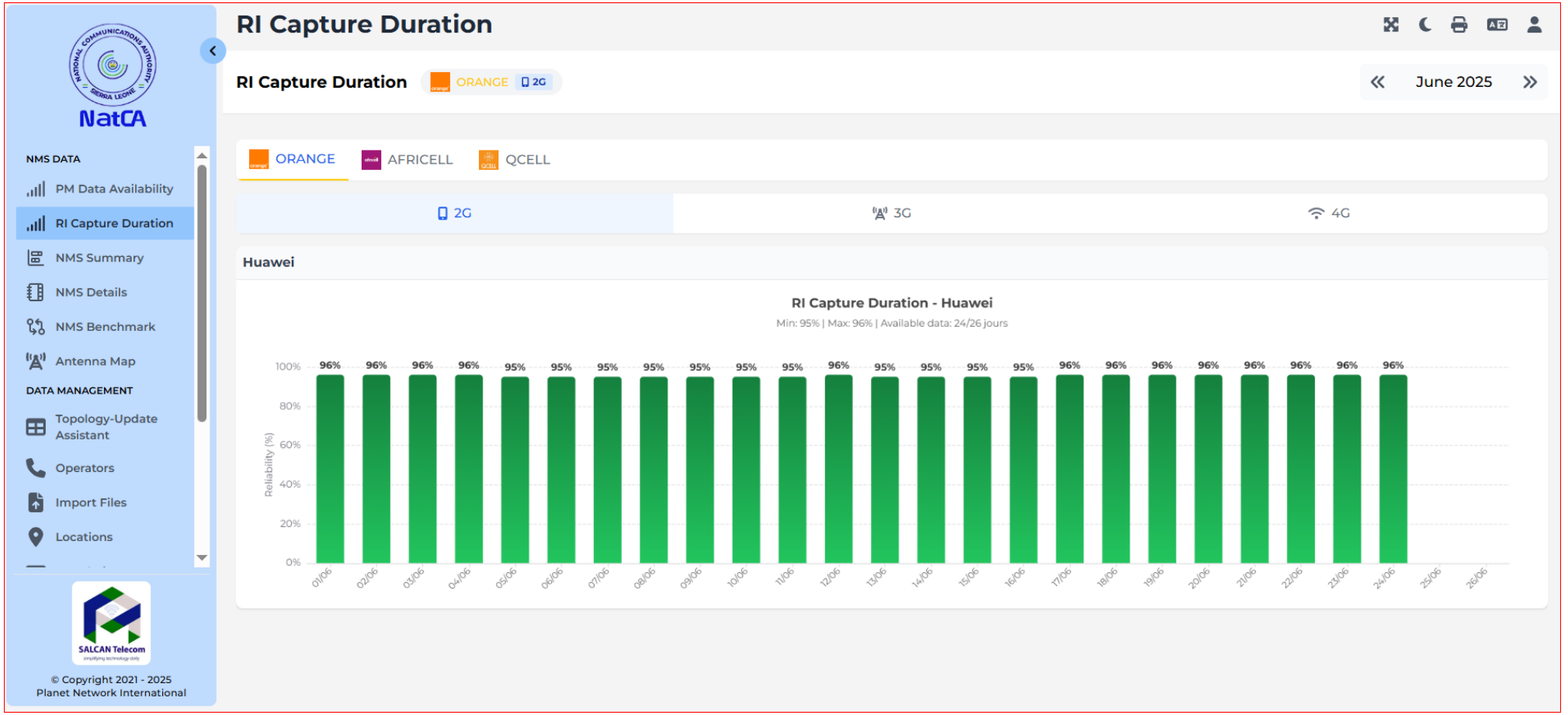
Output of NMS- Africell Antenna Map



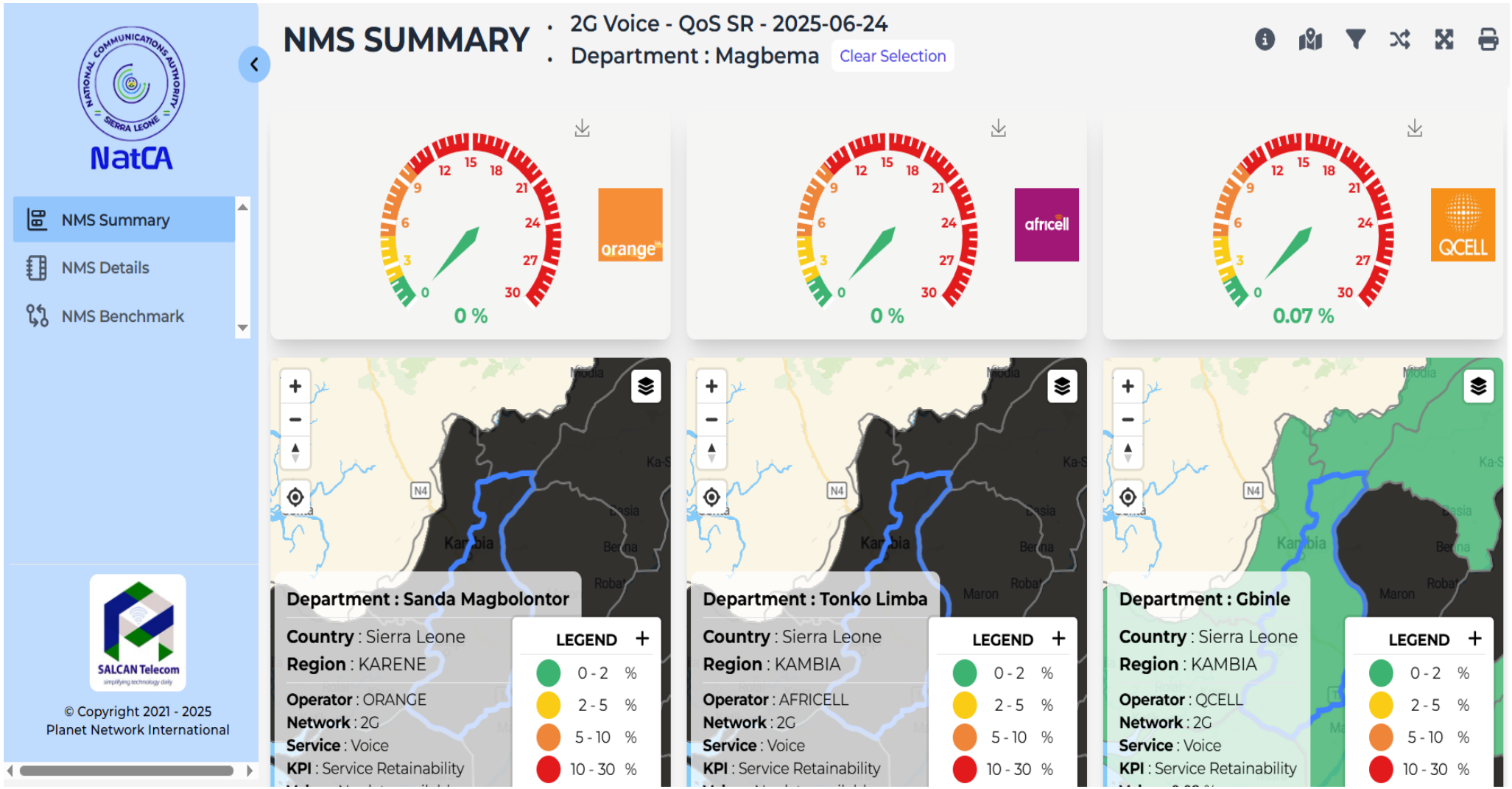
Output of NMS- Qcell Antenna Map



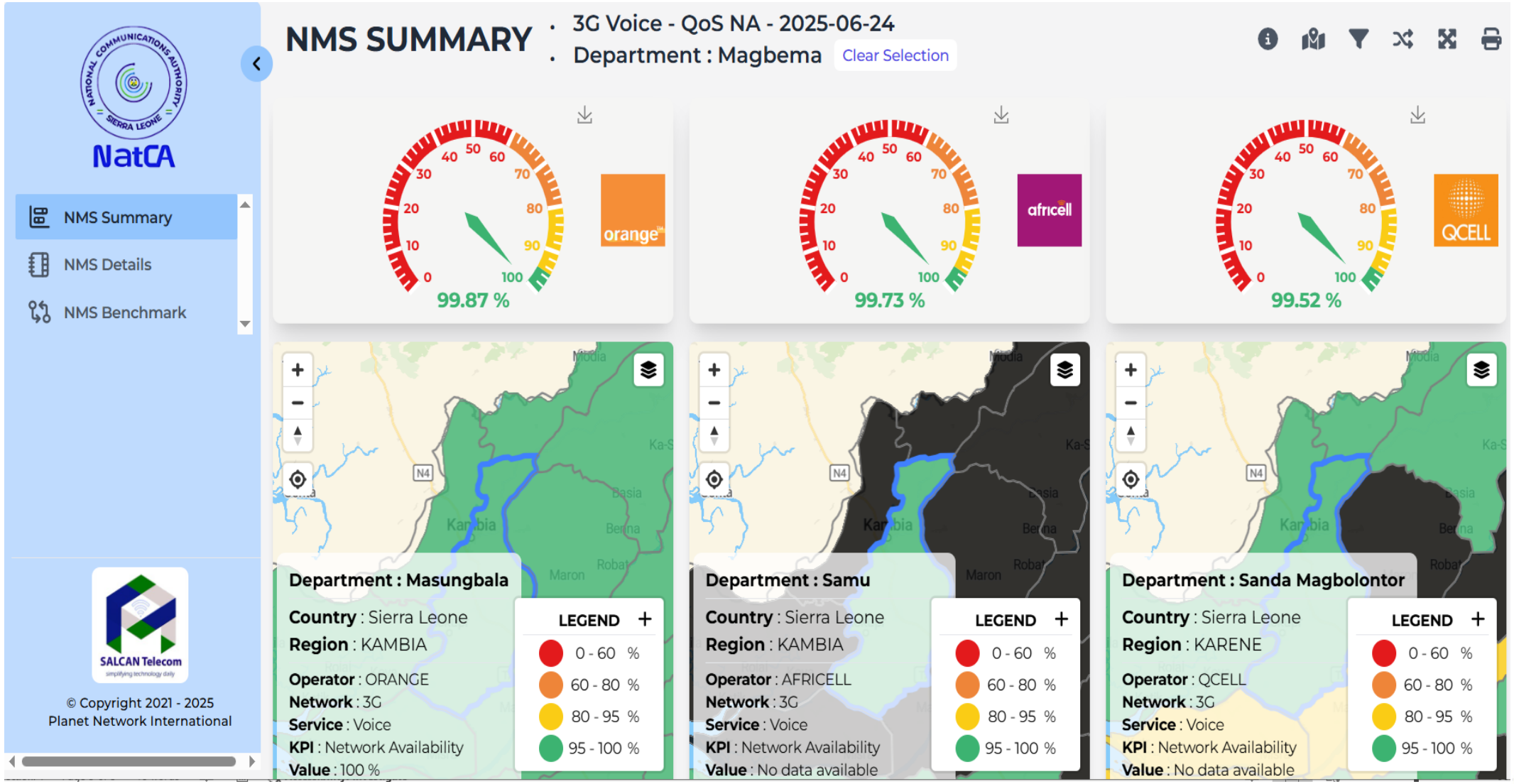
Output of NMS- Network Reliability Sample



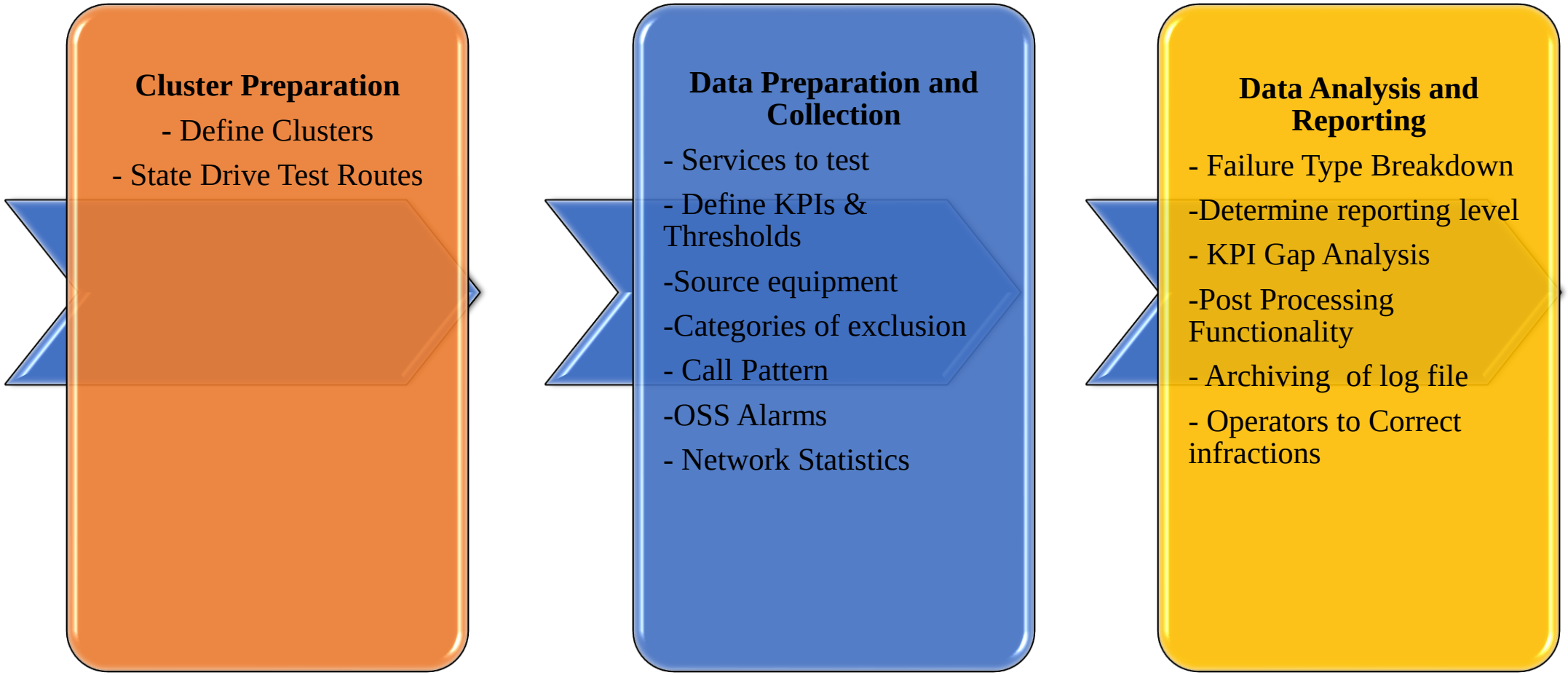
Output of NMS- 2G Voice QoS Service Retainability Sample



Output of NMS- QoS 3G Voice Network Availability Sample



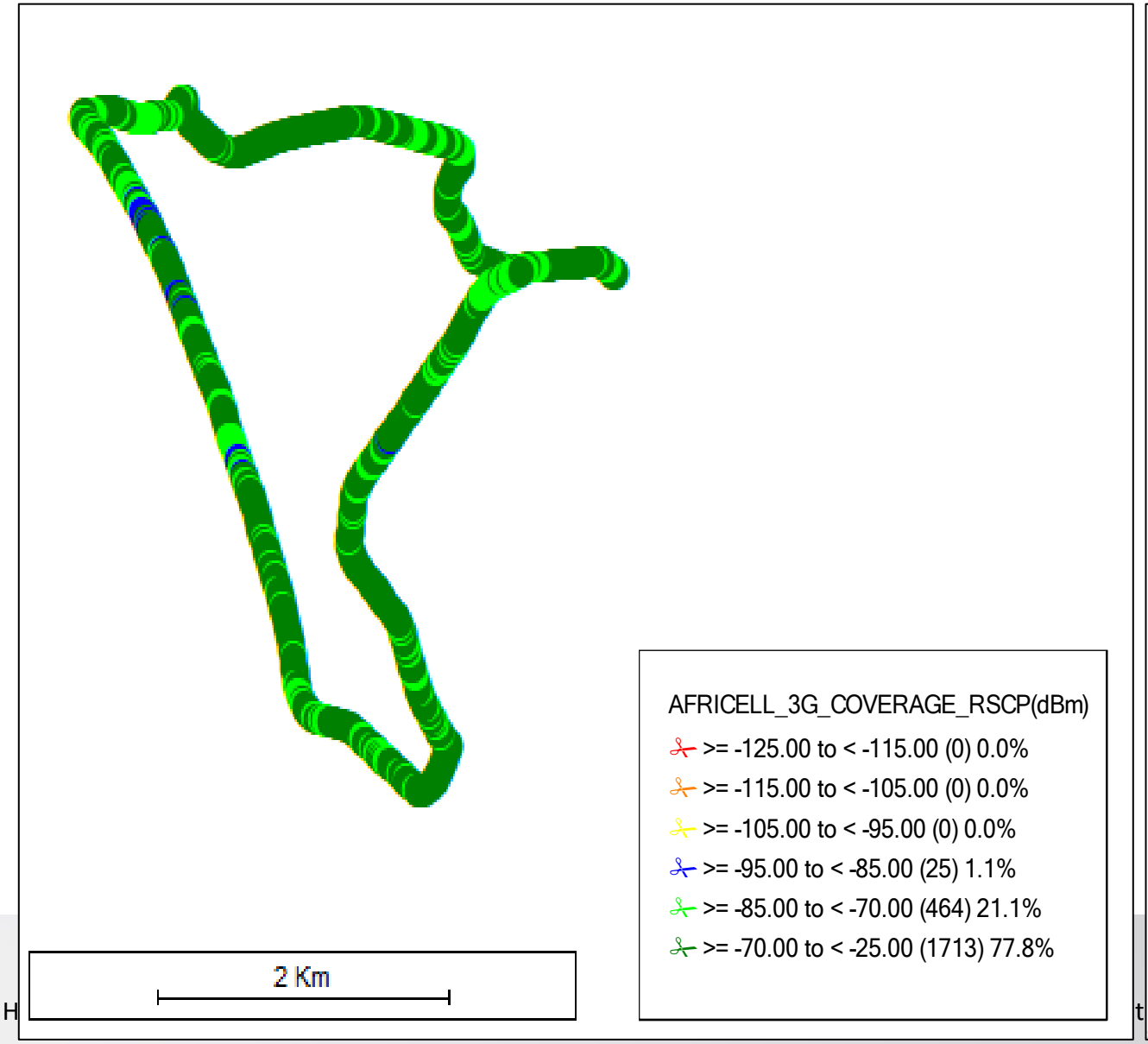
Drive Test Process

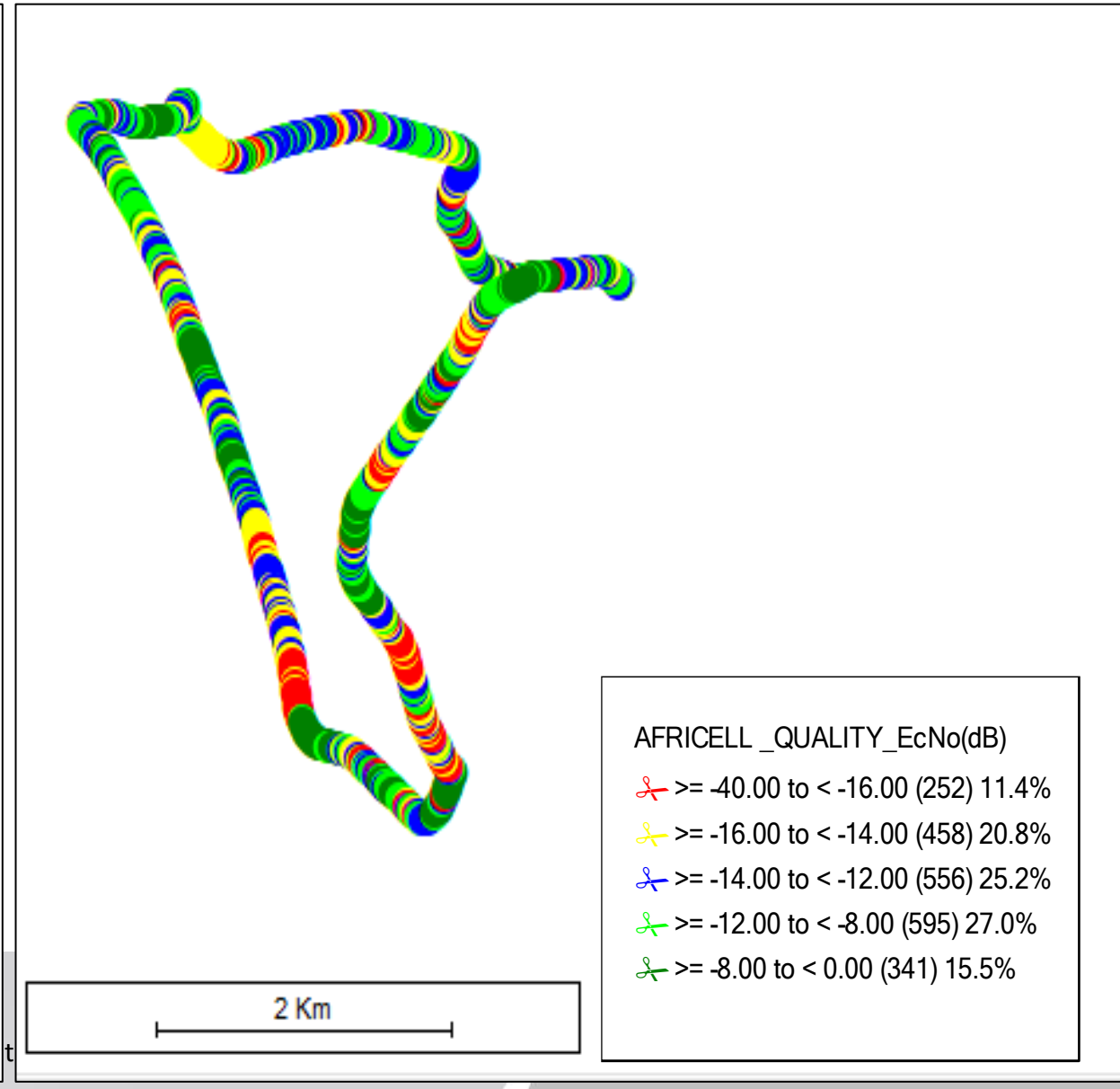


Drive Test Measured and Monitored KPIs and Threshold

KPI	Threshold	Service Type
Call Setup Time	< 6 Second (95% of CST)	2G
Voice Quality (Mean Opinion Score)	≥ 3.5	2G
Coverage Signal Strength (Rx Level/Rx Quality)	Outdoor: >-70dBm (RSSI Levels)	2G
Mobility (Handover Success Rate)	95%-Urban; ≥ 94% Sub-Urban, ≥ 93%-Rural	2G & 3G
Call Setup Time	< 6 Second (95% of CST)	3G
Voice Quality (Mean Opinion Score)	≥ 3.5	3G
Coverage Signal Strength (Received Signal Code Power)	Outdoor: >-85dBm (RSCP Levels)	3G
Data Throughput (Download)	≥ 1.5Mbps	3G
Voice Service Access delay	≤ 10 Seconds	3G
Data Service Access Time	< 5 Second (90% of the time)	3G
Latency	< 105ms-National	3G
Data Service Drop Rate	< 2% (95% of cell)	3G
Data Access Success Rate	95%-Urban; ≥ 94% Sub-Urban, ≥ 93%-Rural	3G
Circuit Switched Fallback (CSFB)	≥ 98% (95% of cell)	4G
Coverage (Reference Signal Received Power)	Outdoor: >-90dBm (RSRP Levels)	4G
Latency	< 100ms-National	4G
Data Throughput (Download)	≥ 10Mbps	4G
Data Service Access Time	< 5 Second (90% of the time)	4G

AFRICELL: 3G Coverage/Quality





AFRICELL: 3G Coverage/Quality Samples

Coverage Samples

Color	Range(dBm)	#Samples	%
	-125.00 to -115.00	0	0
	-115.00 to -105.00	0	0
	-105.00 to -95.00	0	0
	-95.00 to -85.00	25	1.1
	-85.00 to -70.00	464	21.1
	-70.00 to -25.00	1713	77.8

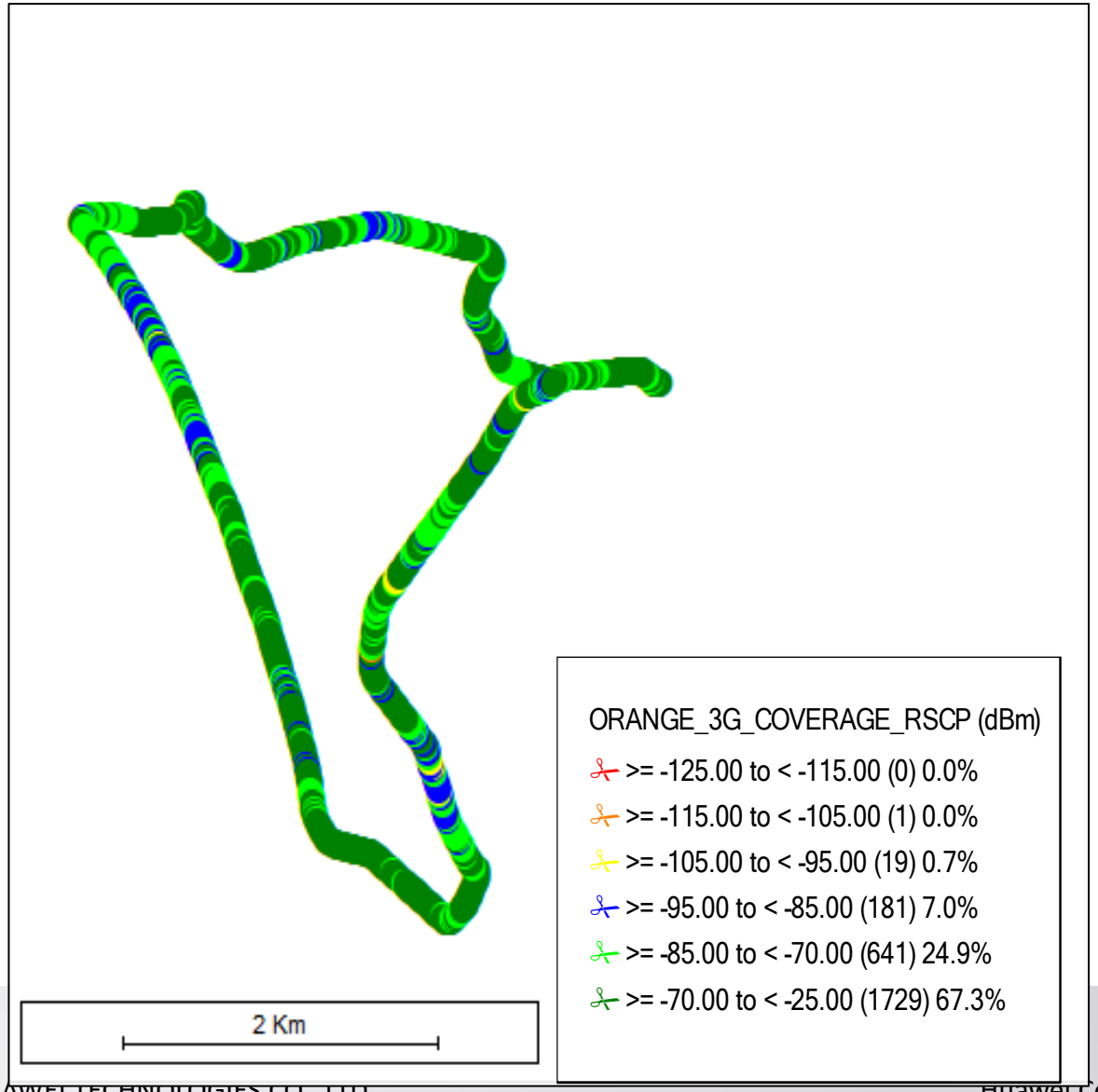
Quality Samples

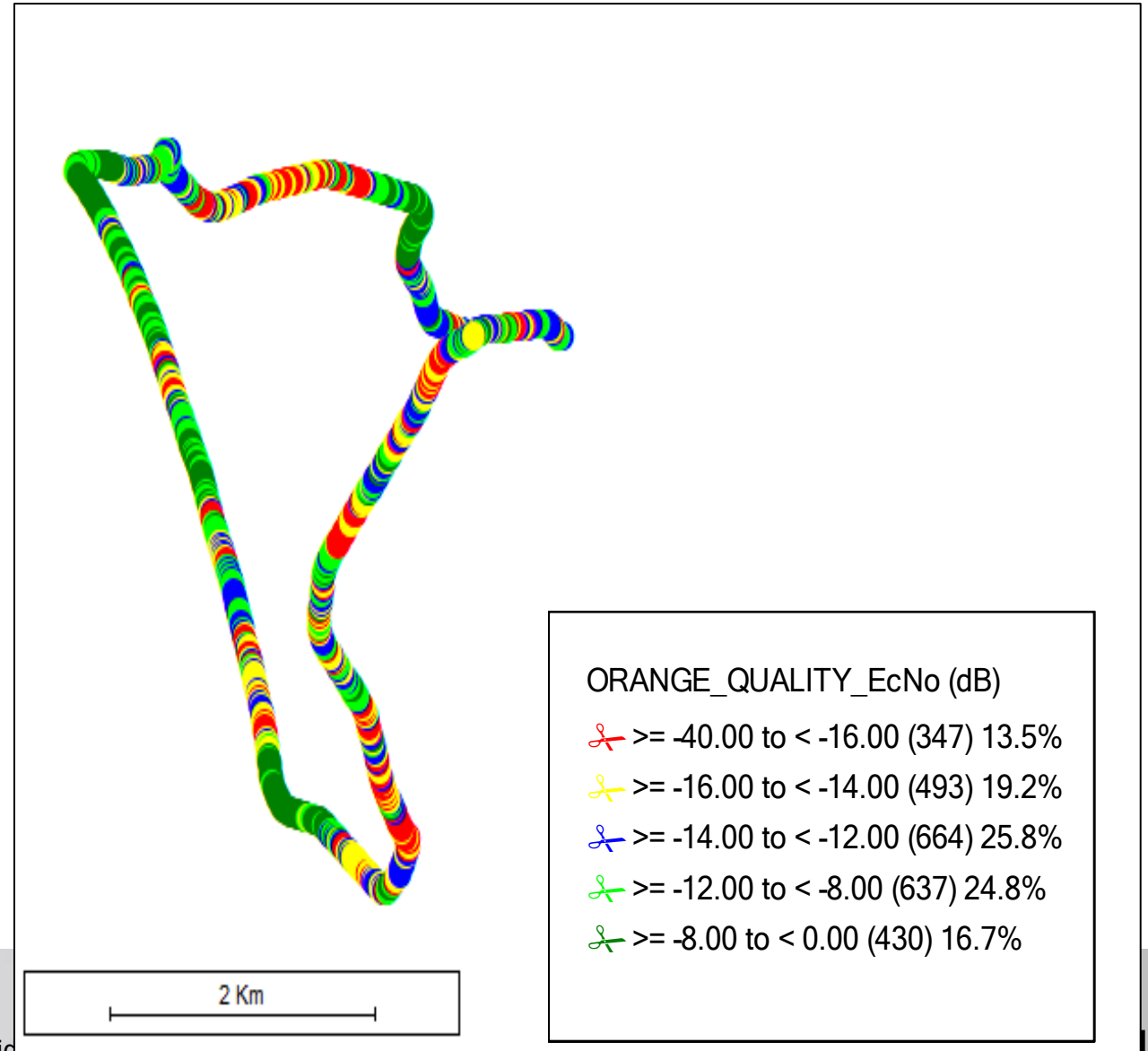
Color	Range(dB)	#samples	%
	-40.00 to -16.00	252	11.4
	-16.00 to -14.00	458	20.8
	-14.00 to -12.00	556	25.5
	-12.00 to -8.00	595	27
	-8.00 to 0.00	341	15.5

Average RSCP: -55.81 dBm

Average EcNo: -12.01 dB

ORANGE: 3G Coverage/Quality





ORANGE: 3G Coverage/Quality Samples

Coverage Samples

Color	Range(dBm)	#samples	%
	-125.00 to -115.00	0	0.0
	-115.00 to -105.00	1	0.0
	-105.00 to -95.00	19	0.00
	-95.00 to -85.00	181	7.0
	-85.00 to -70.00	641	24.9
	-70.00 to -25.00	1729	67.3

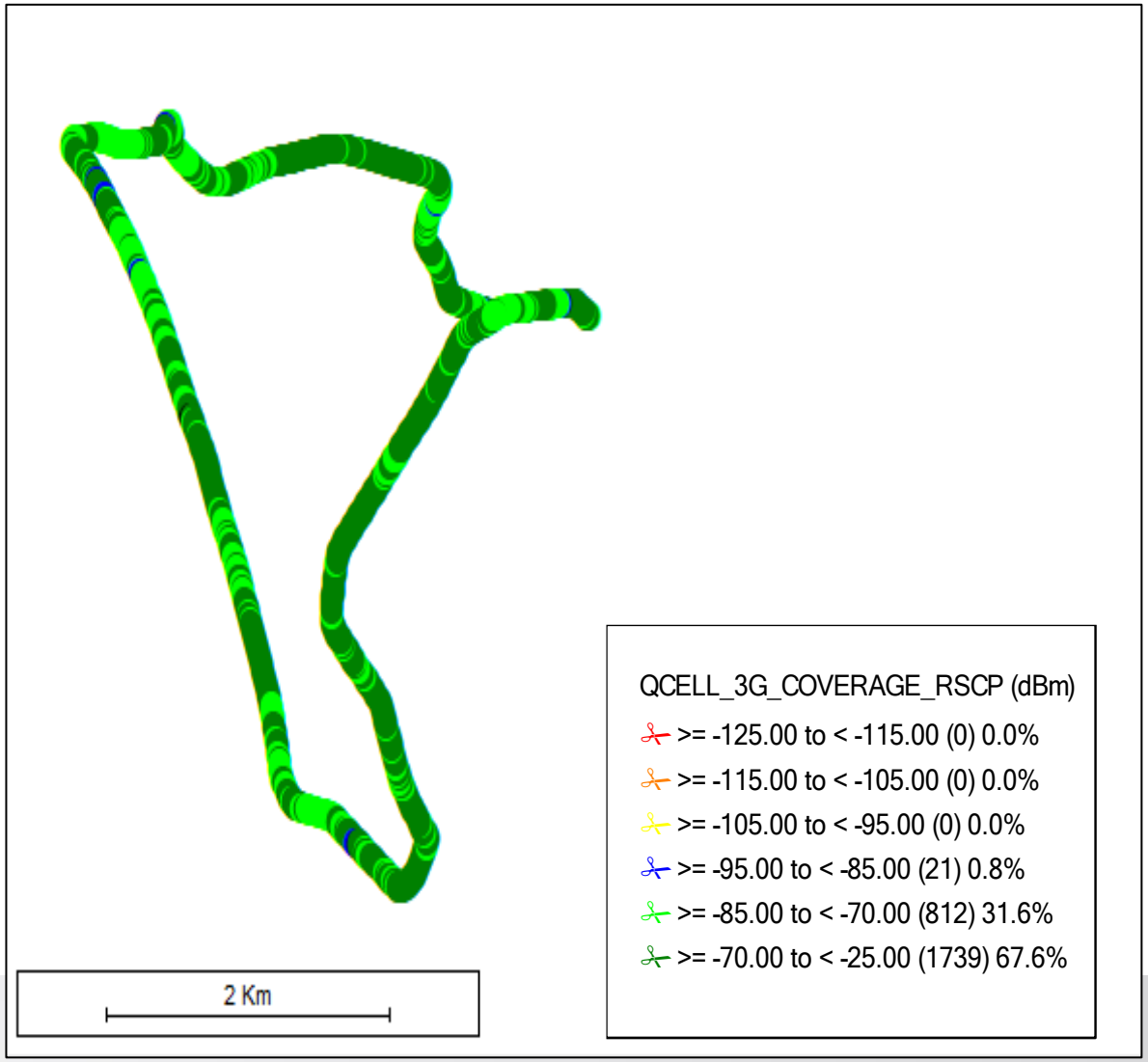
Quality Samples

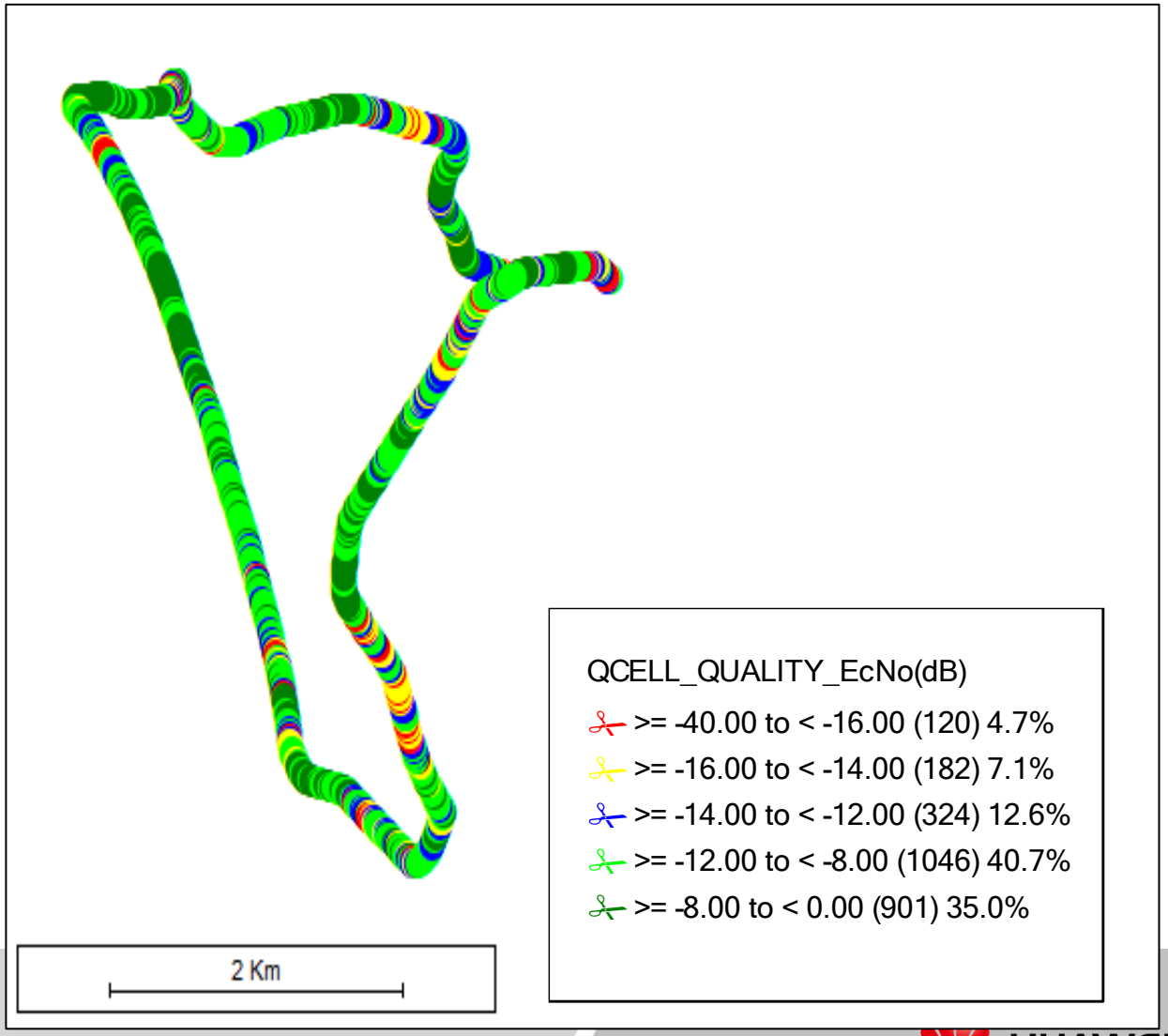
Color	Range(dB	#sample	%
	-40.00 to -16.00	347	13.5
	-16.00 to -14.00	493	19.2
	-14.00 to -12.00	664	25.8
	-12.00 to -8.00	637	24.8
	-8.00 to 0.00	430	16.7

Average RSCP: -61.62 dBm

Average EcNo: -12.20 dB

QCELL: 3G Coverage/Quality





QCELL: 3G Coverage/Quality Samples

Coverage Samples

Color	Range(dBm)	#samples	%
	-125.00 to -115.00	0	0
	-115.00 to -105.00	0	0
	-105.00 to -95.00	0	0
	-95.00 to -85.00	21	0
	-85.00 to -70.00	812	31.6
	-70.00 to -25.00	1739	67.6

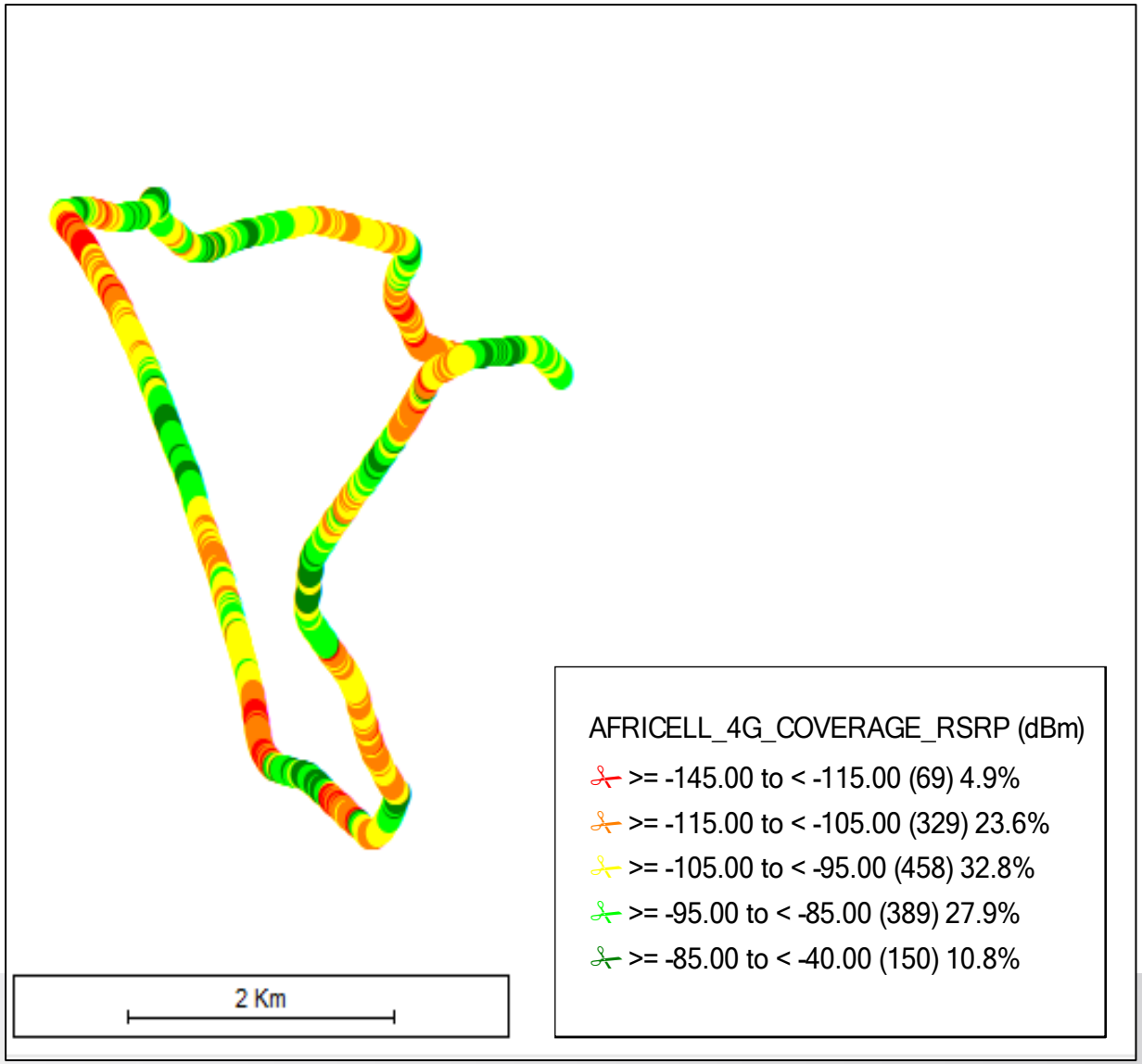
Quality Samples

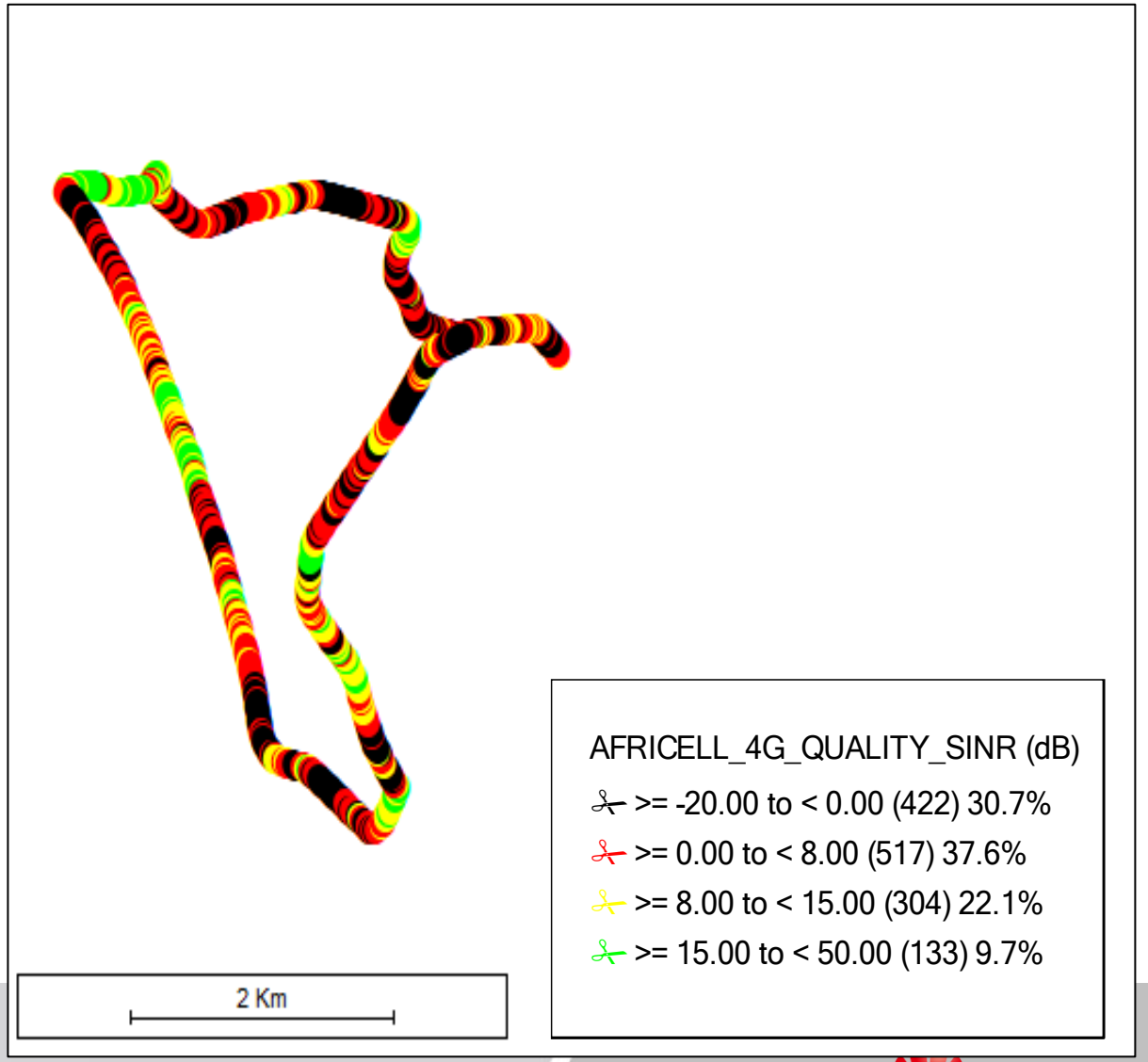
Color	Range(dB)	#samples	%
	-40.00 to -16.00	120	4.7
	-16.00 to -14.00	182	7.1
	-14.00 to -12.00	324	12.6
	-12.00 to -8.00	1046	40
	-8.00 to 0.00	901	35

Average RSCP: -62.26 dBm

Average EcNo: -9.67 dB

AFRICELL: 4G COVERAGE/SINR





AFRICELL: 4G Coverage/Quality Samples

Coverage Samples

Color	Range(dBm)	#RSRP samples	%
	-145.00 to -115.00	69	4.9
	-115.00 to -105.00	329	23.6
	-105.00 to -95.00	458	32.8
	-95.00 to -85.00	389	27.9
	-85.00 to -40.00	150	10.8

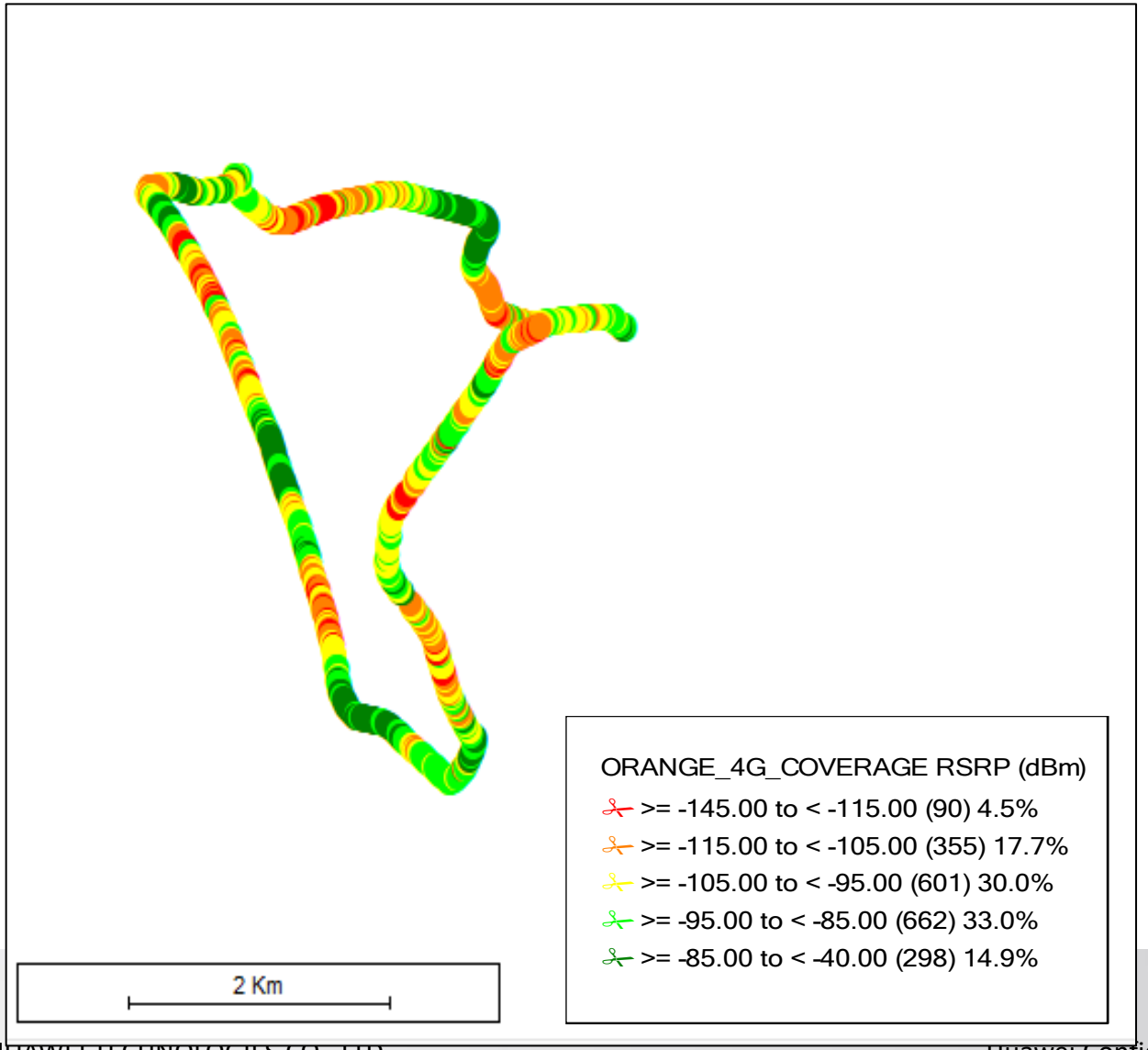
Quality Samples

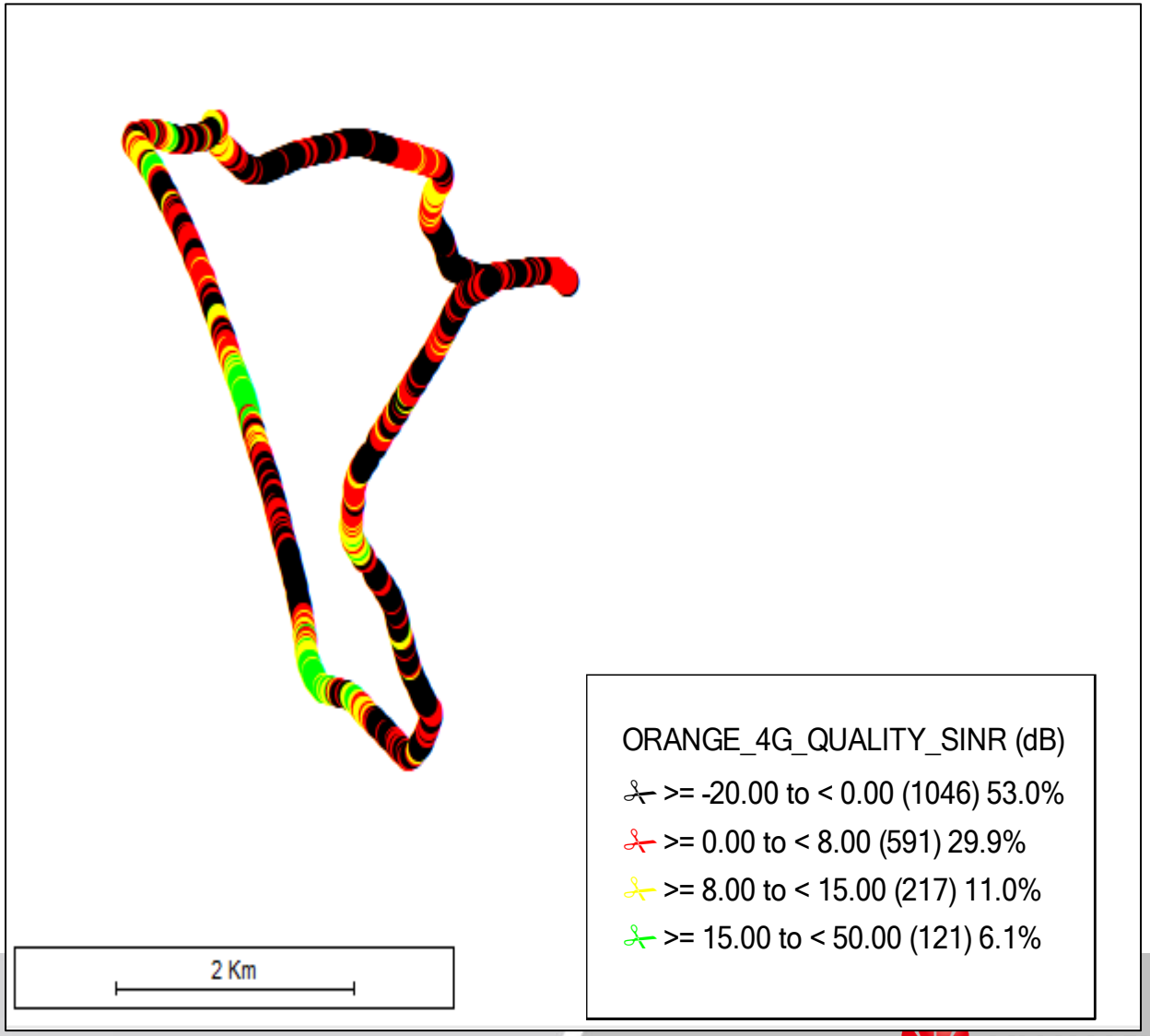
Color	Range(dB)	#samples SINR	%
	-20.00 to 0.00	422	30.7
	0.00 to 8.00	517	37.6
	8.00 to 15.00	304	22.1
	15.00 to 50.00	133	9.7

Average RSRP:-98.38 dBm

Average SINR: 4.38 dB

ORANGE: 4G COVERAGE/SINR





ORANGE: 4G Coverage/Quality Samples

Coverage Samples

Color	Range(dBm)	# Samples_RSRP	%
	-145.00 to -115.00	90	4.5
	-115.00 to -105.00	355	17.7
	-105.00 to -95.00	601	30.0
	-95.00 to -85.00	662	33.0
	-85.00 to -40.00	298	14.9

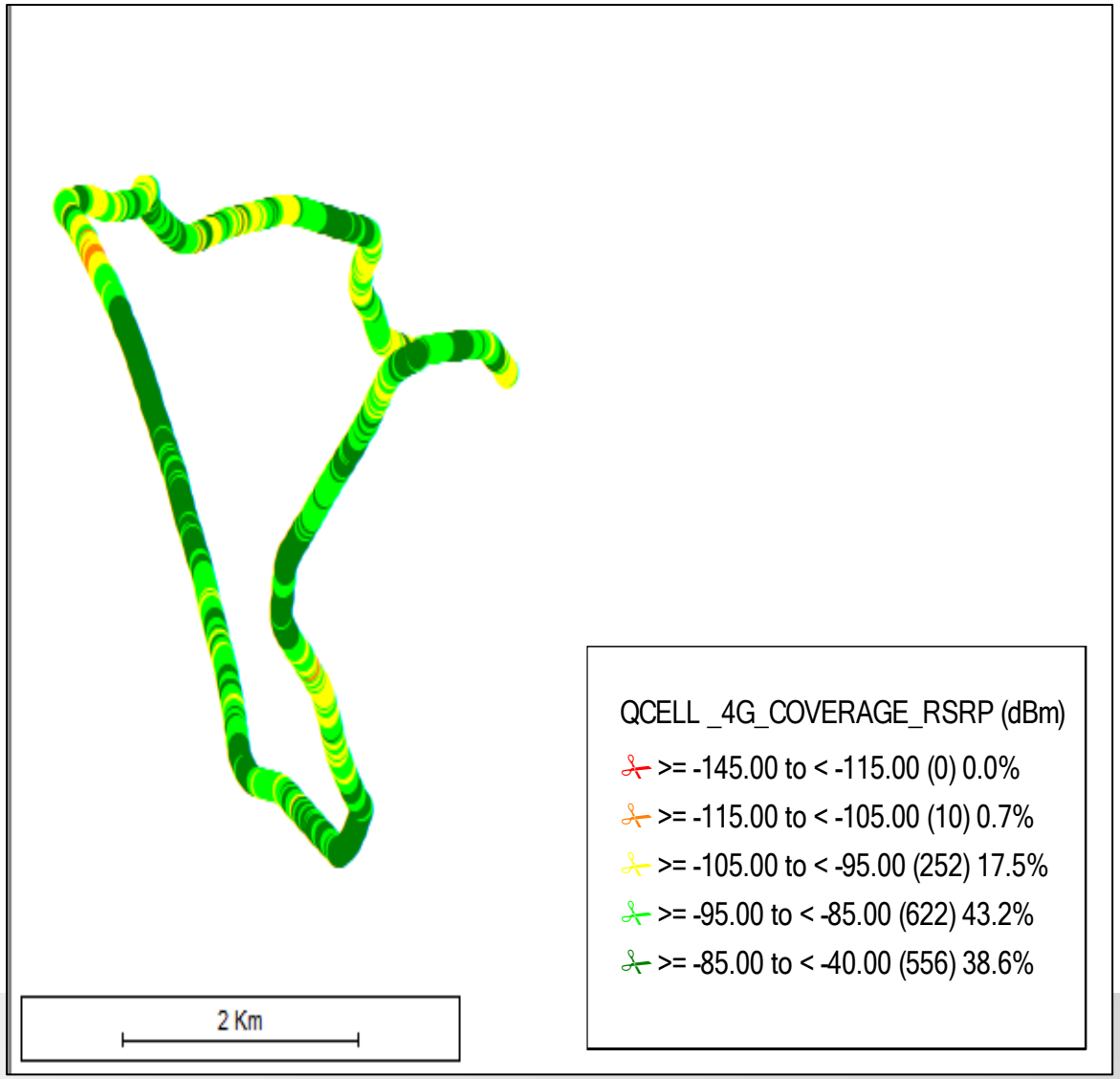
Quality Samples

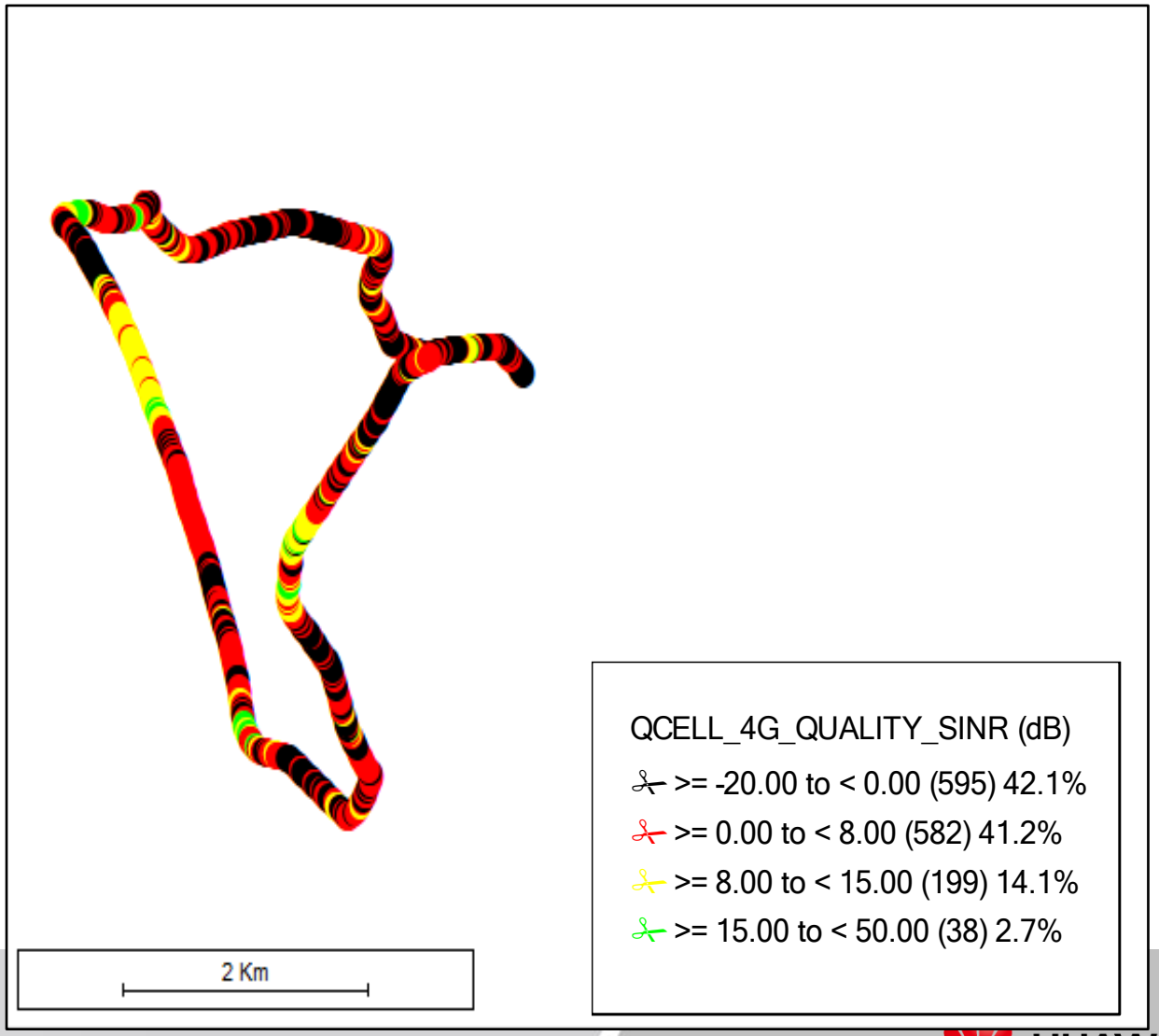
Color	Range(dB)	# Samples SINR	%
	-20.00 to 0.00	1046	53.0
	0.00 to 8.00	591	29.9
	8.00 to 15.00	217	11.0
	15.00 to 50.00	121	6.1

Average RSRP:-96.14 dBm

Average SINR: 0.86 dB

QCELL: 4G COVERAGE/SINR





QCELL: 4G Coverage/Quality Samples

Coverage Samples

Color	Range(dBm)	# Samples_RSRP	%
	-145.00 to -115.00	0	0.0
	-115.00 to -105.00	10	0.7
	-105.00 to -95.00	252	17.5
	-95.00 to -85.00	622	43.2
	-85.00 to -40.00	556	38.6

Quality Samples

Color	Range(dB)	# Samples SINR	%
	-20.00 to 0.00	585	42.1
	0.00 to 8.00	582	41.2
	8.00 to 15.00	199	14.1
	15.00 to 50.00	38	2.7

Average RSRP:-98.38 dBm

Average SINR: 4.38 dB

KPIs, Measurement Methods, Threshold & ITU Reference

2G Mobile Network KPIs			
KPI	**Measurement Method**	**Threshold**	**ITU Reference**
TCH Congestion	Drive Test, PM Tools	≤2%	ITU-T E.880
SDCCH Congestion	Drive Test, PM Tools	≤1.5% (Urban), ≤3% (Rural)	ITU-T E.880
Call Setup Success Rate	Drive Test, PM Tools	≥95%	ITU-T E.850
Drop Call Rate	Drive Test, PM Tools	<2%	ITU-T E.846
Handover Success Rate	Drive Test, PM Tools	≥95% Urban ≥93% Rural	ITU-T E.880
MOS	POLQA (Drive Test)	≥3.5	ITU-T P.863
Call Setup Time	Drive Test Tools	<6 seconds	ITU-T E.721
Cell Availability	PM Tools	>95%	ITU-T E.801
SMS Delivery Success	PM Tools	>98%	ITU-T Q.1400
SMS/MMS Delivery Time	Drive Test Tools	<5 seconds (90%)	ITU-T Q.3930
Signal Strength (RxLev)	Drive Test Tools	Outdoor ≥–70 dBm	ITU-R M.1036
Voice Access Delay	Drive Test Tools	≤12 seconds	ITU-T E.807 / G.1028.2

KPIs, Measurement Methods, Threshold & ITU Reference

3G Mobile Network KPIs			
KPI	**Measurement Method**	**Threshold**	**ITU Reference**
Call Setup Success Rate (CS/PS)	Drive Test, PM Tools	≥95%	ITU-T E.850
RRC Connection Success (CS/PS)	Drive Test, PM Tools	≥95%	ITU-T Q.3910
RAB Establishment Success	Drive Test, PM Tools	≥95%	ITU-T Q.3910
HSUPA/HSDPA Success	Drive Test, PM Tools	≥90%	ITU-T Q.3930
Iub Congestion	PM Tools	<2%	3GPP TS 32.401
RRC Congestion	PM Tools	≤2%	ITU-T Q.3910
RAB Congestion (CS)	PM Tools	<2%	ITU-T Q.3910
Call Drop Rate (CS/PS)	PM Tools	<2%	ITU-T E.846
Soft Handover Success	PM Tools	≥93–95%	ITU-T Q.1706
Inter-RAT Handover Success	PM Tools	≥95%	ITU-T Q.1707
Cell Availability	PM Tools	>95%	ITU-T E.801
MOS	POLQA (Drive Test)	≥3.5	ITU-T P.863
Latency	Probes, Drive Test	<105 ms (national)	ITU-T Y.1541
Data Access Success Rate	Drive Test	≥93–95%	ITU-T Y.1540
Data Access Time	Drive Test	<5 seconds (90%)	ITU-T G.1028.2
Signal Strength	Drive Test	Outdoor ≥–85 dBm	ITU-R M.2135
Voice Access Delay	Drive Test	≤10 seconds	ITU-T G.1028.2

KPIs, Measurement Methods, Threshold & ITU Reference

4G Mobile Network KPIs			
KPI	**Measurement Method**	**Threshold**	**ITU Reference**
Cell Availability	Monitoring Tools	≥95%	ITU-T E.801
CSFB Setup Time	Drive Test	≤6 seconds	ITU-T Q.3920
CSFB Prep Success Rate	Monitoring Tools	≥98%	3GPP TS 32.401
ERAB Setup Success	Monitoring Tools	≥98%	ITU-T Q.3910
RRC Setup Success	Monitoring Tools	≥98%	ITU-T Q.3910
ERAB Drop Rate	Monitoring Tools	≤2%	ITU-T Q.3910
DL Throughput/User	Drive Test (FTP)	≥10 Mbps	ITU-T Y.1541
UL Throughput/User	Drive Test (FTP)	≥1 Mbps	ITU-T Y.1541
Latency	Drive Test/Probes	<100 ms (national)	ITU-T Y.1541
MOS	POLQA	≥2.5	ITU-T P.863
SRVCC Success Rate	Monitoring Tools	≥98%	ITU-T Q.1707
Data Success Rate	Monitoring Tools	≥93–95%	ITU-T Y.1540
Data Access Time	Drive Test	<5 seconds (90%)	ITU-T G.1028.2
Signal Strength (RSRP)	Drive Test Tools	Outdoor ≥–90 dBm	ITU-R M.2135

KPIs, Measurement Methods, Threshold & ITU Reference

5G Network KPIs			
KPI	**Measurement Tool**	**Target**	**ITU Reference**
Latency	Network Monitoring Tools, Drive Test Tools, Emulators	URLLC: 1ms eMBB: 4ms mMTC: <20ms	ITU-T Y.3101, Y.3111
Download Throughput	Network Monitoring Tools, Drive Test, Test Stations	≥100 Mbps	ITU-T G.1011
Upload Throughput	Drive Test Tools, Network Probes	≥50 Mbps	ITU-T G.1011
Cell Availability	Network Monitoring Tools, Drive Test	≥95%	ITU-T E.800

KPIs, Measurement Methods, Threshold & ITU Reference

OTT Services KPIs			
KPI	**Measurement Method**	**Threshold**	**ITU Reference**
Call Success Rate	Test Stations, Drive Test	≥98%	ITU-T E.850
Call Setup Time	Test Stations	≤10 seconds	ITU-T E.721
Call Drop Rate	Test Stations	<2%	ITU-T E.846
Call Clarity (MOS)	POLQA	≥3.5	ITU-T P.863

Digital Financial Services (DFS) – Non-Bank-Led KPIs			
KPI	**Measurement Method**	**Threshold**	**ITU Reference**
Service Accessibility Rate	System Logs, Performance Reports	≥99%	ITU-T Y.1541
Money Transfer Success Rate	System Logs, Performance Reports	100%	ITU-T D.61 (aligned)
Transfer Success Time	System Logs	≤10 seconds	–
Failed Transaction Resolution Time	Trouble Ticket System	≤24 hours	ITU-T E.860

KPIs, Measurement Methods, Threshold & ITU Reference

Interconnection Services KPIs			
KPI	**Measurement Tool**	**Target**	**ITU Reference**
Downtime for Interconnection	Test Station, Performance Monitoring	≤2 hrs	ITU-T E.845
Interconnection Route Utilization	Test Station, Monitoring Systems	≤80%	-
Interconnection Route Availability	Test Station, Monitoring Systems	≥99.99%	ITU-T E.801
Network Effectiveness Ratio (NER)	Test Station, Monitoring Systems	≥95%	ITU-T E.425
Time to Repair Interconnection	Test Station, Monitoring Systems	≤2 hrs (Urban); ≤4 hrs (Sub-urban)	ITU-T E.413
Answer Seizure Ratio (ASR)	Test Station, Monitoring Systems	≥35% (MNOs) ≥40% (Fixed line)	ITU-T E.411

KPIs, Measurement Methods, Threshold & ITU Reference

Broadband Services KPIs			
KPI	Measurement Tool	Target	ITU Reference
Metro Latency	Test Station / Drive Test / Ping	≤10 ms	ITU-T Y.1540
National Terrestrial Latency	Test Station / Drive Test / Ping	≤70 ms	ITU-T Y.1540
International Latency	Test Station / Drive Test / Ping	≤85 ms	ITU-T Y.1540
Service Availability	Ping test, Drive Test	≥99%	ITU-T E.800
Packet Loss	Ping test	≤1%	ITU-T Y.1541
Jitter (Metro)	Ping test	±4ms	ITU-T G.810, BT.1363
Jitter (Long Distance)	Ping test	±10ms	ITU-T G.810, BT.1363
Jitter (International)	Ping test	≤30ms	ITU-T G.810, BT.1363
Traffic Utilization	Ping test	≤95%	-
Download Throughput	Ping test	±5% deviation from assigned capacity	ITU-T G.1011
Upload Throughput	Ping test	±5% deviation from assigned capacity	ITU-T G.1011
Downtime (Radio/Core Equipment)	Network uptime monitoring	<1–6 hrs (depending on area/equipment)	ITU-T E.845
Mean Time to Repair (MTTR)	Network uptime monitoring	<1–6 hrs (depending on area/equipment)	ITU-T E.845

QoS and QoE Enforcement Mechanisms

When there is infraction in meeting QoS and QoE targets, the following are the enforcement mechanisms:

- The Authority informs the operator in writing to improve the target figures.
- The licensee submits additional information about the quality of the relevant service, including implementation of a remedial plan within a timeframe
- The Authority directs the licensee to compensate subscribers for poor quality of service, except in the cases of force majeure or failures attributable to third parties
- The Authority publishes all measurements including network performance deficiencies
- In certain circumstances, the Authority demands extra measurements
- The Authority imposes fines for failing to meet KPI targets for 3 consecutive reporting months
- If the infraction persists, ten percent (10%) of the initial fine shall be levied daily until the licensee remedies the contravention

Thank you