



Balancing Telecom Regulations and Operations for Quality of Service Monitoring in Zambia

**Methodologies and Collaborative Approaches
by ZICTA**

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About Zambia



Land Surface Area

752,618 km²



Provinces

10



Population

19.69 million (2022)



Number of MNOs

4 MNOs, 3 of which are active



Regulator

Zambia Information & Communication Technology Authority (ZICTA)



ZICTA's Mandate

LEGISLATIONS

ICT Act No. 15 of 2009

Electronic Communications & Transactions
Act No. 4 of 2021

Postal Services Act No. 22 of 2009

Cyber Security
and Cyber Crimes Act No. 2 of 2021

FUNCTIONS

Licensing

Technical Regulation

Economic Regulation

Consumer Protection

Cyber Security

Universal Access

Quality of Service
(QoS) functions fall
under the umbrella
of Technical
Regulation



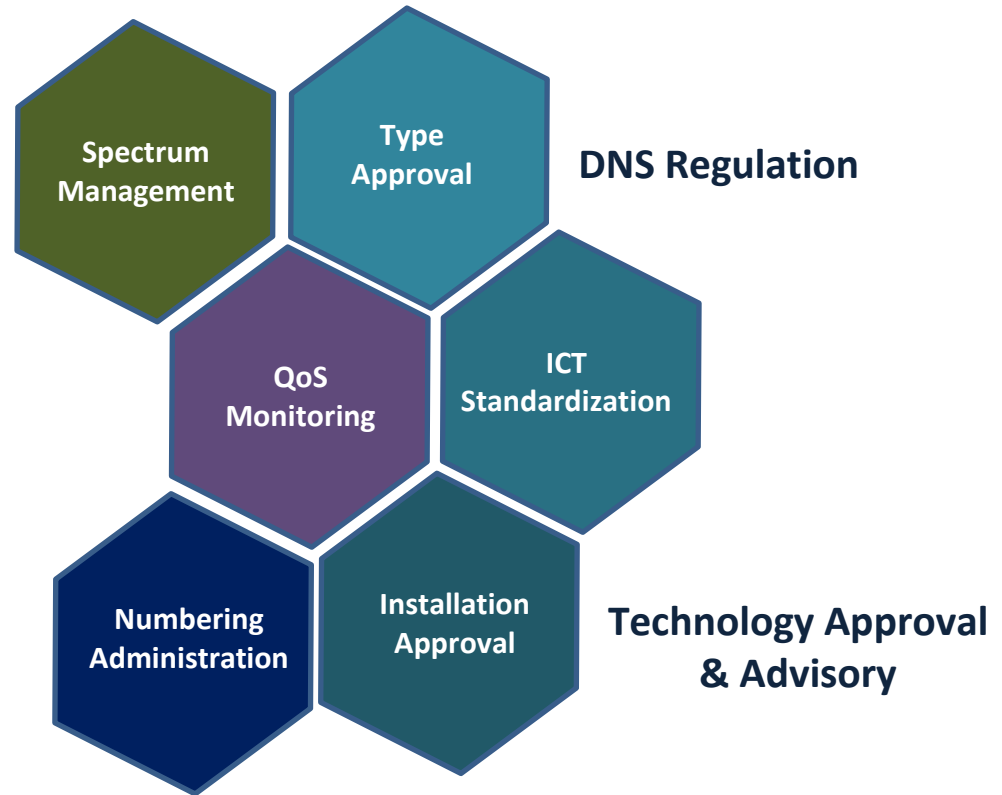
Technical Regulation

Engineering & Technology Services Department is Responsible for Technical Regulation

Mandated by the ICT Act of 2009 (Parts IV & VI)

Oversees the ICT & Telecom sector in terms of Quality Service Delivery, among others

Engineering & Technology Services Key Functions

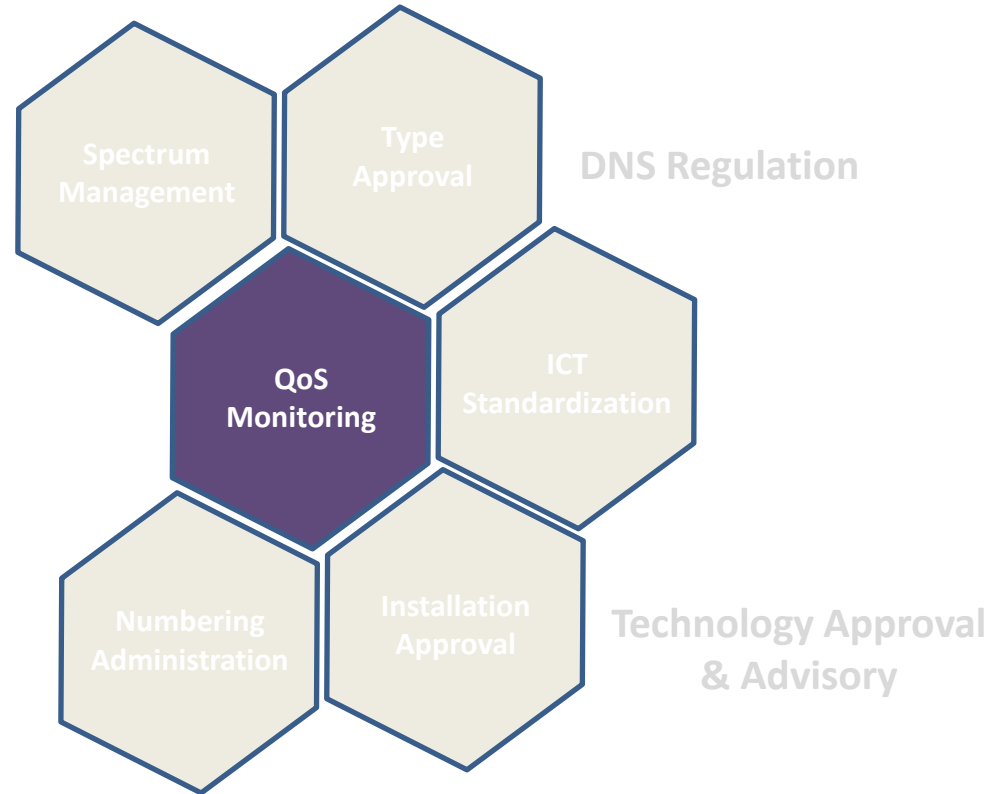




Quality of Service Functions

- ❑ Conducting **Quality of Service monitoring** of mobile networks to benchmark and ensure services meet minimum standards in QoS guidelines
- ❑ **Analyzes Network Performance based** on MNOs' performance data (collected through a network performance tool)
- ❑ Investigates and **verifies consumer complaints** related to quality of service
- ❑ Tracks and **validates network outages and failures** reported by operators
- ❑ Conducts **physical Network audits** of critical MNO components like RNCs, BSCs, Data Centers to evaluate power, cooling & capacity to ensure uninterrupted services
- ❑ Holds **Periodical reviews with MNOs** on QoS trends, issues, and improvement plans

Engineering & Technology Services Key Functions





ITU-T (E.800) Four View QoS Perspective

CUSTOMER

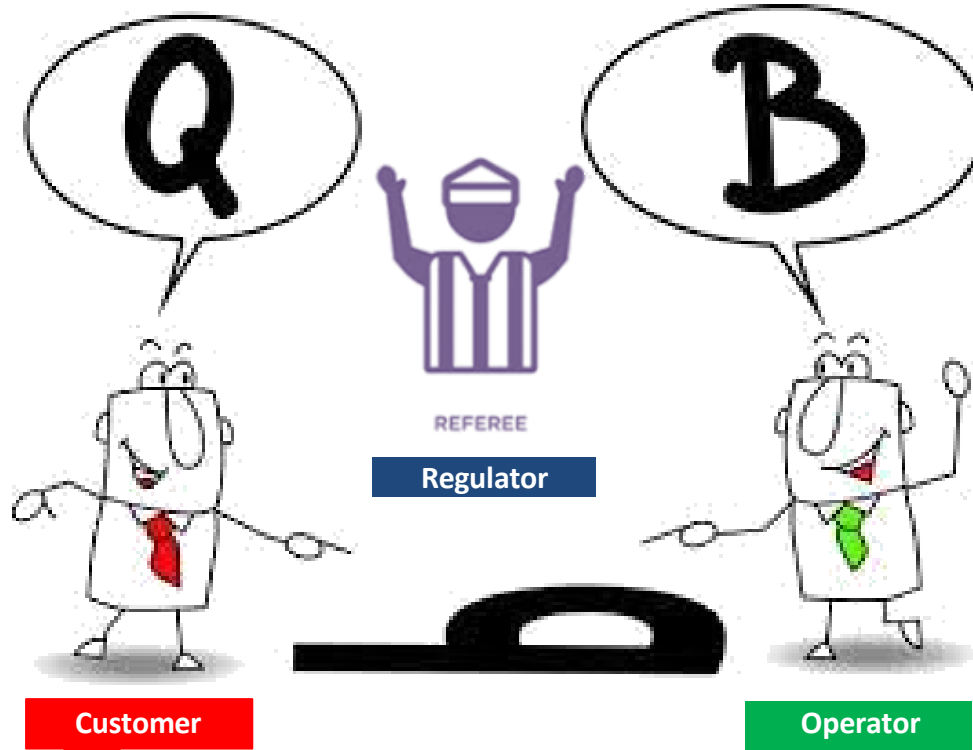


SERVICE PROVIDER



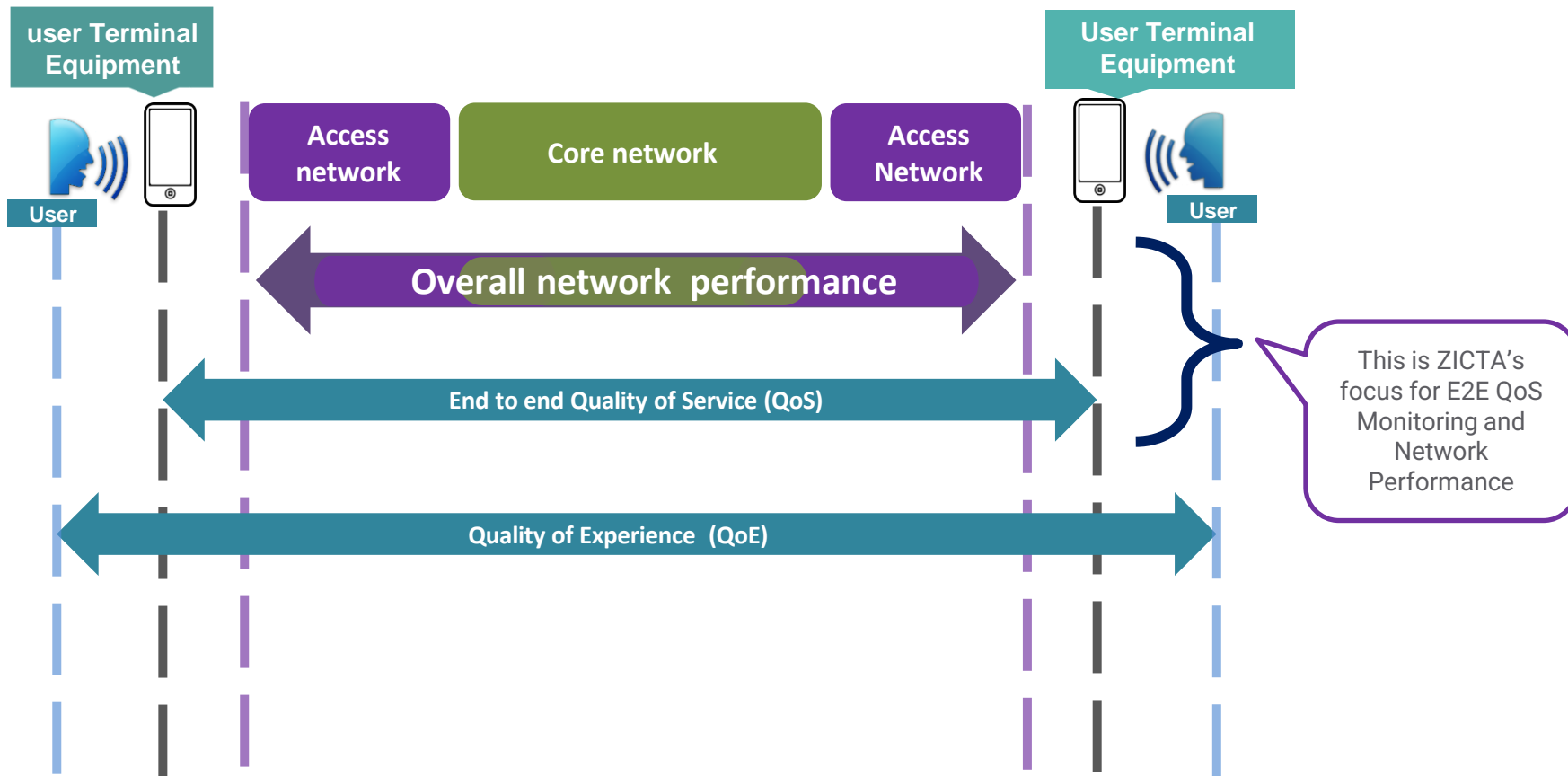


QoS's Different View Points





QoS a Regulator's Perspective

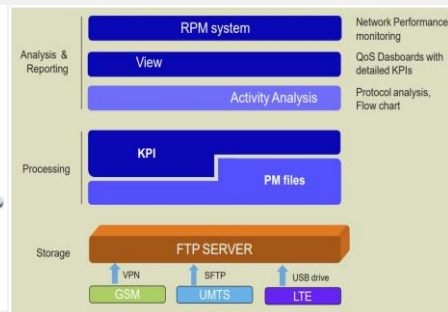




QoS Monitoring Tools



Network Performance Monitoring Solution



Capabilities

- ✓ Tracks QoS provided by MNOs almost in real time
- ✓ Utilizes enforcement modules aligned with ITU-T E.800 recommendations.
- ✓ Non-Intrusive Data Collection
- ✓ Collects 3GPP PM files hourly via FTP servers at MNO premises
- ✓ PM data pushed to central FTP server at ZICTA
- ✓ Processes 2G/3G/4G PM files for regulatory oversight and outputs Monthly QoS Audit Reports
- ✓ Country-wide mobile network insights down to cell level

Nemo Mobile Testing Solution



Capabilities

- ✓ 2G/3G/LTE(4G) (Indoor and Outdoor)
- ✓ Voice Quality (POLQA)
- ✓ Coverage (signal level and Quality)
- ✓ Concurrent monitoring of 3 MNOs simultaneously.
- ✓ Utilizes enforcement modules aligned with ITU-T E.800 recommendations.





QoS Benchmarking, Analysis and Monitoring Process

Inputs Guide QoS Drive Testing

Areas which were previously monitored

Areas with high number consumer complaints

Areas with high number of Outages

Areas with social and economic activities

Locations with consistent quality failures observed from Network Performance System

Network Performance and QoS Drive Testing Complementarity



Network Performance Monitoring
(focus daily QoS monitoring & generating monthly audit reports)



QoS Drive Testing benchmarking
(e.g. focuses on voice quality and service integrity)



Targeted QoS drive testing (e.g. where gaps exists)



Holistic Visibility in MNOs Service Provision



Enabling ZICTA to evaluate quality of service provision comprehensively in Zambia



Sample Size for DT logs and RI for NMS PM files

Drive Test Sample Size Considerations

Sample size (number of tests per service) per town varies based on population density

Monitoring Duration Per Town

- 3-5 days of drive testing per town
- Target of 120 tests collected per day
- Results in 360-600 tests per town

Over 600 tests for larger towns (e.g., Lusaka).

Minimum 400 tests for smaller towns

Network Performance RI

Reliability Indicator(RI) of at least 80%

Over 18+ hours of PM data per day (24hrs) from all Network Elements

Confidence Levels

rpm SYSTEM



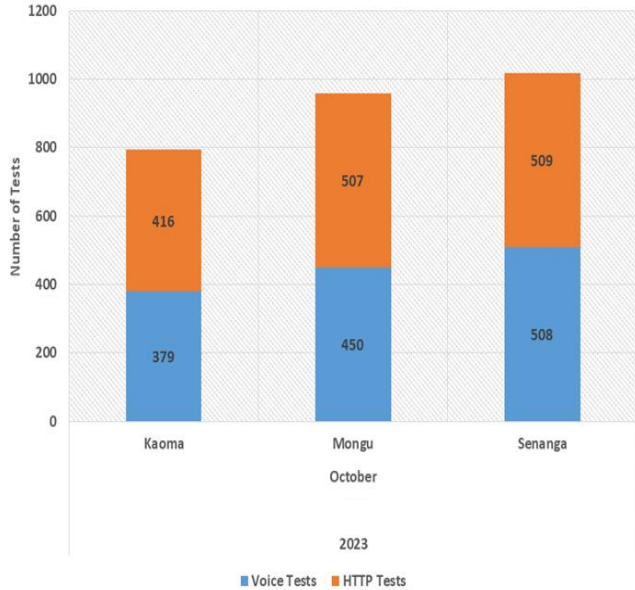
KEYSIGHT TECHNOLOGIES

This ensures we collect sufficient data to accurately assess QoS through drive tests and network performance measurement in each town, regardless of town size.

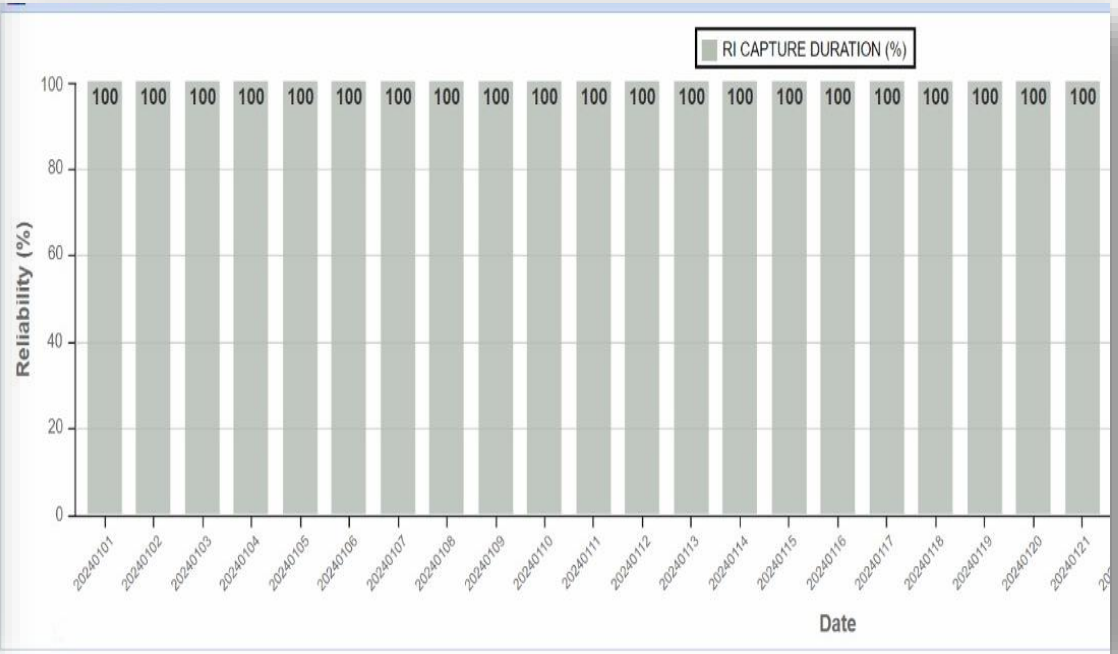


Sample Size for DT logs and RI for NMS PM files – Sample Results

Number of QoS Tests



Number of tests per achieved during DTs



RI 100% from RPM system



QoS Monitoring Activities & Network Audits

QoS Monitoring Activities categories

Scheduled QoS Monitoring (*routine QoS monitoring to Benchmark QoS provided by MNOs*)

Complaint Verification QoS monitoring (*QoS Monitoring to verify customer complaints*)

Special Assignment QoS Monitoring (such as major events, traditional Ceremony , Trade fairs etc)

Network Audit

Physical Network audits of critical MNO components like RNCs, BSCs, Data Centers to evaluate power, cooling & capacity

This ensures that we verify MNOs meet service agreements and promises to consumers



Some of the QoS Key Performance Indicators Monitored

We Measure **Accessibility**

- Call Setup Success Rate (CSSR) $\geq 98\%$
- Call Setup Time (CST) $\leq 10s$
- Successful Internet Logins $\geq 98\%$
- Successful SMS Rate $\geq 98\%$



We Measure **Integrity**

- HTTP Download Throughput on 4G ≥ 10 Mbps
- HTTP Download Throughput on 3G ≥ 1.5 Mbps
- Voice Call Quality (MOS) ≥ 3
- SMS Delivery Time $\leq 10s$



We Measure **Mobility & Coverage**

- Signal Levels and Quality
 - UMTS (3G)
 - LTE (4G)
 - GSM (2G)



We Measure **Retainability**

- Call Drop Rate (CDR) $\leq 5\%$
- Internet Session Drop Ratio $\leq 5\%$

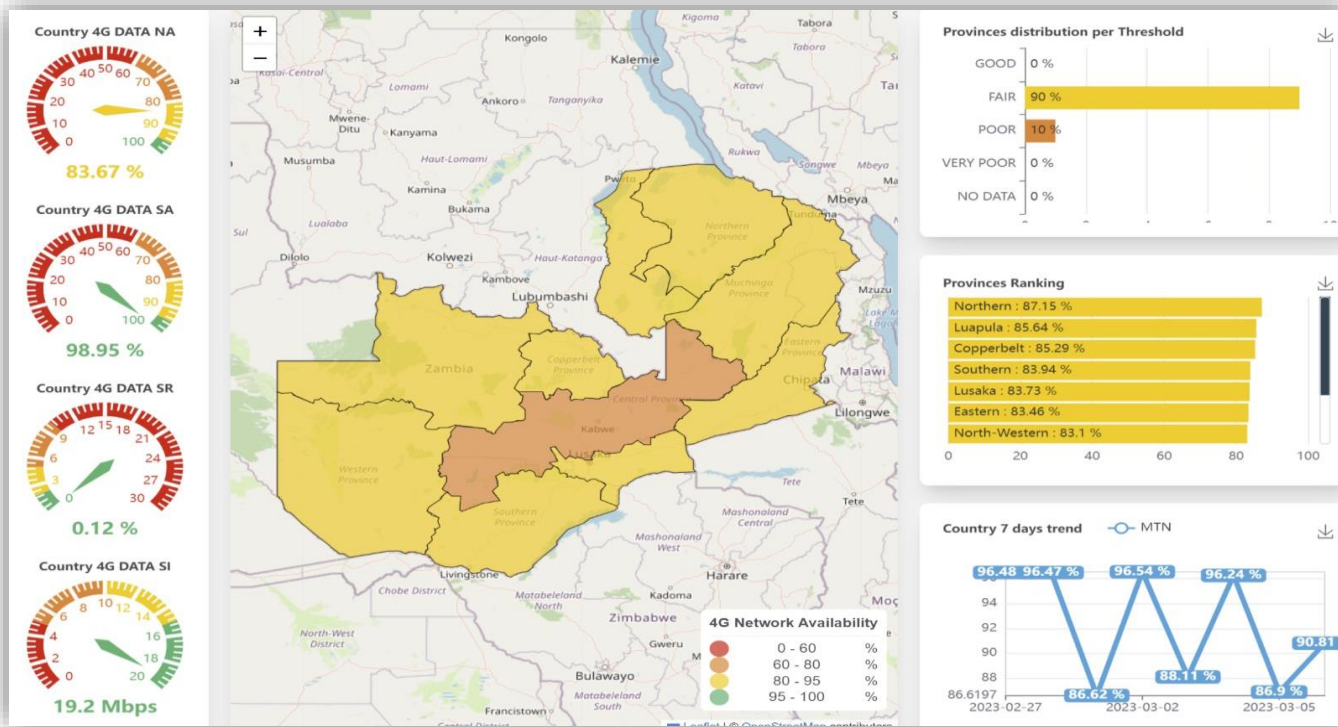


□ Prioritizing User Experience by Selecting KPIs like Service Accessibility



NPMS – Sample Results

QoS Status of one of the MNOs in Zambia on its worst day in an observed month



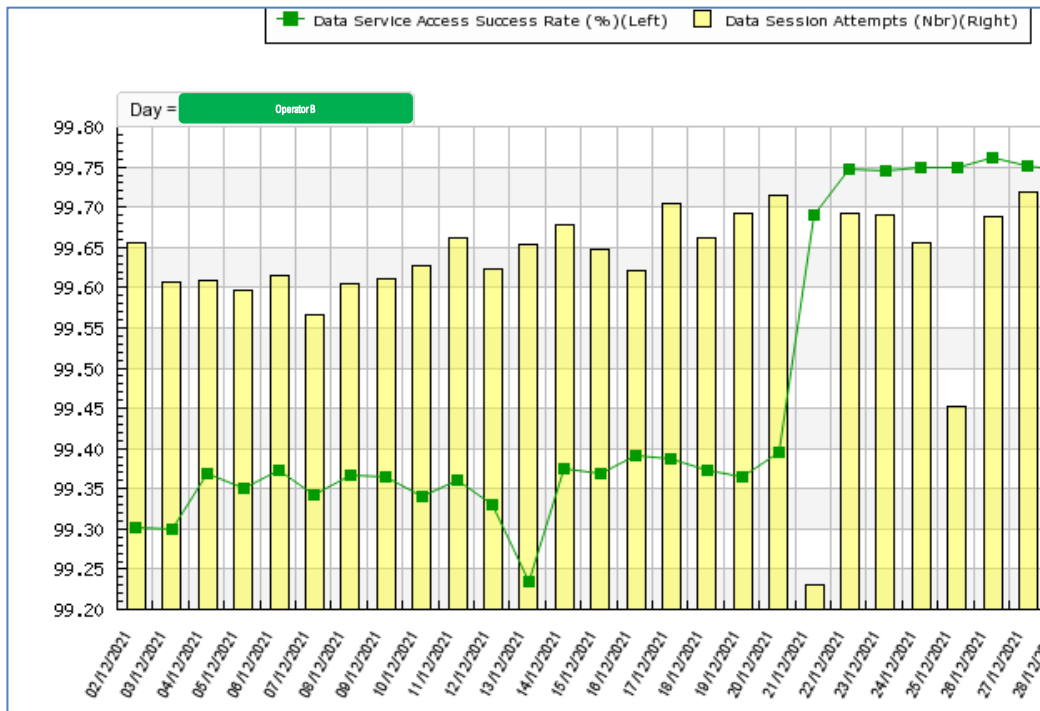
❑ From an end-user viewpoint, service accessibility significantly impacts user experience

- ❑ Provides a snapshot of the QoS delivered nationwide on a given day, beyond just Lusaka
- ❑ Capability to Provide National Overview and Highlight Poor Performing Areas



NPMS – Sample Results

QoS Status of one of the MNOs in Zambia



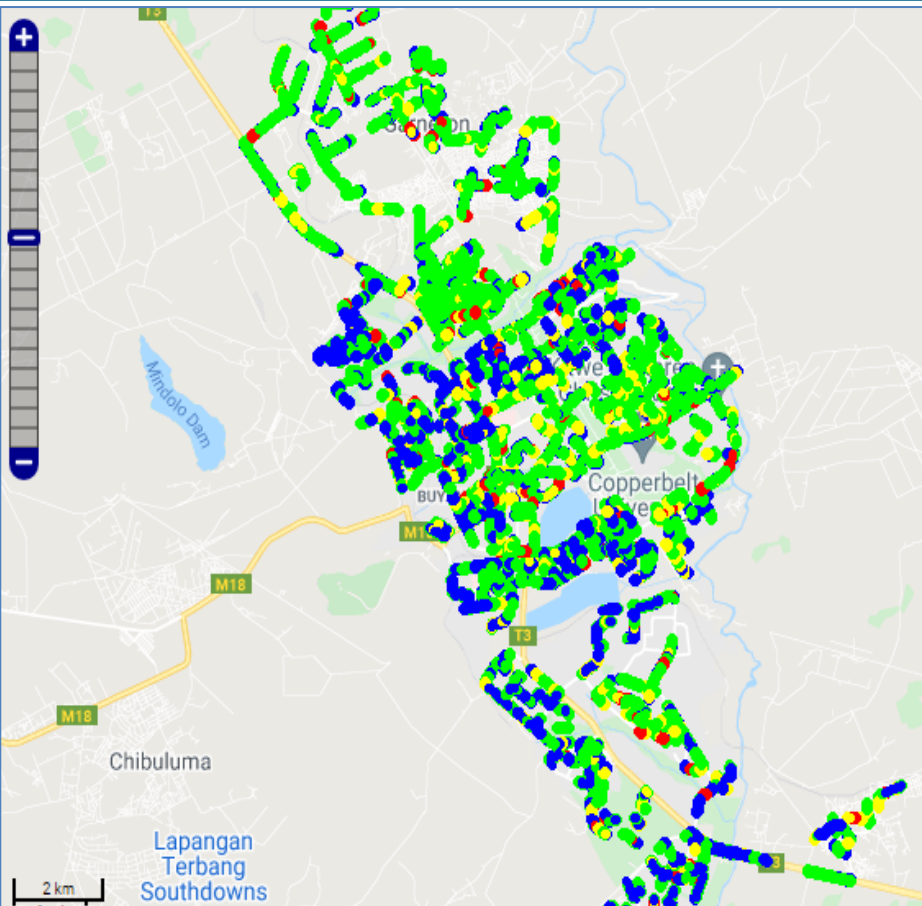
District	eNodeB Name	No. of Cells	DATA SERVICE ACCESS SUCCESS RATE (%)	DL TRAFFIC VOLUME (GB)
Mumbwa	T3579_AMATHEON MUMBWA	3	49.67	9.84
Lusaka	T0487_KANYAMA WEST_3 RLF	6	49.86	161.86
Lusaka	T0489_KAMWALA BASIC RLF	3	49.91	274.54
Solwezi	T1024_KIPEMBA	6	88.66	52.27
Isoka	T3068_ISOKA	9	89.62	187.57
Shangombo	T1128_NATUKOMA	3	93.36	0.60
Isoka	T3477_ISOKA_TURN_OFF	3	94.32	18.91
Siavonga	T0316W_SIAVONGA_URANIUM	3	94.80	0.48
Lumezi	T2074U_MPONDA REPEATER	1	96.12	22.81
Masaiti	T3038_KANSANFU	3	96.59	57.21
Chitambo	T3172_KUNDA	1	96.66	44.53
Nsama	T3459_NSAMA	3	96.77	1.22
Kaoma	T1121W_KAOMA TOWN	3	96.98	5.21
Mumbwa	T1053_NAMBALA	6	97.18	52.58
Nkeyema	T1073_TBZ NKEYEMA	9	97.52	51.25

☐ **Prioritizing User Experience by Selecting KPIs like Service Accessibility**

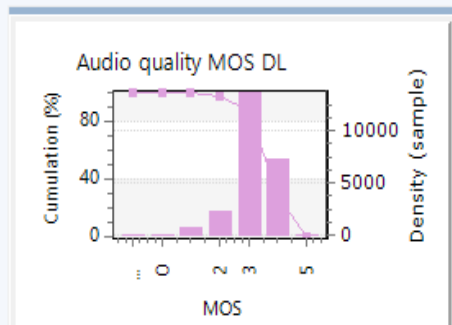
☐ **Helps identify problematic areas down to the cell level**

Mobile Drive Tests Solution – Sample MOS Using POLQA

Voice Quality (MOS) Map and Descriptive Statistics



MOS [Time/s]	
>= 0 and < 1	0 0.00%
>= 1 and < 2	3906 2.76%
>= 2 and < 3	13193 9.34%
>= 3 and < 4	81386 57.59%
>= 4 and <= 5	42840 30.31%



Density & Cumulation Histogram Aggregates

Aggregates		Kitwe (AQ type DL: Any)
Average		3.639
Maximum		4.5
Minimum		1.007
Std. deviation		0.609
Variance		0.371
Threshold < 2		2.764
Sample count		23556

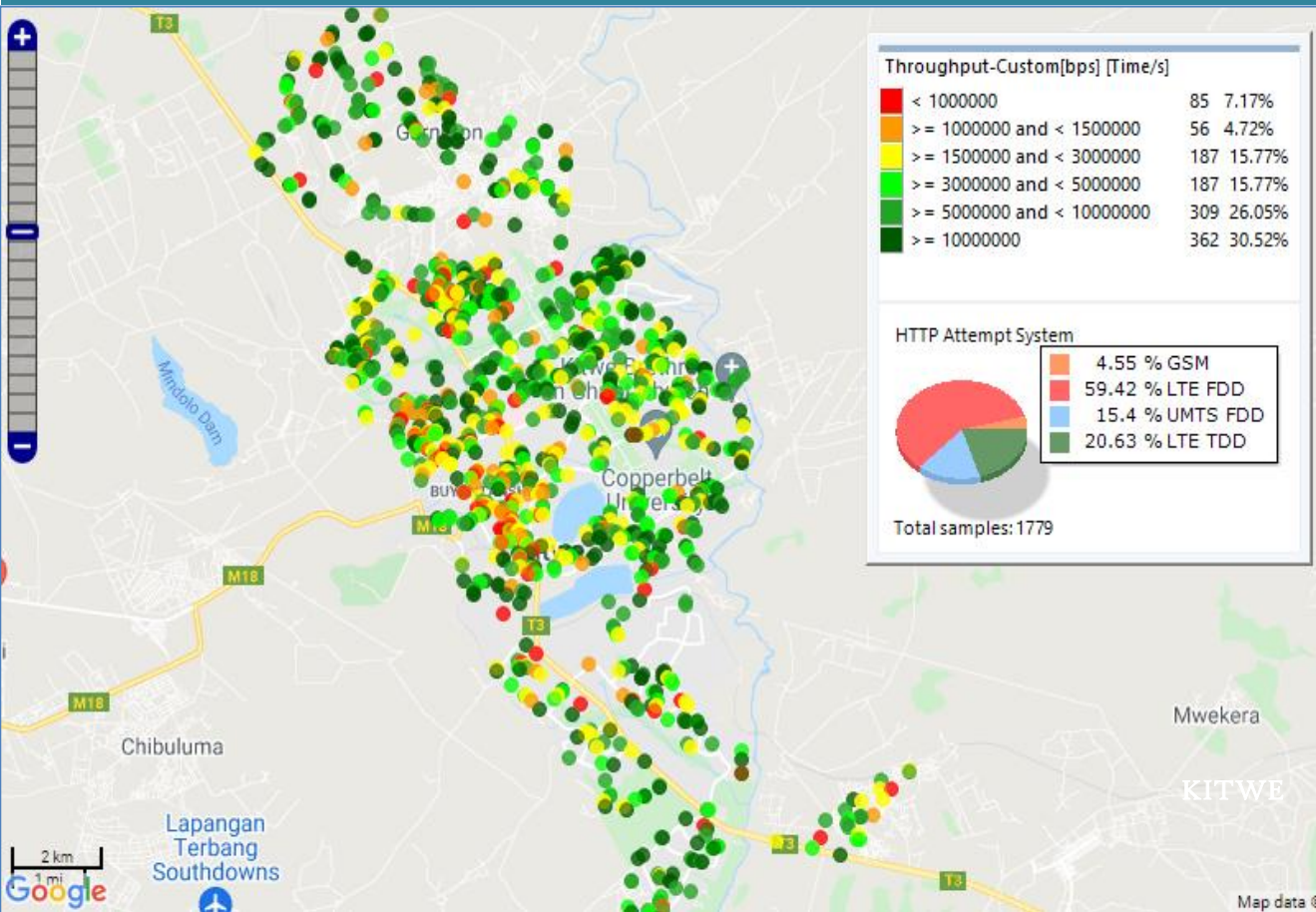
Maps, Graphs, and Descriptive Statistics



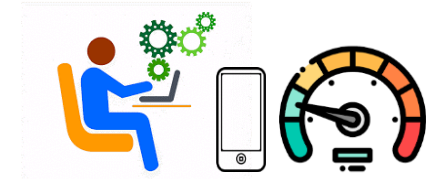


Mobile Drive Tests Solution – Sample Results

Download (DL) Throughput Coverage Map

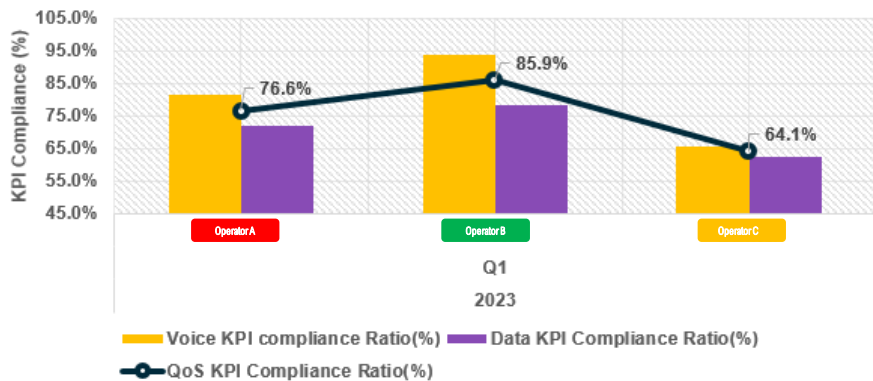


- Analyze and Visualize Specific Areas with Poor Download Speeds



Analyzing QoS Performance Against Defined Standards & Compliance

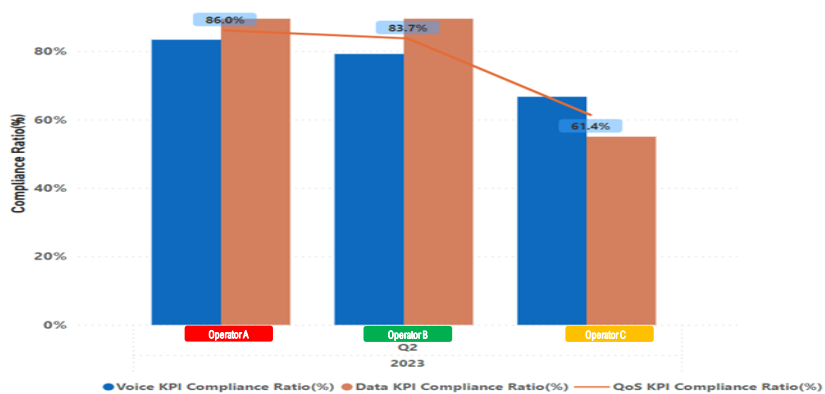
Voice vs Data KPI Compliance [%]



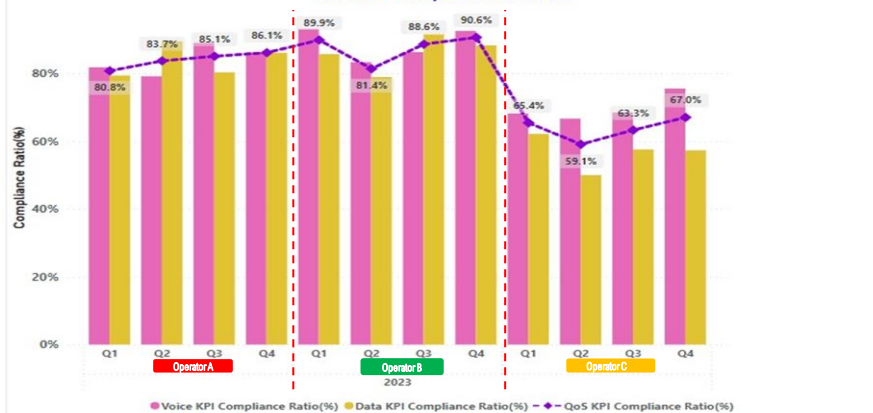
Achieved QoS - Q1 2023

KPI	Target	MNOs		
		Operator A	Operator B	Operator C
VOICE				
Call Setup Success Rate(%)	≥ 98%	91.39	98.01	89.89
Call Setup Time(sec)	≤ 10 s	6.55	5.50	8.19
Call Drop Rate(%)	≤ 5%	0.42	0.30	1.13
Audio Quality [MOS]	≥ 3	3.77	4.00	3.34
DATA				
Successful Internet Logins(%)	≥ 98%	94.29	98.55	88.20
Internet Session Drop Rate(%)	≤ 5%	0.71	0.36	1.55
HTTP Download Rate on 4G (Mbps)	≥ 10Mbps	33.63	27.32	13.06
HTTP Download Rate on 3G (Mbps)	≥ 1.5Mbps	9.84	1.63	3.66
Compliance		6/8	8/8	6/8

QoS KPI Compliance Ratio(%)

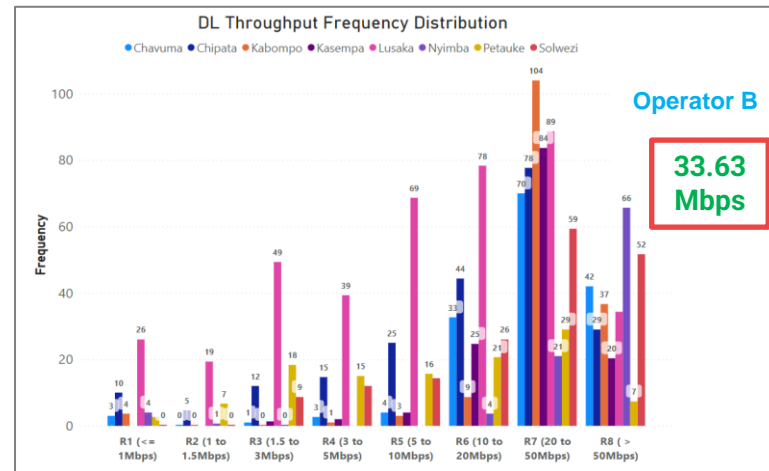
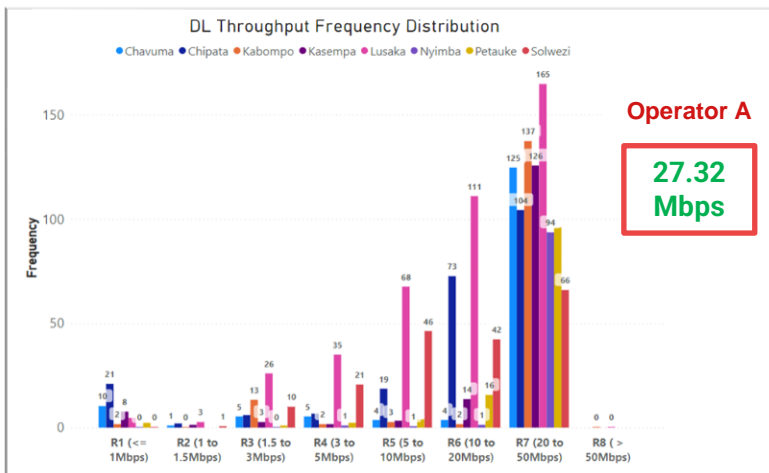


QoS KPI Compliance Ratio(%)



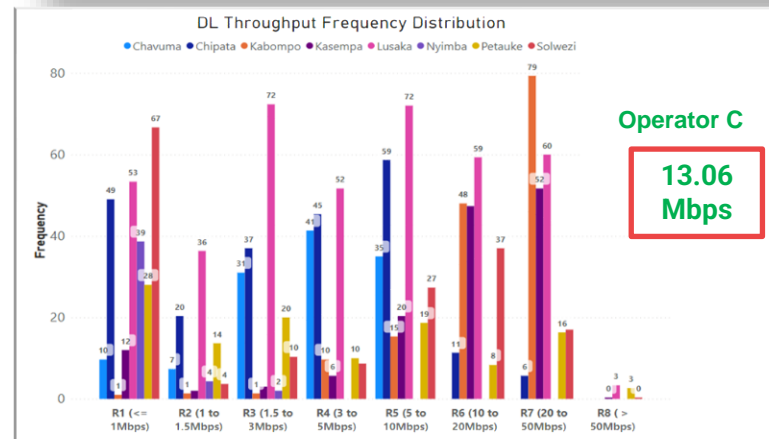


Understanding MNO Performance Through Download Speed Distribution Analysis



Interpreting Data Speed Skew from Graphs

- ✓ Data service experience on Operator C was poor for almost all the towns monitored.
- ✓ A significant number of Download Tests achieved DL speeds of less than 10 Mbps especially in Lusaka indicating poor user experience.
- ✓ A significant number of Download Tests achieved DL speeds of less than 10 Mbps especially in Chipata and Lusaka indicating poor user experience.





Collaborative Engagement With Stakeholders to Improve QoS Performance

Discuss QoS Performance

Review QoS Report findings (Network Audits, QoS monitoring, Network Outages)

In the QoS Discussion Meeting, all Units and Departments provide input and discussion

Network Operators Provide Feedback on the performance, with improvement plans and timeframes

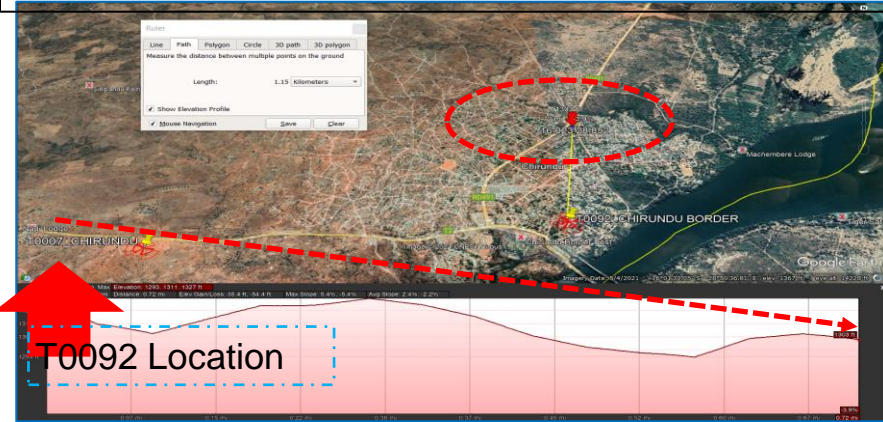
The feedback is evaluated, and progress of implementation is monitored against timeframes



Case Study/Success Story



Collaborative Engagement With Stakeholders - Case Study/Success Story 1



Observation

- As per analysis most of the unsuccessful Internet logins occurred in subterranean areas of T0092 & T0007 where RSRP was averaging at ≥ -130 as highlighted in the figures above

Short Term Solution

1. Team to visit the area and perform RF optimization – Q1

Long Term Solution

1. Add L800 on T0007 and T0261 planned for 2025
2. Build a new site

●Chirundu- affected by poor coverage

RSRP (dlm) [Time/s]	
■ ≥ -80	11290 22.98%
■ ≥ -90 and < -80	22148 45.08%
■ ≥ -100 and < -90	9249 18.83%
■ ≥ -110 and < -100	5702 11.60%
■ ≥ -130 and < -110	742 1.51%
■ < -130	1 0.00%

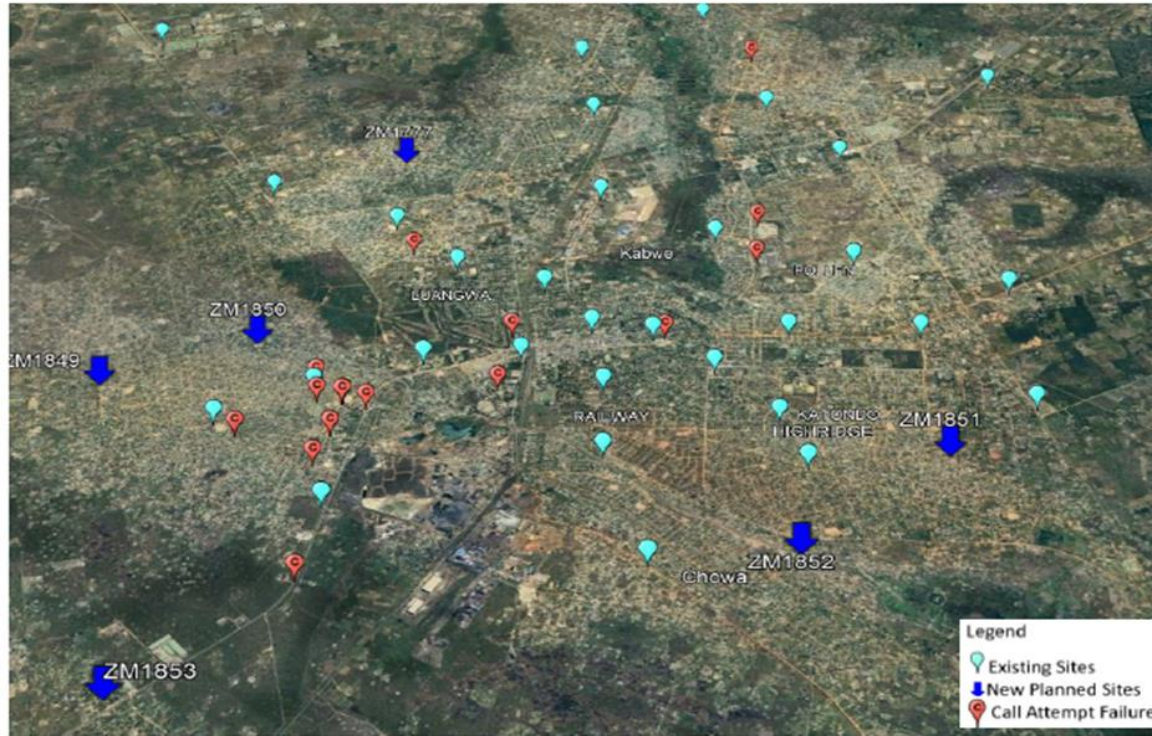
RSCP (dbm) [Time/s]	
■ ≥ -80	147580 68.46%
■ < -80 and ≥ -90	47705 22.13%
■ < -90 and ≥ -100	16630 7.71%
■ < -100	3650 1.69%

RX level (dbm) [Time/s]	
■ < 0 and ≥ -65	34 3.99%
■ < -65 and ≥ -75	302 35.78%
■ < -75 and ≥ -85	392 45.26%
■ < -85 and ≥ -95	126 14.91%
■ < -95 and ≥ -104	1 0.06%

Figure 29: Received Signal Levels (3G and 4G) - Chirundu



Kabwe – Call Voice Plots



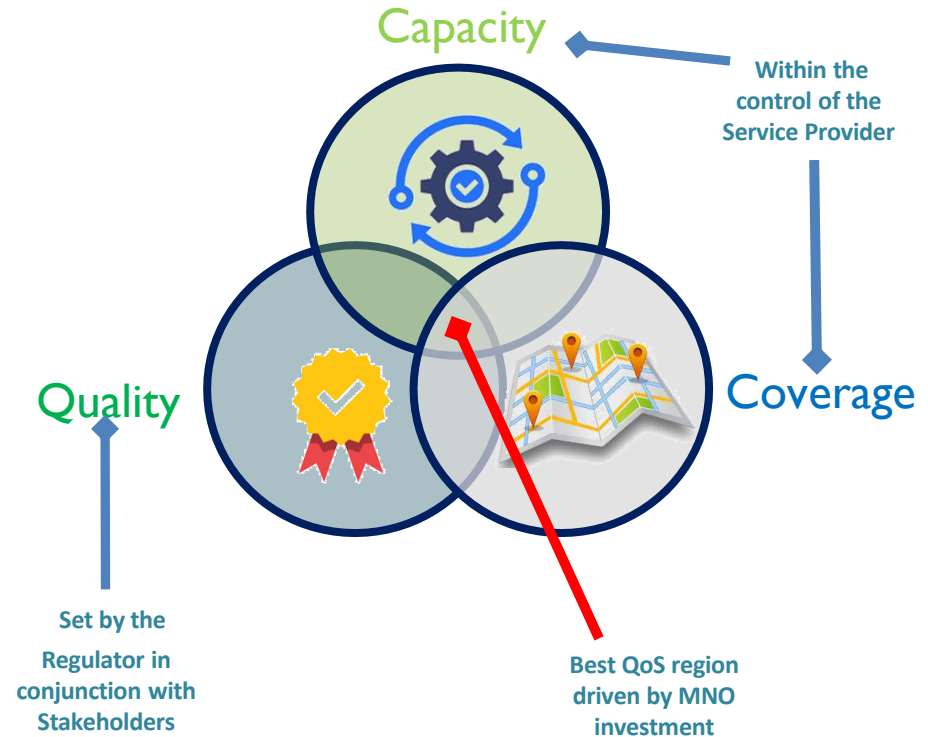
Analysis/Action Plan

1. L800 (10) / L2600 (15) addition – Closed.
2. New capacity/infill planned [6 Sites]
3. Assessment/Optimization to be closed by 31st March,2024



Conclusion - QoS Compliance is a Collaborative Framework

- ❑ **Collaborative** - Setting QoS standards is a joint effort between the regulator and mobile operators
- ❑ **MNO Investment** - Coverage and capacity are determined by operators' network investments
- ❑ **Impact on Quality** - MNOs invest to enhance capacity and coverage. This impacts service quality.
- ❑ **Balancing Act** - There needs to be a balance between capacity, coverage and quality - achieved by MNOs investing in network upgrades and expansion.





Thank You