Measurement Campaigns, and Sampling Methodologies to Monitor the QOS in Mobile Networks in Sudan

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ITU Workshop – Banjul 2023

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introduction

- **According to the ITU-T Rec E.806:** “describes a baseline framework of best practices for measuring quality of service (QoS) throughout the industry, and mobile network QoS measurement campaigns, characteristics and requirements for monitoring systems, post-processing scenarios, as well as sampling methodologies used by regulators”
- QoS monitoring covers mobile, fixed and broadband services. Currently TPRA focus on monitors mobile network services, which includes Voice, Data and Network coverage from user's perspective in line with license

TPRA Scope for QoS monitoring

- QoS monitoring covers mobile, fixed and broadband services. Currently TPRA focus on monitors mobile network services, which includes Voice, Data and Network coverage from user's perspective in line with license.
- QoS measurement campaigns aim to gather information to characterize the QoS of mobile networks in terms:
- key performance indicators (KPIs)
- perform benchmarking
- evaluate conformance to existing legislation commitments and imposing finds

QoS AUDIT

- **Purpose of QoS Auditing:**
- **Verify QoS of Mobile Networks experienced by customer’s complaints;**
- **Compare results against KPIs thresholds;**
- **Produce benchmarking reports**

1st Monitoring method implemented by TPRA

Drive test(QOS/QOE)

QOS Methodology adopted:

1. Drive test(QOS/QOE) :

- specify locations,
- prepare maps for measurement locations,
- calculate samples to be collected,
- calculate number of hours / days for every location,
- For data calculate number of hotspots and locate them,
- Measurement tools setup,
- Prepare scripts / test cases to be used, etc.

QOS Methodology adopted

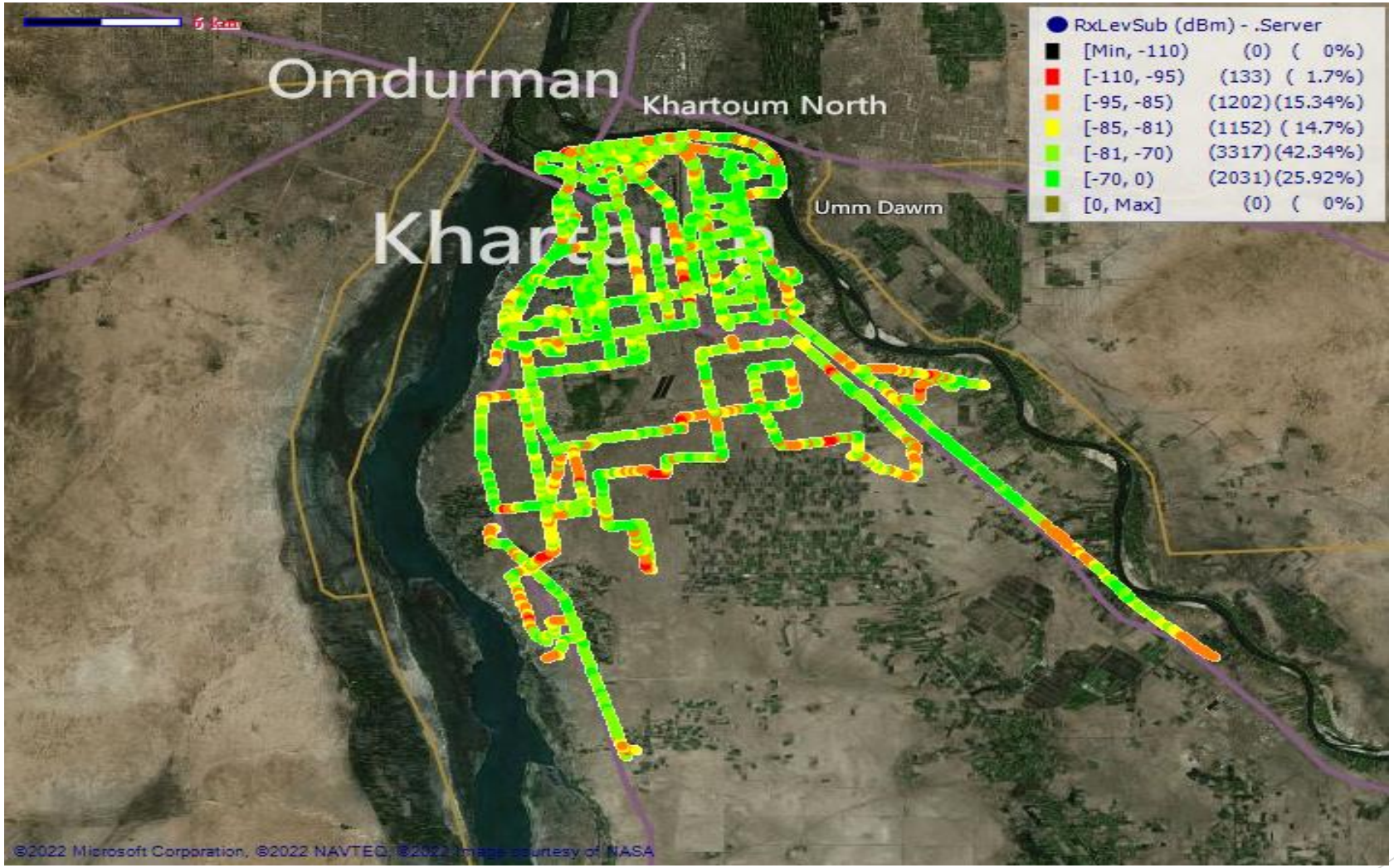
1.1 DRIVE TEST SAMPLING METHODOLOGGY

- Geographic area
- ✓ Use stratification method to classify the area to:
- ✓ urban
- ✓ rural
- Population density
- ✓ Based on area classification the sample size determined(urban or rural)
- Building types
- ✓ Horizontal and vertical construction

AUDITED KPIs

Tested Service KPI Comments	KPI	Comments
Coverage and Quality	Signal Strength (RxLev, RSCP, RSRP)	Network Availability
	Signal Quality (Ec/No, RSRQ)	Network Accessibility
Dual Mode (2G/3G) Voice and CS Fall Back LTE	Call Setup Time	Network Accessibility
	Call Setup Success Rate	Service Accessibility
	Call Drop	Service Retainability
	Voice Quality MOS	Service Integrity
Data 4G / 3G	Application Throughput	Service Integrity
	LATENCY	Service Integrity

Rxlev


Omdurman
Khartoum North
Umm Dawm
RxLevSub (dBm) - .Server
[Min, -110) (0) (0%)
[-110, -95) (133) (1.7%)
[-95, -85) (1202) (15.34%)
[-85, -81) (1152) (14.7%)
[-81, -70) (3317) (42.34%)
[-70, 0) (2031) (25.92%)
[0, Max] (0) (0%)
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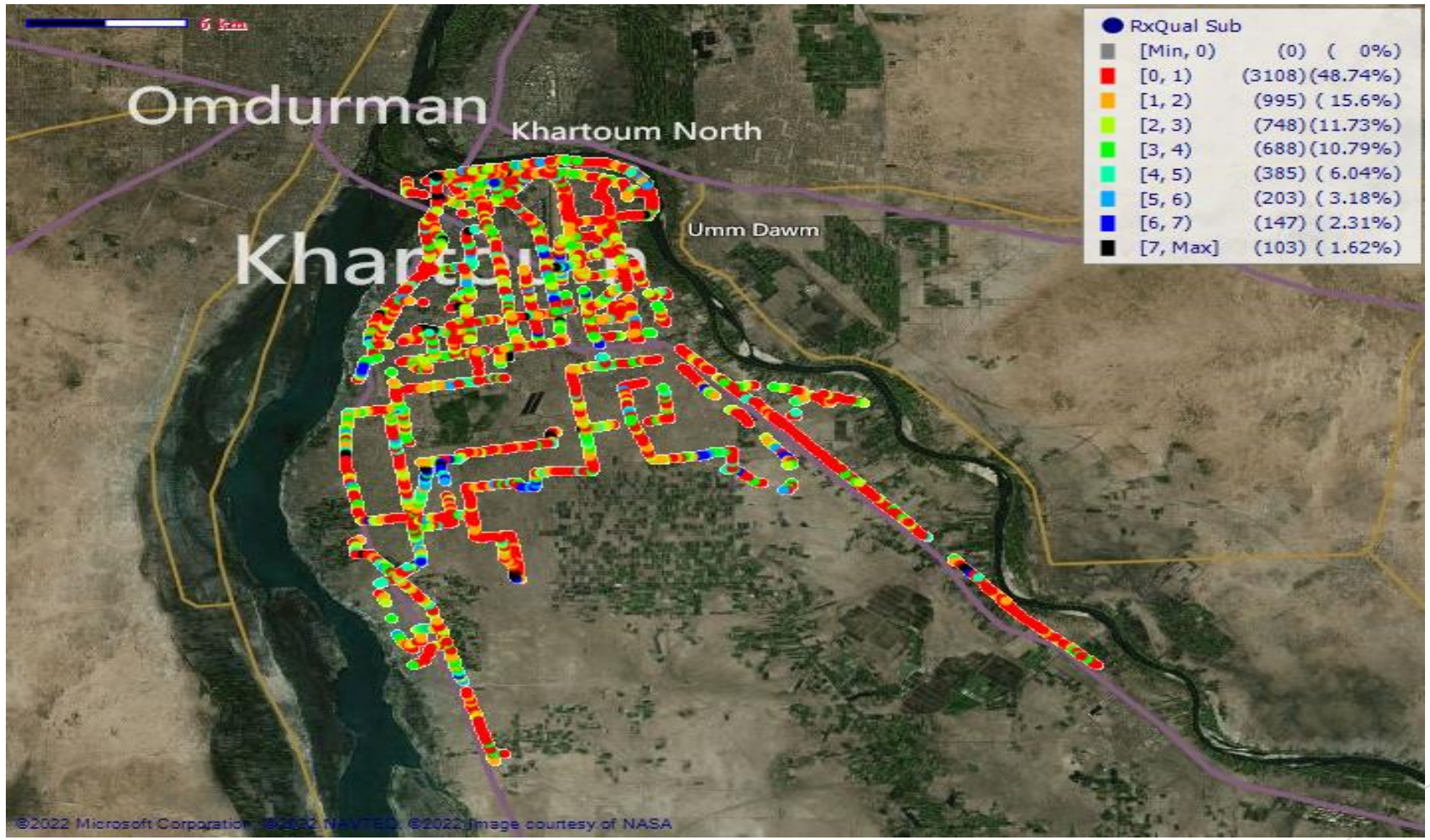
RxQual


Omdurman
Khartoum North
Umm Dawm
RxQual Sub
[Min, 0) (0) (0%)
[0, 1) (3108)(48.74%)
[1, 2) (995) (15.6%)
[2, 3) (748)(11.73%)
[3, 4) (688)(10.79%)
[4, 5) (385) (6.04%)
[5, 6) (203) (3.18%)
[6, 7) (147) (2.31%)
[7, Max] (103) (1.62%)
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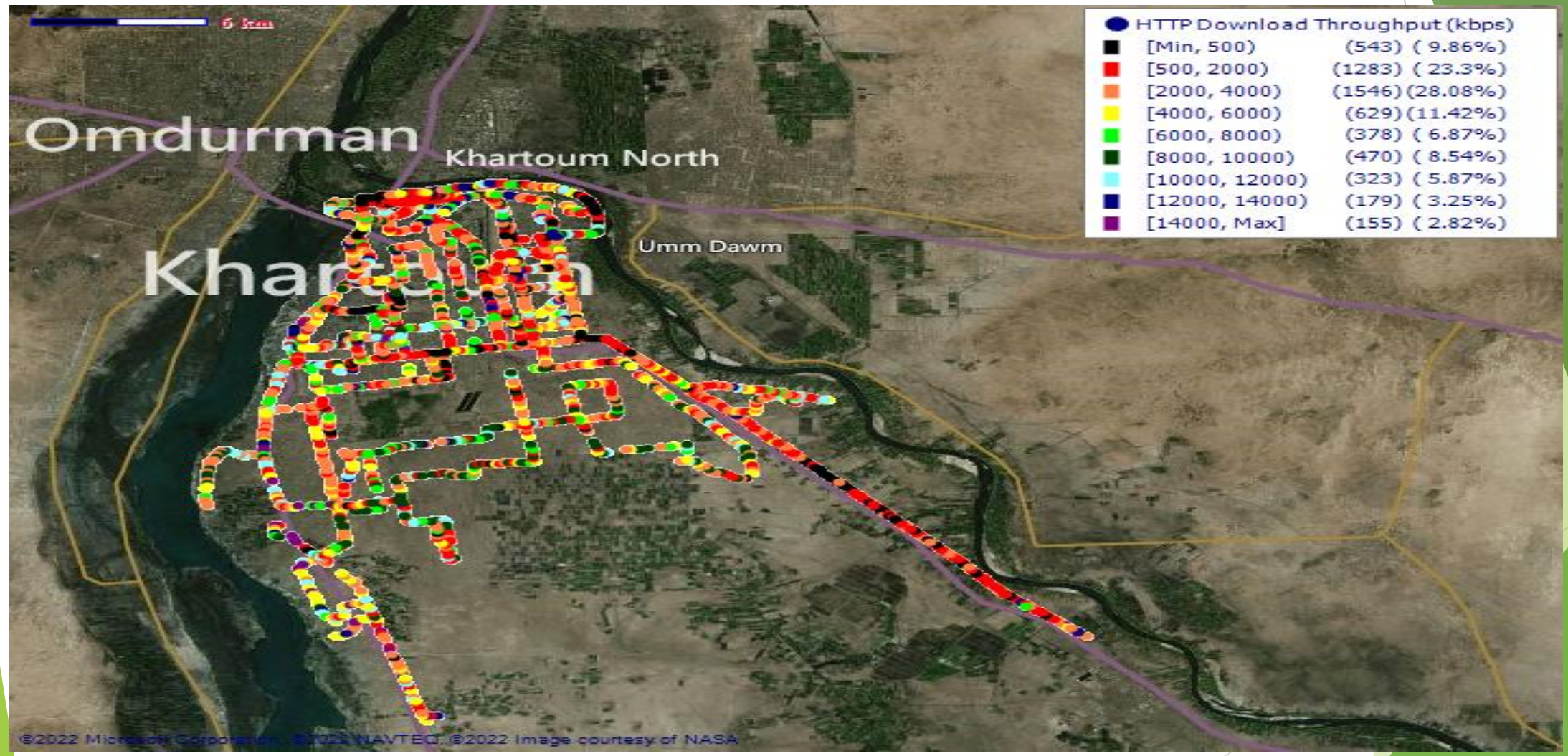
HTTP DL Throughput



2nd Monitoring method implemented by TPRA

Performance management system(OMC-R counter)

QOS Methodology adopted

2.Performance management system(OMC-R counter)

- MNO’s pushing the raw data hourly to the TPRA Servers; the system make a calculation on this data depend on vender formula. Before that we make consent to this formula with MNO’s.
- Reports can be generated every hour,evry day even weekly and monthly.
- We use this reports for benchmarking and to take a decision about QOS situation according to the TPRA regulation.
- The system evaluate QOS form the network perspective regardless QOE.

List of KPI's that we monitor by QOS tracker system:

comment	KPI's		
	2G	3G	4G
Network Availability	TCH Availability SDCCH Availability	Cell availability	Cell availability
Network Accessibility	TCH congestion rate SDCCH congestion rate Call Setup Success Rate	CS RRC connection setup success rate PS RRC connection setup success rate CS RAB setup success rate PS RAB setup success rate CS Call Setup Success Rate PS Call Setup Success Rate	Service RRC setup success rate Signal RRC setup success rate ERAB setup success rate CS fall back
Network Maintainability	TCH Drop rate SDCCH Drop rate Call Drop Rate Call Success Rate	CS Call Drop Rate PS Call Drop Rate	RRC Drop Rate ERAB Drop Rate
Network Mobility	HO Success Rate	Soft HO Success Rate CS HO 3G to 2G PS HO 3G to 2G	Intra frequency HO Out Success Rate Inter frequency HO Out Success Rate

Snapshots display the QOS KPI’s based on technology

- As shown as below the list of main KPI’s in normal case and in busy hour by color code (red means KPI’s less than threshold)

Global QoS

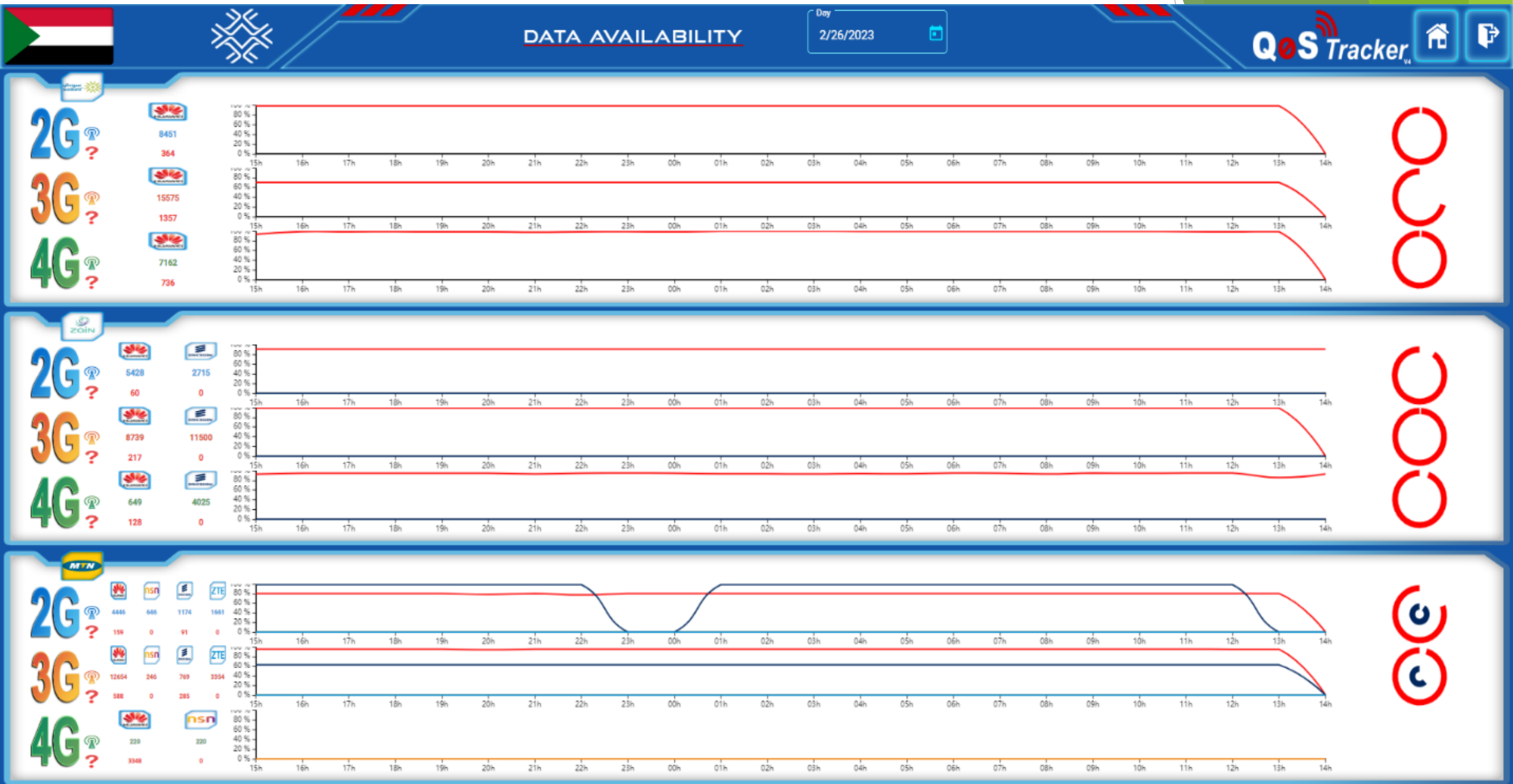
KPI	Threshold	All Cells	Not Conform Cells Number
Cell Availability @ Busy Hour	< 98.0	94.45	637.0
TCH Availability @ Busy Hour	< 99.0	95.55	335.0
SDCCH Availability @ Busy Hour	< 99.0	94.94	285.0
Call Setup Success Rate @ Busy Hour	< 98.0	92.56	708.0
Call Success Rate @ Busy Hour	< 98.0	91.97	1357.0
TCH Congestion Rate @ Busy Hour	> 2.0	5.24	909.0
TCH Drop Rate @ Busy Hour	> 1.0	0.63	1363.0
SDCCH Congestion Rate @ Busy Hour	> 2.0	0.89	104.0
SDCCH Drop Rate @ Busy Hour	> 1.0	0.02	11.0
Call Drop Rate @ Busy Hour	> 1.0	0.63	1363.0
HO Success Rate @ Busy Hour	< 98.0	92.16	3808.0
Data Availability Rate	< 95.0	98.26	141.0

2G network KPI’s

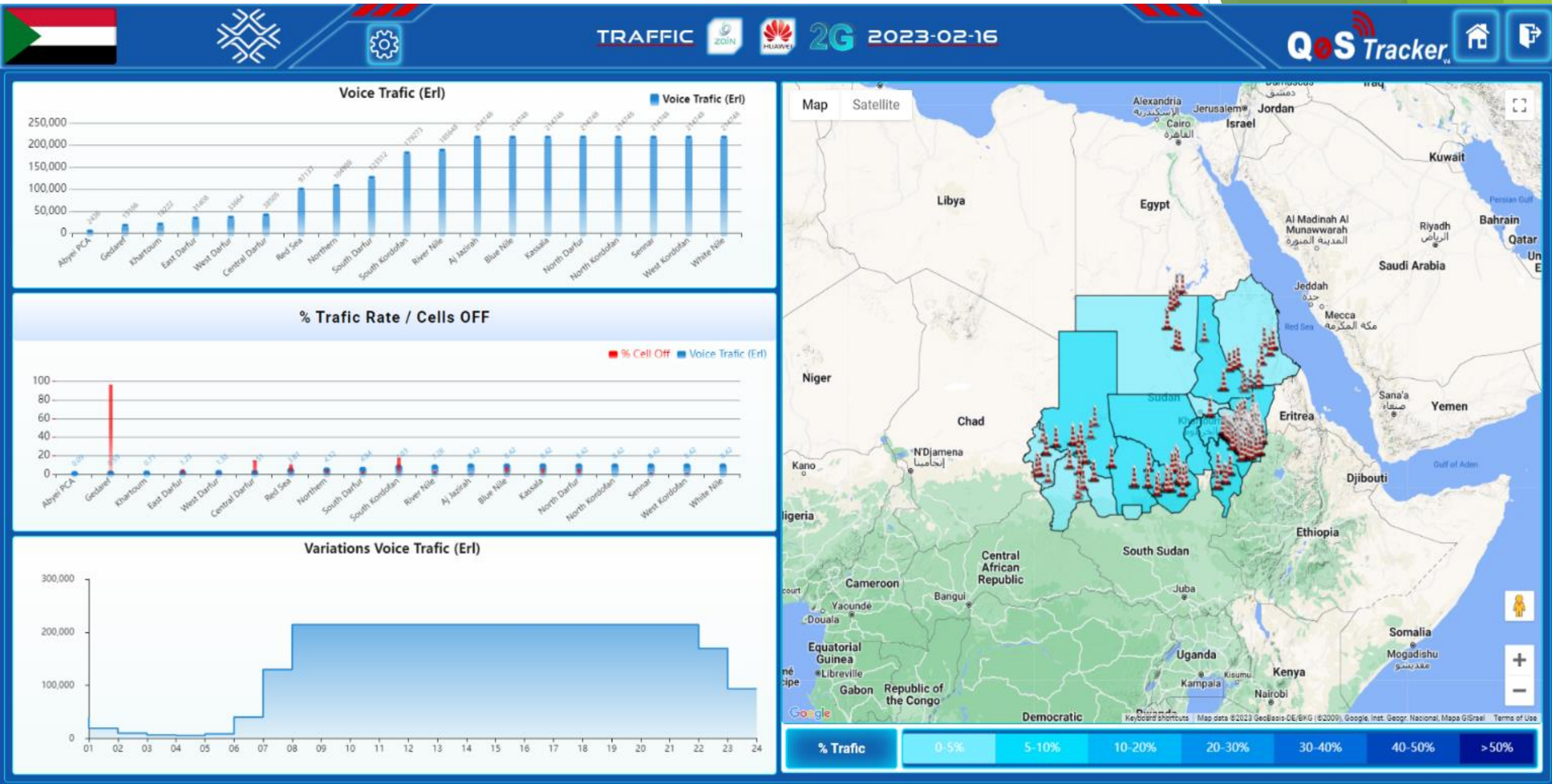
3G network KPI’s

4G network KPI’s

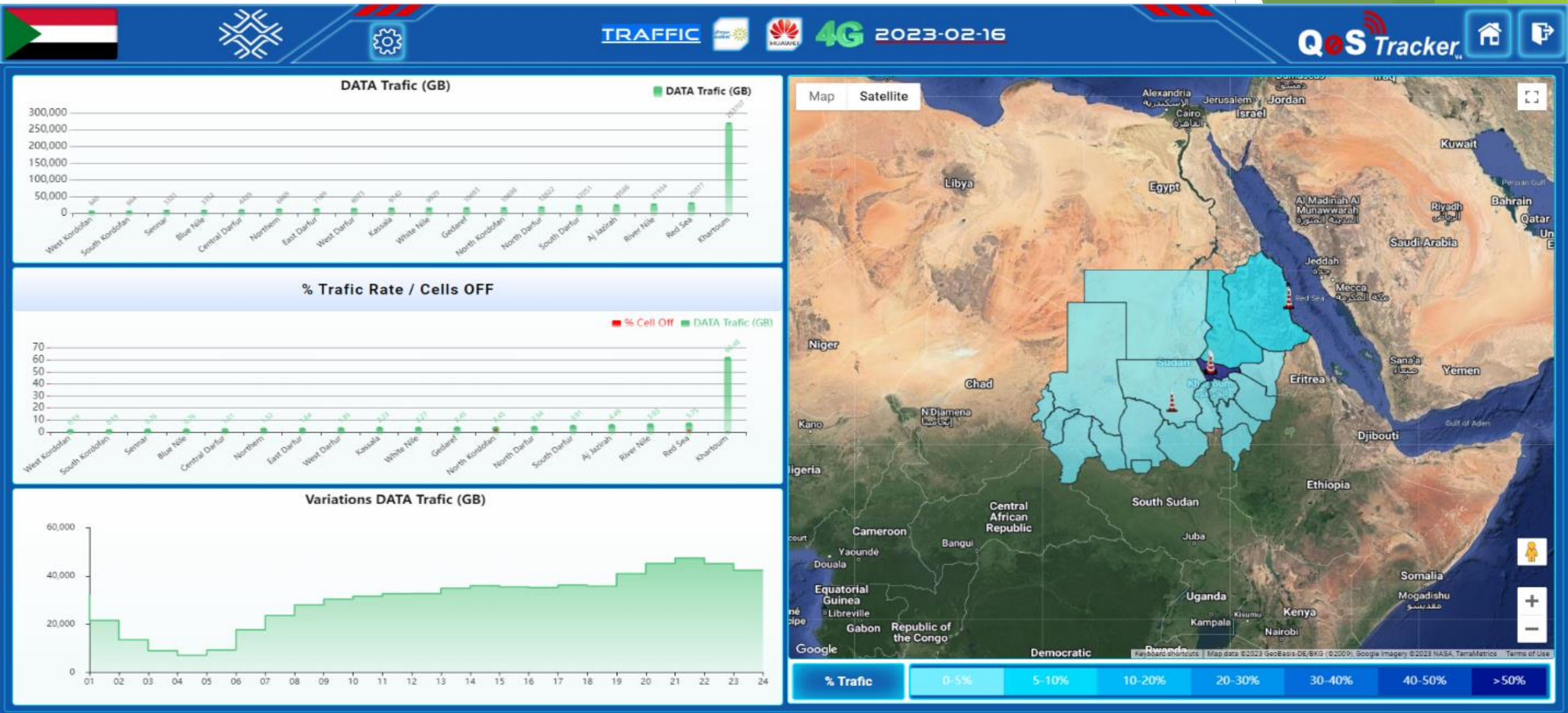
Data Availability



Voice Traffic



Data Traffic



3rd Monitoring method implemented by TPRA

Customer complaints

QOS Methodology adopted

3.Customer complaints

The TPRA has recently begun to establish rules and regulations for customer complaints as the main methodology for assessing the QOS.

The practices implemented by TPR for handling customer complaints are:

- ✓ Receipt of complaint from the client by the department protection of consumer.
- ✓ and transferred to QOS team for further analysis may need to contact the customer directly for more details.
- ✓ Using TPRA NMS or making a drive test for further analysis.
- ✓ Recommend intended MNO to solve the complaint and their feedback on how they fixing the complaint.
- ✓ Finally, TPRA will check in with the customer to make sure the complaint has been fixed.

Challenges:

- Population in Sudan distribute horizontally so the reside in large areas that is a big challenge to measure QOS for all these area.
- The financial inability to provide a lot of equipment to measure the quality of service.
- Security problems in some regions.
- For NMS the MNO’s used to work with more than one vendor
- Due to political issues and the understanding the perceived QoE by end users, So,we could not go forward to implement crowdsource QoE monitoring system.

Possible Solutions

- Suggestion to hire outsource companies to perform DT.
- Coordination with big public app providers to integrate and include TPRA's QoE application.
- Study a road map to implement performance management system vender agnostic

Any Questions?