



Independent Communications Authority of South Africa

350 Witch-Hazel Avenue, Eco Point Office Park
Eco Park, Centurion.
Private Bag X10, Highveld Park 0169
Telephone number: (012) 568 3000/1

**2021/2022 Quarter 2:
Voice Quality of Service
Report
Eastern Cape Province**

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List of Abbreviations

CD	Call Duration
CSFB	Circuit Switched Fall Back
CRR	Call Retention Ratio
CSSR	Call Setup Success Ratio
CST	Call Setup Time
DCR	Drop Call Ratio
GSM	Global System for Mobile Communications
HD	High Definition
ICASA	Independent Communications Authority of South Africa
IVR	Interactive Voice Response
KPI	Key Performance Indicator
LTE	Long-Term Evolution
LTE-A	Long-Term Evolution Advanced
R&S	Rohde & Schwarz
MOC	Mobile Originating Call
MOS	Mean Opinion score
POLQA	Perceptual Objective Listening Quality Analysis
WCDMA	Wideband Code Division Multiple Access
VoLTE	Voice over Long-Term Evolution

1. Executive Summary

The Independent Communications Authority of South Africa (ICASA) contracted Metro Global Telecom Services (Pty)Ltd. (MetroTelworks) to conduct Quality of Service (QoS) measurements on the networks of mobile operators; Cell C, MTN, Telkom and Vodacom. The measurements were performed to monitor performance of mobile voice services offered by the operators in the Eastern Cape Province. The measurements were carried in the period 2 September to 1 October 2021, covering a total distance of over 3185 kilometres.

The purpose of conducting QoS measurements was to monitor and analyse the quality of mobile voice service as experienced by the end-user. The results were later benchmarked against the QoS standard set by the Authority. The measurements were conducted in areas and in circumstances where mobile voice service is likely to be accessed. These areas include towns, townships, farm areas, rural areas, and economic activity nodes. The sampled areas within the Eastern Cape Province were Payne, Sibangweni, Mvumelwano, Gomolo and Lusikisiki.

A vehicle equipped with Rohde and Schwarz Smart Benchmarker II testing system, and 12 mobile phones was used to collect data in mobility conditions. The four Key Performance Indicators (KPIs) used to assess QoS are Accessibility, Retainability, Call Setup Time and Speech Quality. The Drop Call Ratio (DCR) KPI is used to measure a user's ability to successfully complete a call and Call Setup Success Ratio (CSSR) KPI measures a user's ability to make a phone call.

According to the End-User and Subscriber Service Charter Regulations of 2016, the average DCR should be less than 3% and the average CSSR should be greater than 98%. The average Call Setup Time must be less than 20 seconds and the score for the average Speech Quality must be greater than 3.

The results show that in terms of overall Call Setup Success Ratio, all operators achieved less than 98% CSSR, thus failing to meet the Accessibility target.

All operators achieved the Drop Call Ratio of more than 3%, thus failing to achieve the Retainability target.

All operators met the Call Setup Time target of less than 20 seconds.

Cell C and Telkom failed to meet the Speech Quality Target of greater than 3. Eastern Cape Province overall voice performance was poor.

2. Introduction

ICASA's mission is to regulate electronic communications, broadcasting, and postal services in the public interest. The Authority ensures the quality of service through its Quality of Service (QoS) monitoring activities. The Authority contracted Metro Global Telecom Services (Pty) Ltd. (MetroTelworks) to conduct drive testing in selected areas of the Eastern Cape Province. The test was focused on monitoring the cellular voice telephony service being offered by MTN, Vodacom, Cell C and Telkom within the Eastern Cape Province of South Africa.

QoS monitoring was conducted in areas within the OR Tambo District Municipality. The areas of interest that were selected within this municipality were Payne, Sibangweni, Mvumelwano, Gomolo and Lusikisiki. These areas consist of major towns, townships, farm areas, rural areas, major road arteries, economic activity nodes and areas of previous complaints.

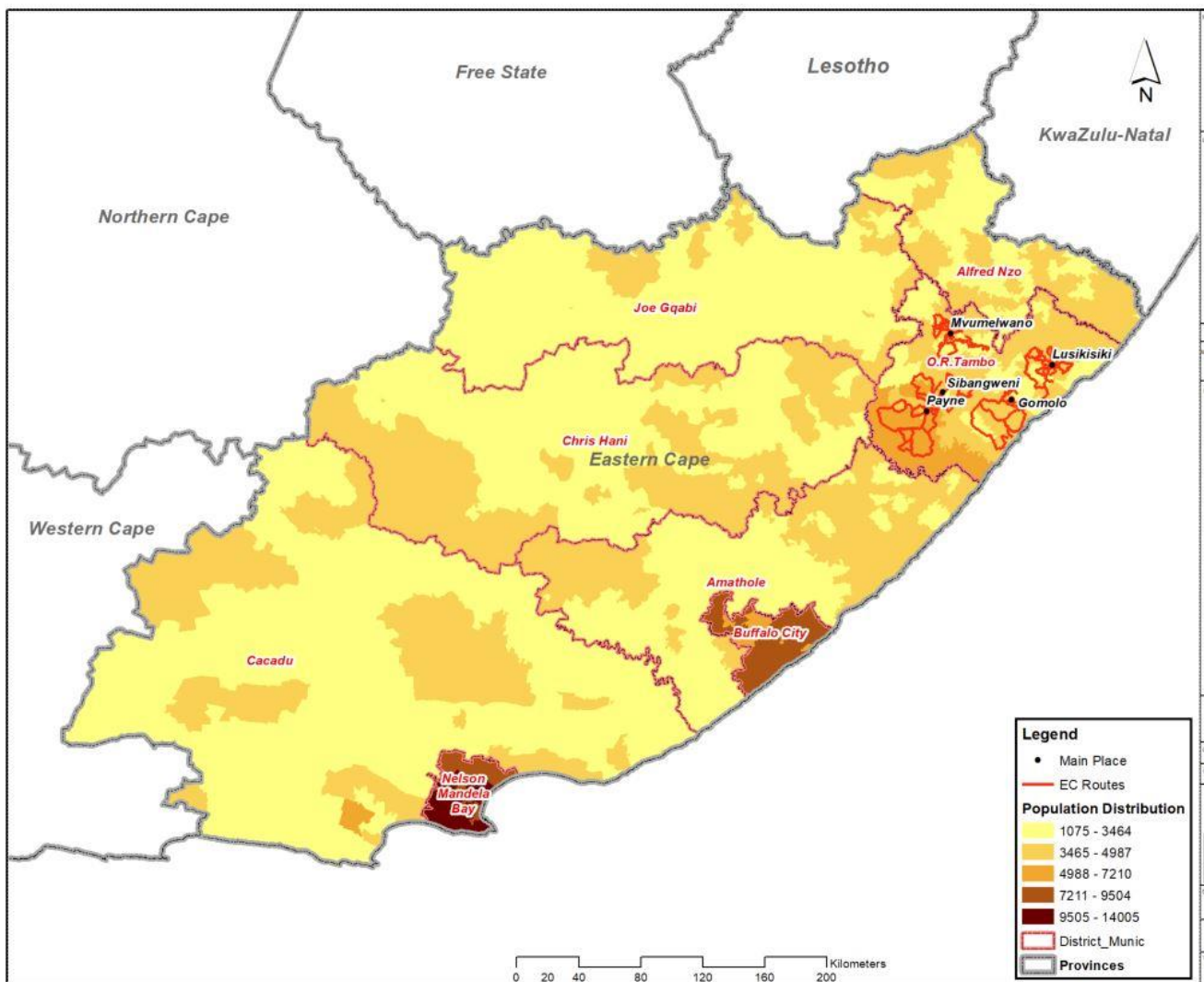


Figure 1. Eastern Cape Province Route Map with Population Distribution

QoS is defined as the collective effect of service performance that determines the degree of satisfaction a user derives from a service. It provides an indication of what a customer experiences when using a mobile network and is evaluated in terms of Call Accessibility, Call Setup Time, and Call Retainability and Speech Quality parameters.

- a) Call Accessibility is reported as a percentage and is a measure of the number of times a user can successfully establish a call as a ratio of the total calls attempted. It is measured using Call Setup Success Ratio (CSSR).
- b) Call Setup Time is the time interval from the instant a user initiates a mobile call request until a complete message indicating call disposition is received by the calling terminal. It is measured from the time a user presses the dial button until the user gets connected to the dialled party.
- c) Retainability is defined as the ability for a call to stay connected through to a normal call tear-down process, without abnormally disconnecting from the cell site that carries the call. It is measured using Drop Call Ratio (DCR).
- d) Speech Quality is the condition of conversational speech without noise and echo interference. It is measured using the Mean Opinion Score (MOS).

3. Methodology

A minimum of 120 test samples per network operator were collected for each area tested. A drive-test sampling methodology which provides a snapshot view of the mobile operator's quality of service was adopted. It provides a realistic picture of network performance from a user's point of view. The method adopted provides a snapshot of an operator's network performance on the selected routes and particular time of the day, which may not be a true representation of the mobile service provider's overall network performance, however, it is considered statistically relevant.

Voice test set-up consisted of two test scenarios namely, short calls and long calls which are defined in this section. The short calls were used to measure Call Accessibility and Call Setup Time(s) whilst the long calls were used to measure Call Retainability and Speech Quality. The Long call scenario required the use of two test mobiles per Operator i.e., call initiating side (A-side) and call receiving side (B-side). The Short call scenario required the use of a single test mobile for each Operator making calls to the Operators IVR system. This set-up results in three mobile devices per operator bringing the total number of devices used for the test to twelve with three for each Mobile Operator. The Call Windows were set up as follows: Call duration + 30 seconds, (for the setup and release phases) + 30 seconds (for the minimum pause interval after call termination). The call duration for the long call was set at 120 seconds bringing the total call window size to 180 seconds with the short call duration set at 10 seconds resulting in a total call window of 70 seconds. The audio quality of speech samples was evaluated using the HD-voice capable and ITU standardized POLQA wideband algorithm with 10 samples being recorded during each call.

The devices were set to select the best available technology whilst the test SIMs in use were not activated for VoLTE services. With this setup, in areas where operators had LTE, they performed Circuit Switched Fall Back (CSFB) calls.

Voice testing was done in two phases with a measurement window gap of at least seven days in between both measurements.

3.1. Equipment test setup and configuration

3.1.1. System used



The Test Equipment used was the Rohde & Schwarz SwissQual Benchmarker II platform with Sony XZ Premium smartphones installed inside the car using the R&S Phone Mount Walls. 4 mobile devices were used for Short Call and 8 mobile devices were used for Long Call. The mobile devices were configured to automatically select a mobile network and radio access technology.

technology.

3.1.2. Device Description

The Sony Xperia XZ Premium Smartphone was selected as the measurement User Equipment (UE) for Voice Services. It supports the following technologies: GSM, HSPA, LTE and LTE-A.

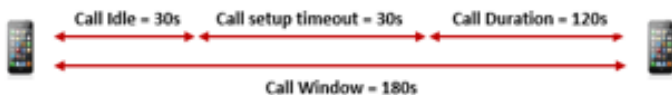
3.1.3. Short and Long Call Windows

Figure 2 shows the call windows for the long and short calls as highlighted in the methodology section.

Short Call:



Long Call:



Test Scenar..	Value
Short Call	Call Duration = 10s
	Call Setup timeout = 30s
	Call Window = 70s
Long Call	Call Duration = 120s
	Call Setup timeout = 30s
	Call Window = 180s
POLQA (WB)	

Figure 2. Call Window Duration

3.2. Route selection

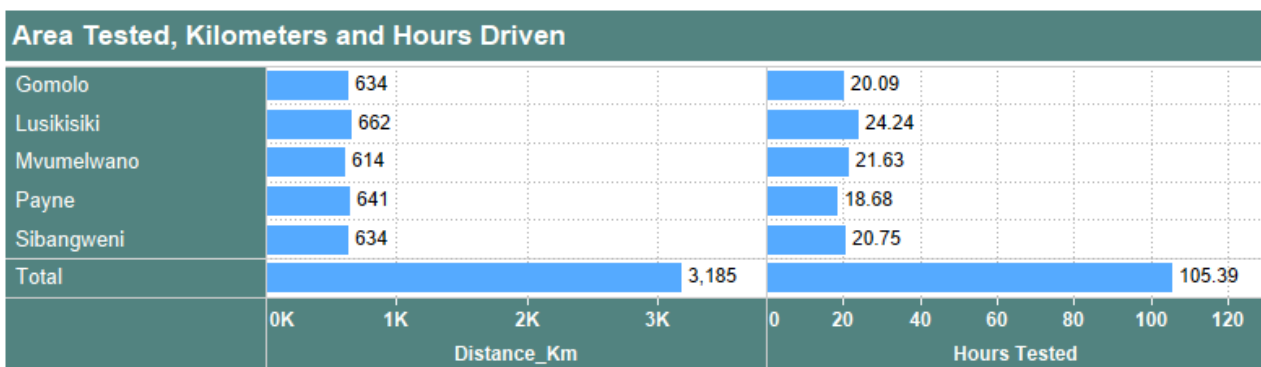
Measurement routes were selected so that they would reflect end user distribution at different geographical locations in areas where people live and use mobile phones - major towns, townships, farm areas, rural areas, major road arteries, economic activity nodes and areas of previous complaints. The selected five areas in which the QoS measurements were conducted are within one district municipality as indicated in Table 1.

Table 1. Test timeline for area covered

Routes and Dates			
District	Area	Dates	Phase
O R Tambo	Payne	02/09/2021 & 03/09/2021	Phase1
		20/09/2021 & 21/09/2021	Phase 2
	Sibangweni	06/09/2021 & 09/09/2021	Phase1
		22/09/2021 & 23/09/2021	Phase 2
	Mvumelwano	10/09/2021 & 13/09/2021	Phase1
		25/09/2021 & 27/09/2021	Phase 2
	Gomolo	14/09/2021 & 17/09/2021	Phase1
		28/09/2021 & 29/09/2021	Phase 2
	Lusikisiki	15/09/2021 & 16/09/2021	Phase1
		20/09/2021 & 01/10/2021	Phase 2

Table 2 shows the total distance covered in each area for both phases and active measurement duration.

Table 2. Distance and time driven per area



3.3. Measurement parameters and targets

3.3.1. Parameters

3.3.1.1. Call Setup Success Ratio [%]

The Call Setup Success Ratio (CSSR) is the percentage of calls that are successfully set up as a percentage of the total call attempts. The formula to calculate CSSR is shown below:

$$\text{CSSR} = Y/X * 100$$

Where, Y represents the calls that are established, and X is the total number of call attempts.

3.3.1.2. Drop Call Ratio [%]

Dropped Call Ratio (DCR) is the proportion of incoming and outgoing calls, which, once correctly established and therefore having been assigned a traffic channel, are dropped, or interrupted prior to the deliberate completion by the user. The formula to calculate DCR is shown below:

$$\text{DCR} = D/S * 100$$

Where, D = number of dropped calls and S = number of successful calls established

3.3.1.3. Call Setup Time [s]

Call Setup Time is the time interval from the instant a user initiates a network connection request until a complete message indicating call disposition is received by the calling terminal. It is measured from the time a user presses the dial button until the user gets connected to the dialled party.

3.3.1.4. Speech Quality (MOS)

Speech quality on call basis is an indicator representing the end-to-end speech transmission quality of the mobile telephony service. This parameter computes the speech quality on the basis of completed calls. Measurement made use of the POLQA Algorithm which compares the reference signal received from the transmitting side against an equivalent sample on the receiving side.

3.3.2. Targets

According to the End User and subscriber Service Charter Regulations of 2016, the following voice parameters' targets are defined as follows:

1. Call Setup Success Ratio – Average Call Setup Success Ratio must be greater than 98%.
2. Call Setup Time Ratio – Average Call Setup Time must be less than 20 seconds.
3. Drop Call Ratio – Average Drop Call Ratio must be less than 3%.

4. Speech Quality – Average Speech Quality of MOS must be greater than 3.

4. Results and Analysis

This section provides a summary of the mobile operators' performance results based on the drive test route in the following test areas: Payne, Sibangweni, Mvumelwano, Gomolo and Lusikisiki.

4.1. Accessibility, Retainability, Call Setup Time and Quality Measurements KPI Results per Area

Table 3 shows a summary of KPI results per area. All operators show poor performance for Call Accessibility in all the tested areas. Gomolo, Lusikisiki and Mvumelwano are the worst performing area for all operators where Accessibility and Retainability is concerned. Cell C and Telkom has poor Voice Quality in all the tested areas. Detailed results are provided in the Appendix 1 and Appendix 2.

Table 3. Summary of KPI Results per Area

		Gomolo	Lusikisiki	Mvumelwano	Payne	Sibangweni
Call Setup Success Ratio - [%]	Cell C	85.58%	88.94%	88.76%	84.93%	85.62%
	MTN	90.53%	91.49%	92.41%	87.30%	87.75%
	Telkom	82.11%	91.60%	81.15%	88.96%	93.09%
	Vodacom	86.95%	92.76%	92.01%	96.07%	96.61%
Drop Call Ratio [%]	Cell C	4.89%	6.58%	11.98%	2.76%	11.96%
	MTN	2.68%	4.75%	1.63%	4.28%	2.56%
	Telkom	7.17%	5.93%	5.79%	6.69%	3.56%
	Vodacom	3.57%	3.63%	5.41%	2.11%	1.66%
Call Setup Time [s]	Cell C	4.31	4.43	4.51	4.36	4.47
	MTN	3.63	3.74	4.15	3.65	3.74
	Telkom	5.19	4.09	5.34	4.52	4.48
	Vodacom	3.80	3.78	3.82	3.63	3.76
POLQA MOS	Cell C	2.77	2.76	2.74	2.78	2.74
	MTN	3.49	3.40	3.51	3.52	3.46
	Telkom	2.78	2.91	2.76	2.91	2.97
	Vodacom	3.28	3.14	3.23	3.50	3.36

4.1.1. Call Accessibility (Short Call)

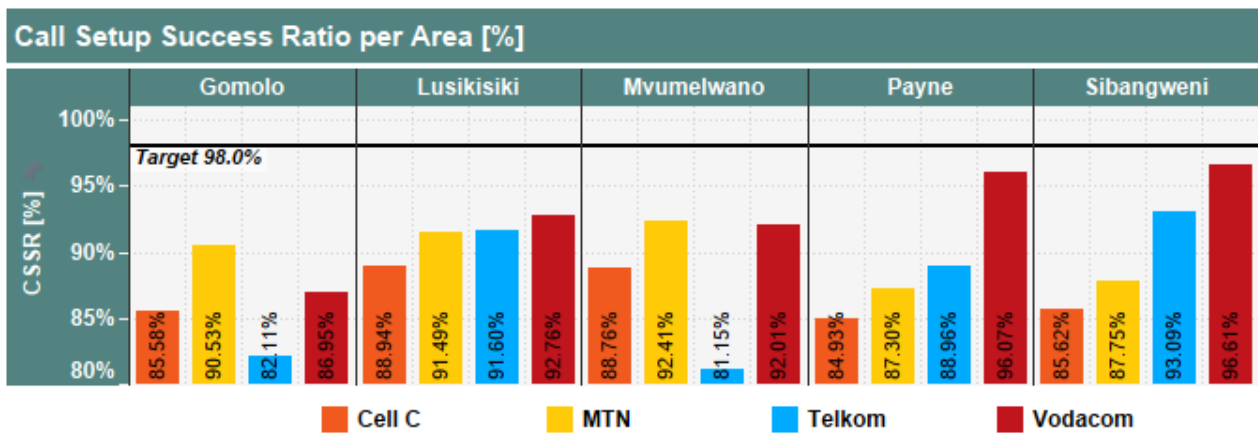


Figure 3. CSSR KPI per Area - Short Call

Figure 3 shows that all operators failed to meet the 98% CSSR target in all the tested areas.

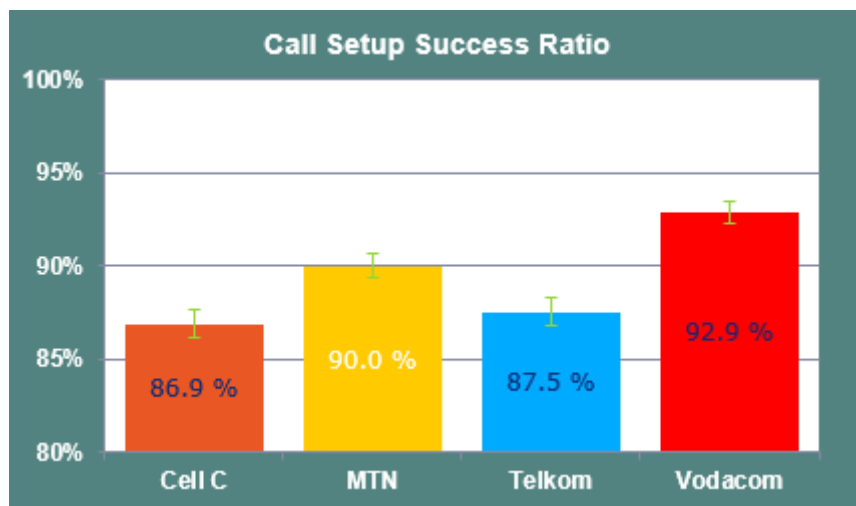


Figure 4. CSSR KPI Overall Results

Figure 4 shows that all operators failed to achieve the overall CSSR target of 98%. There is statistical significance difference recorded between MTN, Vodacom and Cell C. There is no statistical significance difference recorded between Cell C and Telkom results.

4.1.2. Drop Call Ratio (Long Call)

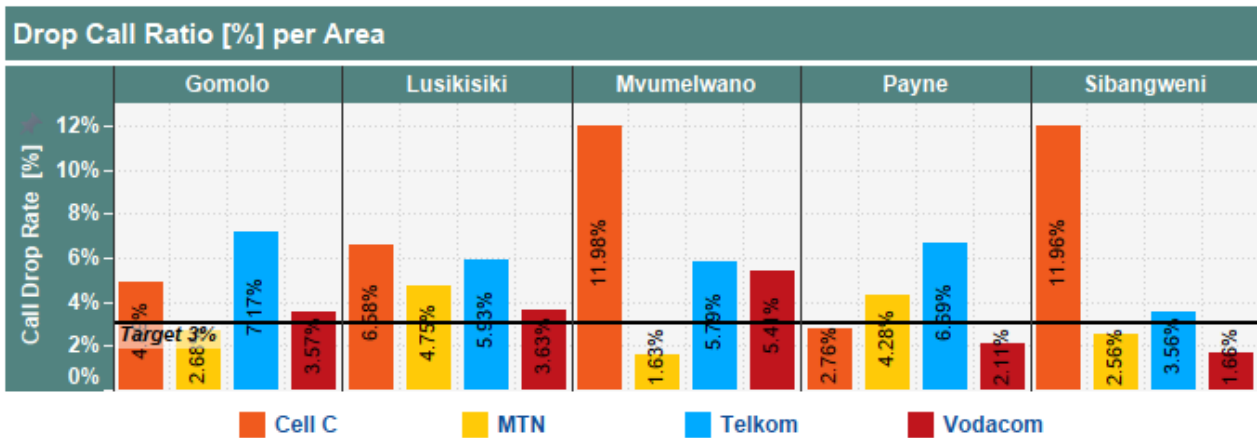


Figure 5. DCR KPI per Area Long Call

Figure 5 shows the operators' DCR KPI results per area. MTN met the target in Gomolo, Payne and Sibangweni while Vodacom met the target only in Payne and Sibangweni. Telkom failed to achieve the target in all five tested areas and Cell C failed to achieve the target in four tested areas except Payne.

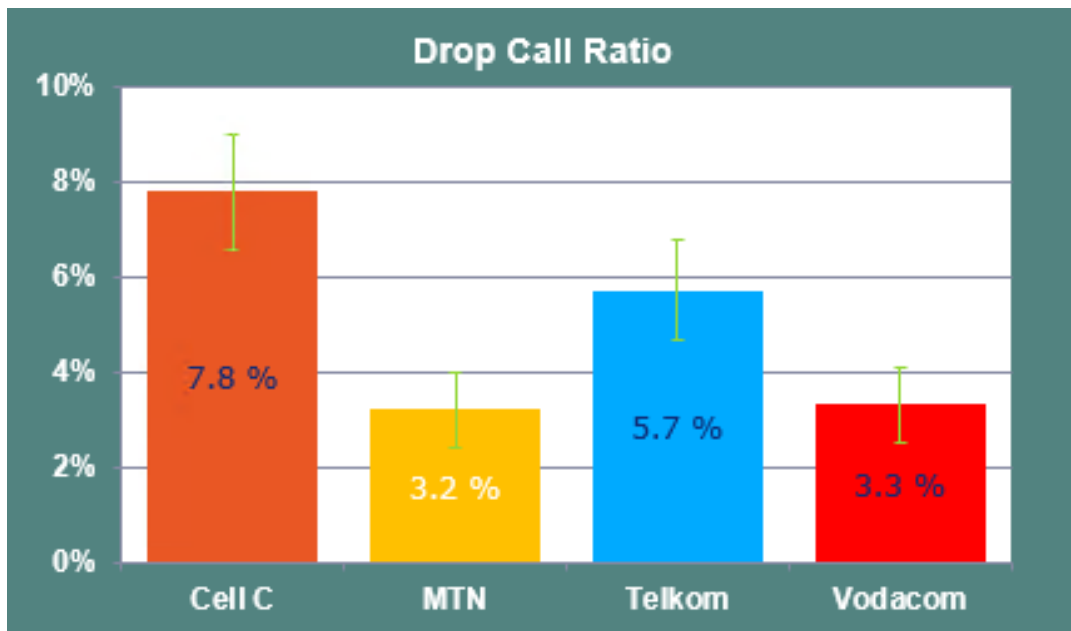


Figure 6. DCR KPI Overall Results

Figure 6 Overall results show that all operators failed to meet the DCR KPI target of less than 3%. MTN's Overall DCR is the lowest followed by Vodacom, Telkom and Cell C. There is no statistically significant difference recorded between MTN and Vodacom and no statistical difference between Cell

C and Telkom. There is statistical significance difference between the results of both MTN and Vodacom with the other two operators: Cell C and Telkom.

4.1.3. Call Setup Time (Short Call)

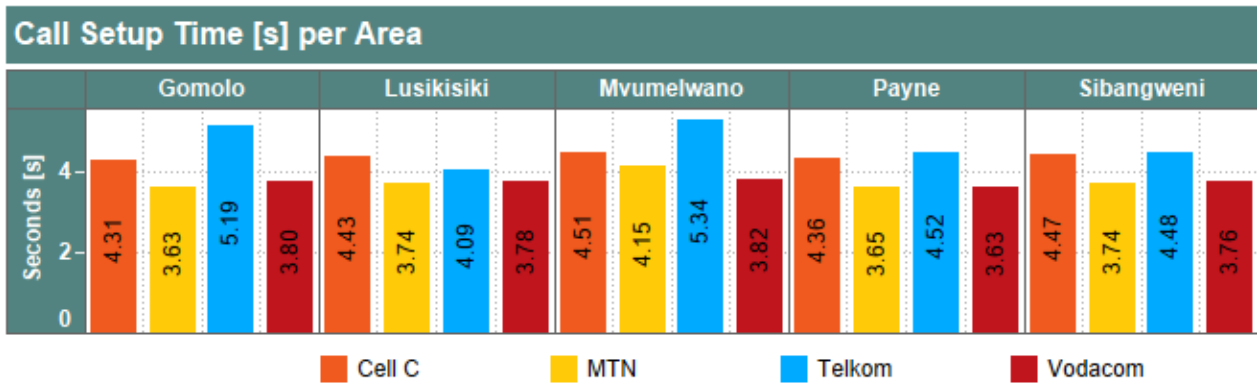


Figure 7. Call Setup Time[s] KPI per Area

Figure 7 shows all operators met the Call Setup Time target of less than 20 seconds in all the tested area of Eastern Cape as per the End-User and Subscribers Service Charter Regulations of 2016.

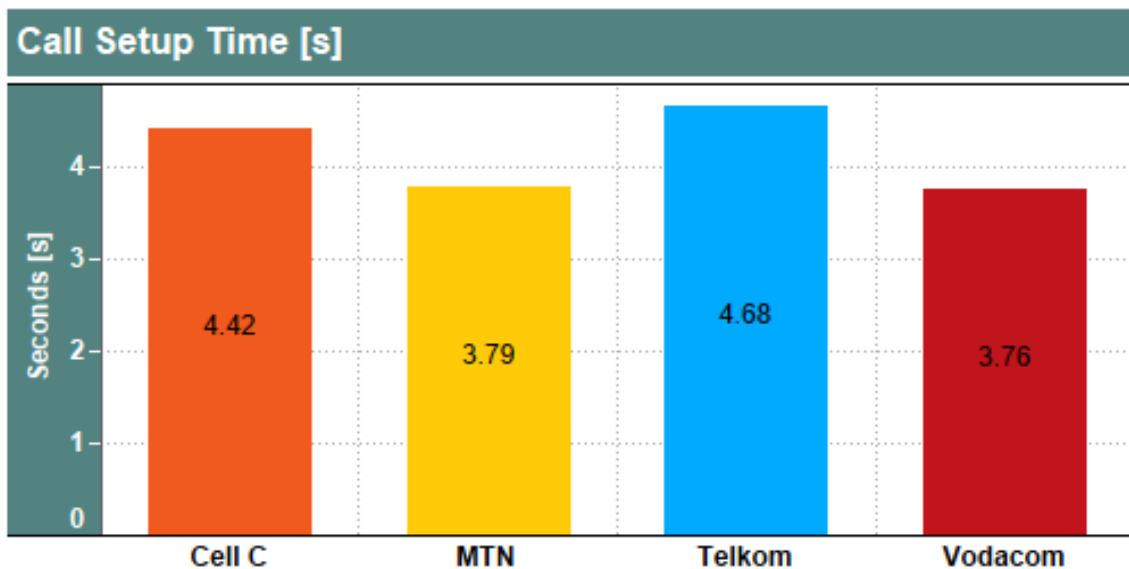


Figure 8. Call Setup Time[s] KPI Overall Results

Figure 8 shows the overall Call setup time results for the Eastern Cape Province. Vodacom had the lowest overall Call Setup Time followed by MTN, Cell C and Telkom.

4.1.4. POLQA MOS (Long Call)

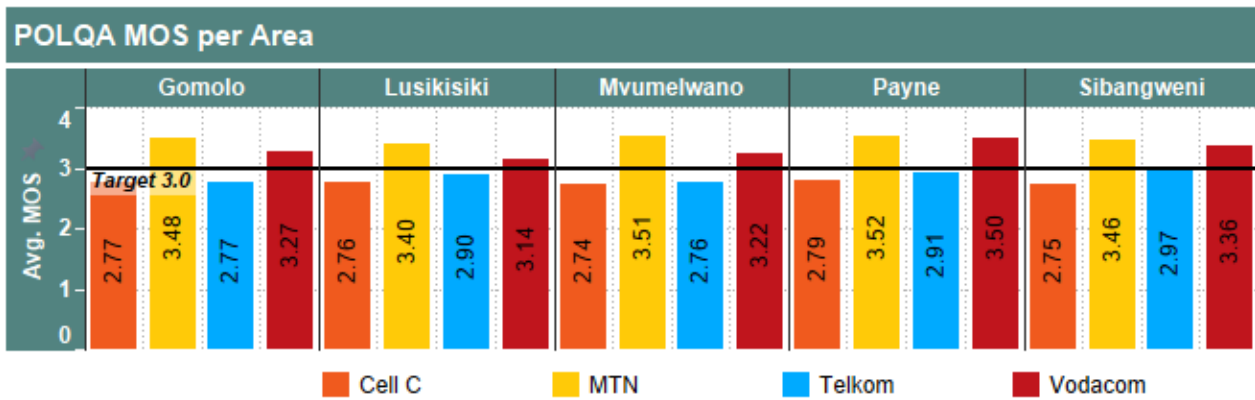


Figure 9. Speech Quality per Area

Figure 9 depicts speech quality results per tested area. MTN and Vodacom are the only two Operators that achieved an average POLQA MOS of at least three (3) in all the tested areas thus meeting the required speech quality target. Cell C and Telkom failed to meet the target for speech quality in all tested areas of Eastern Cape province.

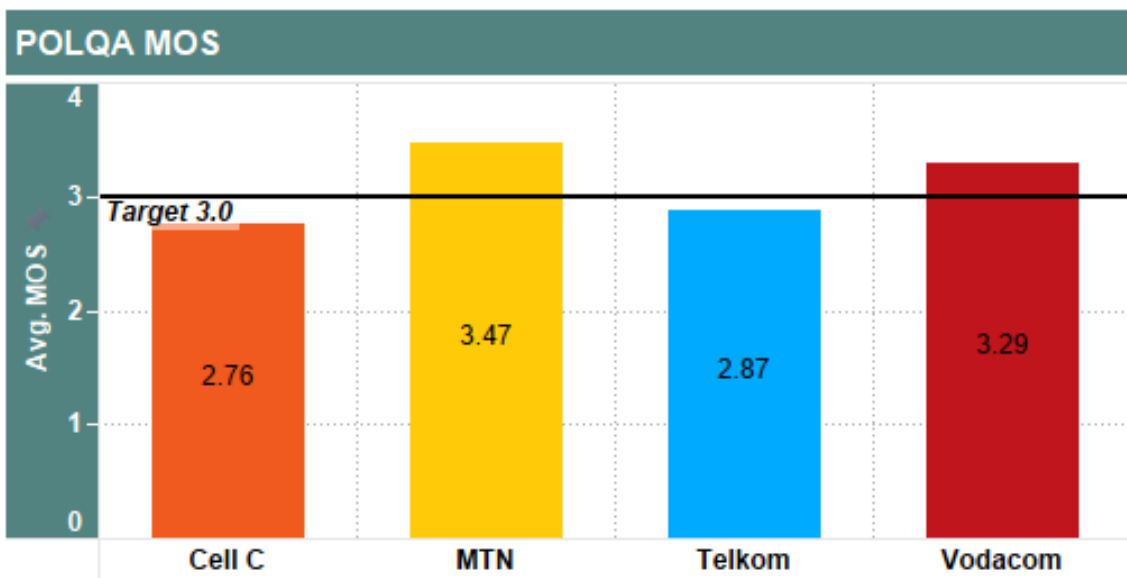


Figure 10. Speech Quality Results

Figure 10 shows the overall Voice Quality scores for each Operator for the Eastern Cape Province. MTN achieved the best Overall Speech Quality followed by Vodacom, Telkom and Cell C in descending order. Cell C and Telkom failed to meet the required speech quality target of a score of three.

4.2. Radio Technology

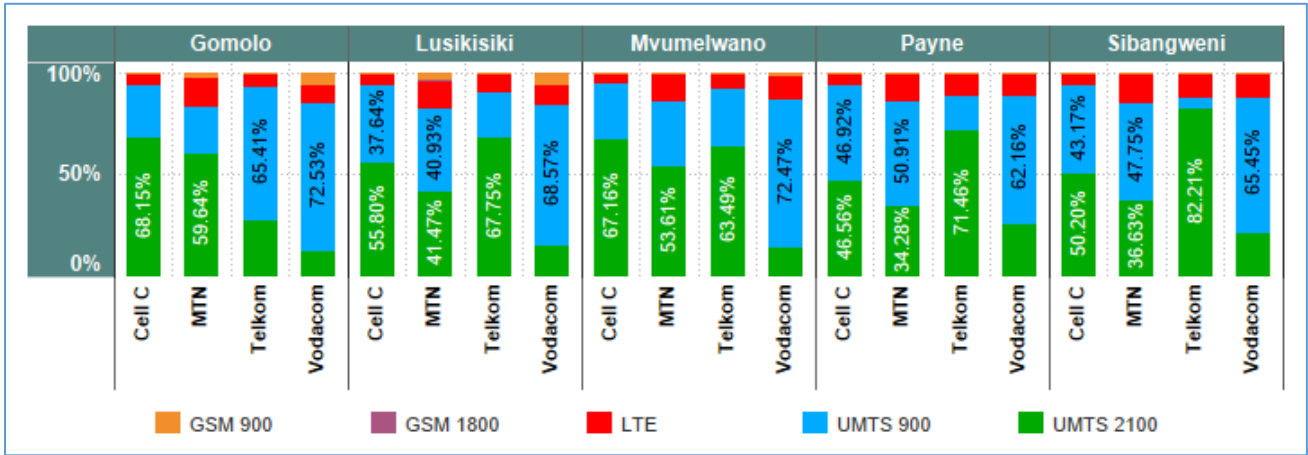


Figure 11. Serving Radio Technology per Area

Figure 11 shows the distribution of the serving radio technology per area. Vodacom showed significant presence of UMTS 900 for all areas.

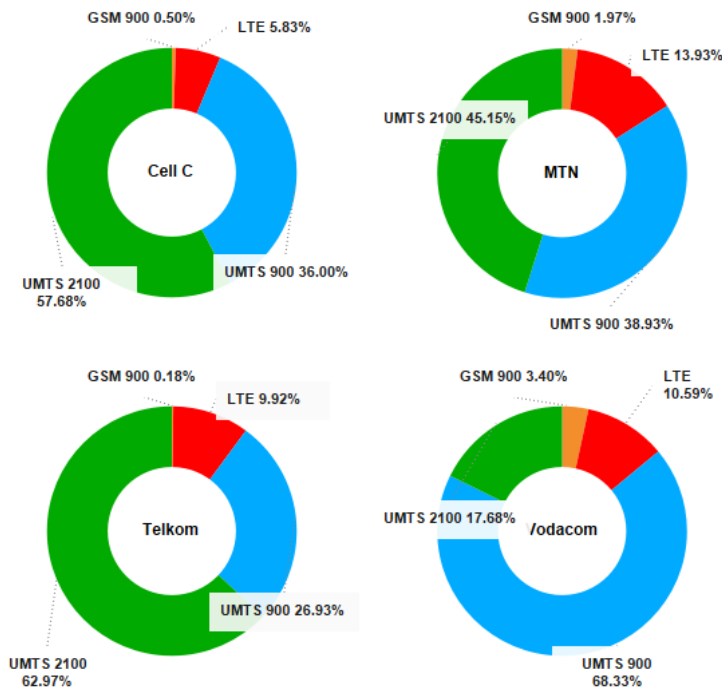


Figure 12. Serving Radio Technology Overall Results

Figure 12 shows the distribution of the overall serving technology during the drive test. All operators' serving technology was mainly on UMTS technology, Telkom showed presence of most samples on

UMTS 2100. Vodacom has the highest UMTS 900 presence followed by MTN, Cell C and Telkom in a descending order. MTN has the highest LTE presence followed by Vodacom, Telkom and Cell C.

4.2.1. CSFB

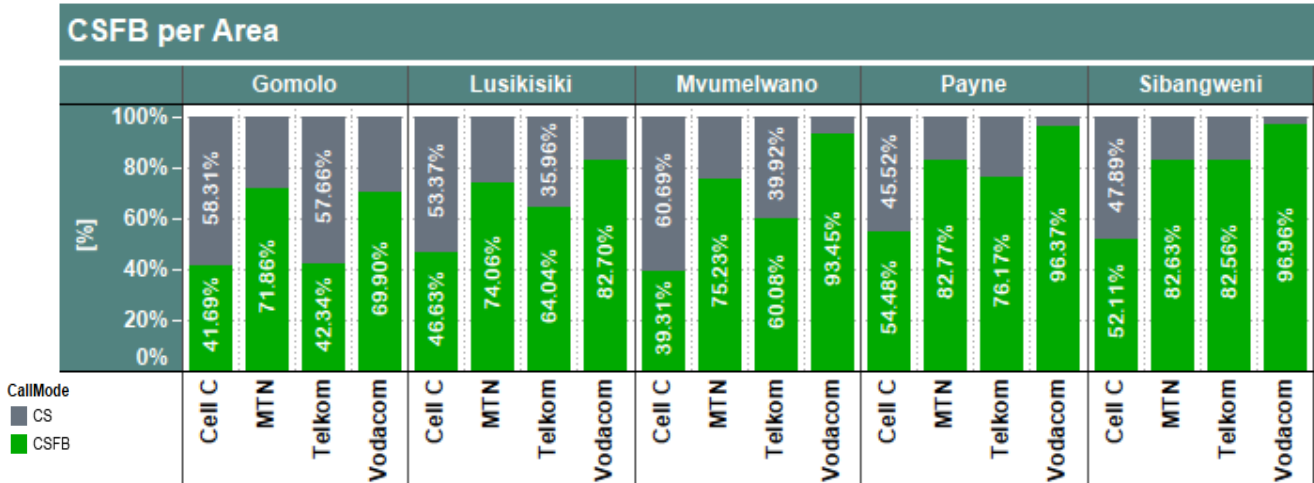


Figure 13. CSFB per Area

Figure 13 shows the breakdown of CS/CSFB calls per Route. Vodacom and MTN are seen with most CSFB samples in all the areas. This is also an indication that both the operators have significant LTE coverage in all the tested areas of Eastern Cape Province.

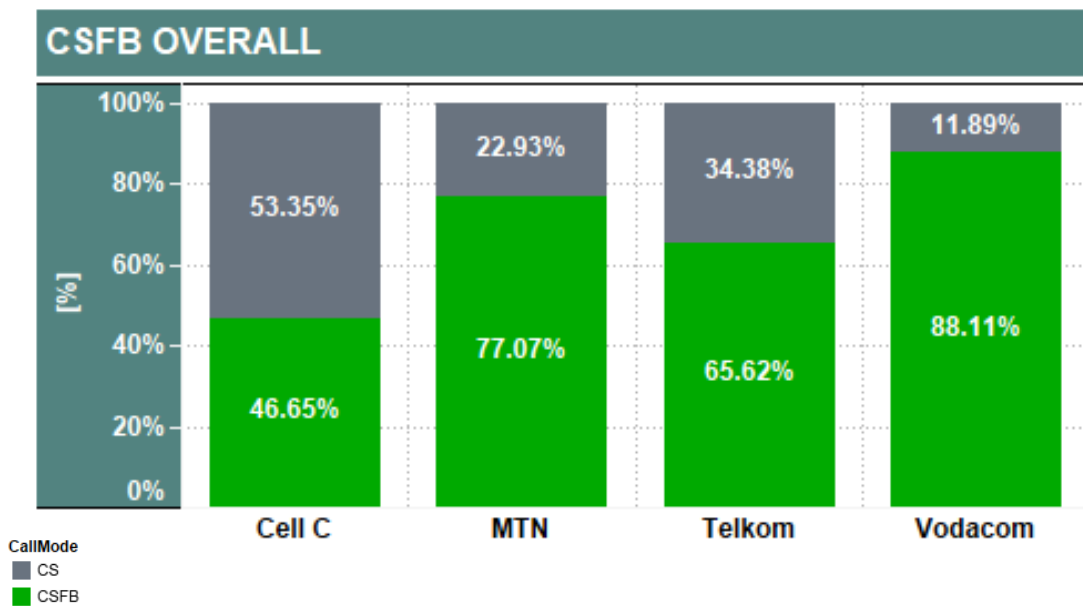


Figure 14. CSFB Overall Results

Figure 14 shows percentage of calls that were attempted on traditional networks as well as the ones initiated on LTE network and made CS fall back to UMTS/ GSM. Vodacom is seen with the most CSFB samples in Overall results.

5. Conclusion

This section provides the summary and key findings of all measurements. The results illustrate a snapshot of the mobile network performance and customer experience within the measured time and location context.

The results indicate that the end-user's Quality of Service and operators' network performance varies significantly per area tested. Below are the highlights:

- **Worst Performing Area:** All the operators failed to meet CSSR target for **all the tested areas**.
- **Call Setup Success Ratio (CSSR):** The results show that in terms of overall Call Setup Success Ratio, all operators achieved less than 98% CSSR, thus failing to meet the Accessibility target.
- **Drop Call Ratio (DCR):** All operators failed to meet the overall Drop Call Ratio target (3%), thus failing to achieve the Retainability target.
- **Speech Quality (MOS):** MTN and Vodacom achieved speech quality target. Cell C and Telkom failed to meet the target of 3 for Speech Quality. Cell C and Telkom failed to achieve more than 3.0 POLQA MOS target in all the tested areas. MTN achieved best MOS with a score of 3.47 followed by Vodacom with 3.29.
- **Call Setup Time (CST):** All operators achieved the target according to the End-User and Subscribers Service Charter Regulation of 2016. Vodacom has the fastest overall Call Setup Time with an average of 3.76s, followed by MTN at 3.79s.

The overall results in the Eastern Cape Province indicates a poor performance on the voice service.

6. Appendices

6.1. Appendix 1: Mobile operators' feedback on the report

6.1.1. Vodacom

Vodacom provided feedback and network improvement plans that are in place for all areas;

- Gomolo – High number of Call Setup Failures occurred in Mhotsheni and in Gogqozo. Poor Coverage and Quality were due to sites being out of service on the 14th, 17th, 28th and 29th of September 2021 impacting both phases of the trial. Some of the sites serving the area are currently without Back-up power after being vandalized and batteries stolen. Performance and optimal quality of experience is guaranteed in this area when all sites are up. Network statistics show that the sites have been restored and are now On Air. The operator will do site hardening and install battery back-up. There has been improvement of quality of service since the rollout of LTE 900 coupled with addition of new mobility parameter in December 2021. There are 2G Capacity upgrades which are also planned for the area.
- Mvumelwano – Sites were out of service which resulted in poor coverage and quality causing high number of dropped calls and call setup failures in the area were due to sites being out of service on the 10th, 13th, 25th, and 27th of September 2021. The network statistics show that the sites have been restored and active. Coverage concern was also picked up in the area and has been addressed with a new site, which was built and integrated in Jan 2022. There are also plans to improve security at the sites and install battery back-up to address power outages and vandalism. There has been improvement of quality of service since the rollout of LTE 900 coupled with addition of new mobility parameter in December 2021.
- Lusikisiki – The high number of call setup failures in both phases occurred due to site outages causing high congestion and mobility challenges. Poor coverage and quality were due to sites being out of service on the 15th, 16th, and 30th of September 2021 as well as on 1st of November 2021, impacting both phases of the trial. Network statistics shows that these sites have been restored and are On Air. There are also plans to improve security at the sites and install battery back-up to address power outages and vandalism. The upgrade of U900 will improve mobility and capacity for 3G network. There has been improvement of quality of service since the rollout of LTE900 coupled with addition of new mobility parameter in December 2021. GSM 1800 Rollout and GSM 900 optimisation are planned to increase GSM capacity.

- Payne - Poor coverage and quality resulting in high number of dropped calls and call setup failures in both phases of network testing were due to sites being out of service on the 1st, 2nd, 20th and 21st of September 2021. The sites have since been restored and network statistics show that performance restored in the area. Site hardening and battery back-up installation is in progress. UMTS 2100 and LTE 2100 Rollout is planned in the out skirts of the area. GSM 1800 Rollout and GSM 900 optimisation is also planned to resolve GSM capacity limitations.

6.1.2. MTN

MTN has indicated that it will remain committed to the improvement of the network quality even in areas where performance was good, thereby improving the end user mobile voice service experience.

- Payne - MTN acknowledges the poor Call Accessibility and Retainability experienced during the drive test conducted by the Authority. To address dropped calls in the areas, MTN will immediately implement optimisation techniques (electrical down tilting) on some sites to address the coverage patches. Two sites had availability issues and were not serving when the drive tests were conducted. The issues on these sites have been resolved. Similarly, with the Call Accessibility, MTN will perform optimisation on the existing sites to improve the coverage in the areas.
- Sibangweni - There are coverage holes that resulted in the blocked calls and drop calls observed when the Authority conducted the drive test. MTN has planned two new sites that are expected to be operational before the end of the fourth quarter of 2021/22 financial year, which will be critical in resolving the coverage issues in the area. Further analysis of the results has also revealed that blocked calls during the drive testing were due to downlink power congestion on few sites and this issue was later resolved.
- Mvumelwano - MTN has a new site planned in the area, which will assist to resolve few coverage patches that resulted in dropped calls experienced during the drive test. Poor Call Accessibility was due to blocked calls in the area and failures due to RRC connections request not receiving setup message on the existing covering sites. MTN will implement corrective optimisation methods immediately on the affected sites to improve the call accessibility in the area.

- Gomolo - MTN has fair amount of coverage sites in the area to ensure that consumers have access in the residential areas, 95% of the negative events are due to poor coverage because the Gomolo area is mountainous with many small coverage patches. MTN will implement optimisation methods, especially electrical down tilts to improve Call Accessibility. Most the dropped calls were due to site availability issues and these issues have been resolved.
- Lusikisiki - Most of the dropped calls and blocked calls experienced in the area are due to coverage holes. MTN will implement electrical down tilts and sectorisation on few existing sites to improve coverage in the area. New locations have been identified where coverage sites will be built from the 2023 financial year to improve coverage as well.

6.1.3. Cell C

Cell C in its response indicated that it notes the findings of the Authority and will continue to provide improved 3G and 4G coverage to its subscribers by working with its national roaming service provider in the tested areas. The operator will engage with its national roaming service provider to resolve and improve the QoS in terms of failed calls and drop calls in the areas identified. Cell C also indicated that an unstable power grid and site upgrades also contributed to the dropped calls. Poor coverage areas were escalated to the operator's roaming partners.

6.1.4. Telkom

Telkom's response to the report indicated that it views the Authority test results as very significant and use them as additional input to further improve the quality of the mobile network. Furthermore, Telkom indicated that they will be engaging with their roaming partners to resolve issues and improve customer experience.

Planned capacity expansion using the provisional assigned sub 1 GHz will also assist to improve network coverage footprint during the National State of Disaster. Telkom continues to use 1800 MHz as a coverage layer, in absence of permanently assigned 700/800 MHz spectrum, in light of the limited period of provisional spectrum. Permanent assignment of sub 1 GHz spectrum to Telkom will assist to deliver increased performance and better customers experience.

The operator only provided information on planned additional sites for Lusikisiki. The operator has 18 sites planned at different roll-out phases within the area.

6.2. Appendix 1: Detailed Test results per Phase

Table 4. CSSR and Call Setup Time - Phase 1 and Phase 2

		Gomolo		Lusikisiki		Mvumelwano		Payne		Sibangweni		Grand Total
		Phase 1	Phase 2	Phase 1	Phase 2	Phase 1	Phase 2	Phase 1	Phase 2	Phase 1	Phase 2	
Call Attempt	Cell C	711	697	810	890	774	739	672	642	742	781	7458
	MTN	717	708	815	900	782	747	678	645	750	785	7527
	Telkom	717	708	816	899	782	746	677	645	750	784	7524
	Vodacom	717	708	814	899	781	746	678	645	750	783	7521
Call Failed	Cell C	101	102	68	120	95	75	73	125	124	95	978
	MTN	64	71	56	90	69	47	66	102	89	99	753
	Telkom	117	138	68	76	138	150	79	67	41	65	939
	Vodacom	83	103	58	66	55	67	24	28	21	31	536
Call Setup Success Ratio [%]	Cell C	85.79%	85.37%	91.60%	86.52%	87.73%	89.85%	89.14%	80.53%	83.29%	87.84%	86.89%
	MTN	91.07%	89.97%	93.13%	90.00%	91.18%	93.71%	90.27%	84.19%	88.13%	87.39%	90.00%
	Telkom	83.68%	80.51%	91.67%	91.55%	82.35%	79.89%	88.33%	89.61%	94.53%	91.71%	87.52%
	Vodacom	88.42%	85.45%	92.87%	92.66%	92.96%	91.02%	96.46%	95.66%	97.20%	96.04%	92.87%
Call Setup Time [s]	Cell C	4.35	4.28	4.36	4.49	4.50	4.52	4.31	4.41	4.54	4.41	4.42
	MTN	3.59	3.67	3.67	3.82	4.27	4.02	3.65	3.65	3.86	3.63	3.79
	Telkom	5.14	5.25	4.23	3.96	5.36	5.31	4.35	4.70	4.35	4.60	4.68
	Vodacom	3.75	3.85	3.81	3.75	3.85	3.79	3.63	3.64	3.79	3.73	3.76

Table 5. DCR and POLQA MOS - Phase 1 and Phase2

		Gomolo		Lusikisiki		Mvumelwano		Payne		Sibangweni		Grand Total
		Phase 1	Phase 2	Phase 1	Phase 2	Phase 1	Phase 2	Phase 1	Phase 2	Phase 1	Phase 2	
Call Completed	Cell C	155	156	184	185	158	158	147	135	114	173	1565
	MTN	164	163	196	205	182	180	151	140	173	169	1723
	Telkom	134	125	173	192	151	142	139	140	177	175	1548
	Vodacom	156	141	184	214	179	171	167	158	170	186	1726
Call Dropped	Cell C	12	4	12	14	21	22	6	2	34	5	132
	MTN	6	3	10	10	3	3	7	6	3	6	57
	Telkom	9	11	13	10	7	11	8	12	6	7	94
	Vodacom	4	7	8	7	9	11	4	3	2	4	59
Drop Call Ratio [%]	Cell C	7.19%	2.50%	6.12%	7.04%	11.73%	12.22%	3.92%	1.46%	22.97%	2.81%	7.78%
	MTN	3.53%	1.81%	4.85%	4.65%	1.62%	1.64%	4.43%	4.11%	1.70%	3.43%	3.20%
	Telkom	6.29%	8.09%	6.99%	4.95%	4.43%	7.19%	5.44%	7.89%	3.28%	3.85%	5.72%
	Vodacom	2.50%	4.73%	4.17%	3.17%	4.79%	6.04%	2.34%	1.86%	1.16%	2.11%	3.31%
POLQA MOS	Cell C	2.79	2.75	2.77	2.75	2.73	2.74	2.78	2.79	2.71	2.77	2.76
	MTN	3.49	3.48	3.44	3.37	3.48	3.55	3.52	3.52	3.41	3.52	3.47
	Telkom	2.76	2.78	2.87	2.93	2.75	2.77	2.92	2.90	2.97	2.98	2.87
	Vodacom	3.30	3.24	3.14	3.15	3.26	3.19	3.52	3.46	3.31	3.40	3.29

6.3. Appendix 2 Technology Maps

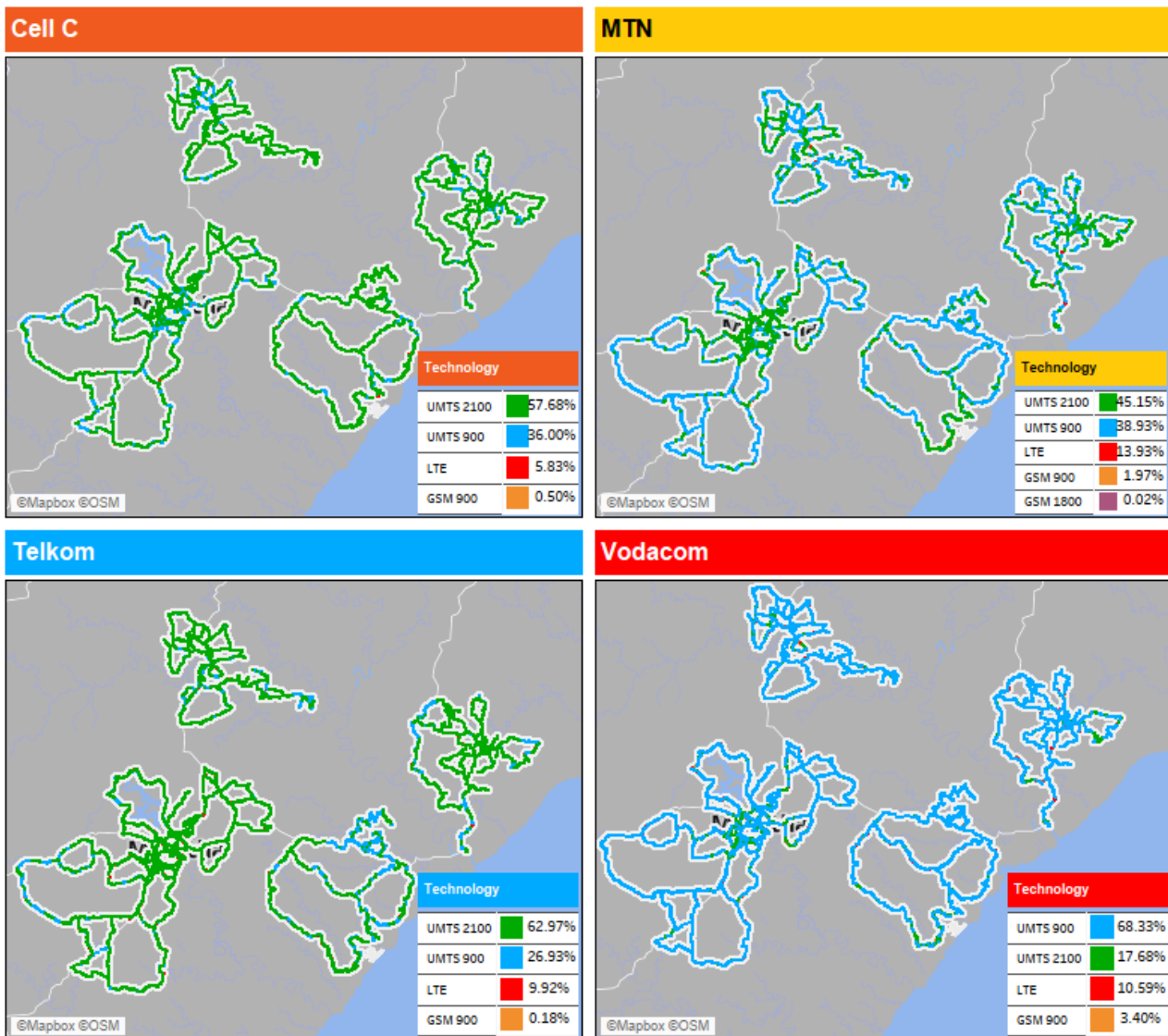


Figure 15. Radio Technology Maps

6.4. Appendix 3 UMTS Coverage Maps

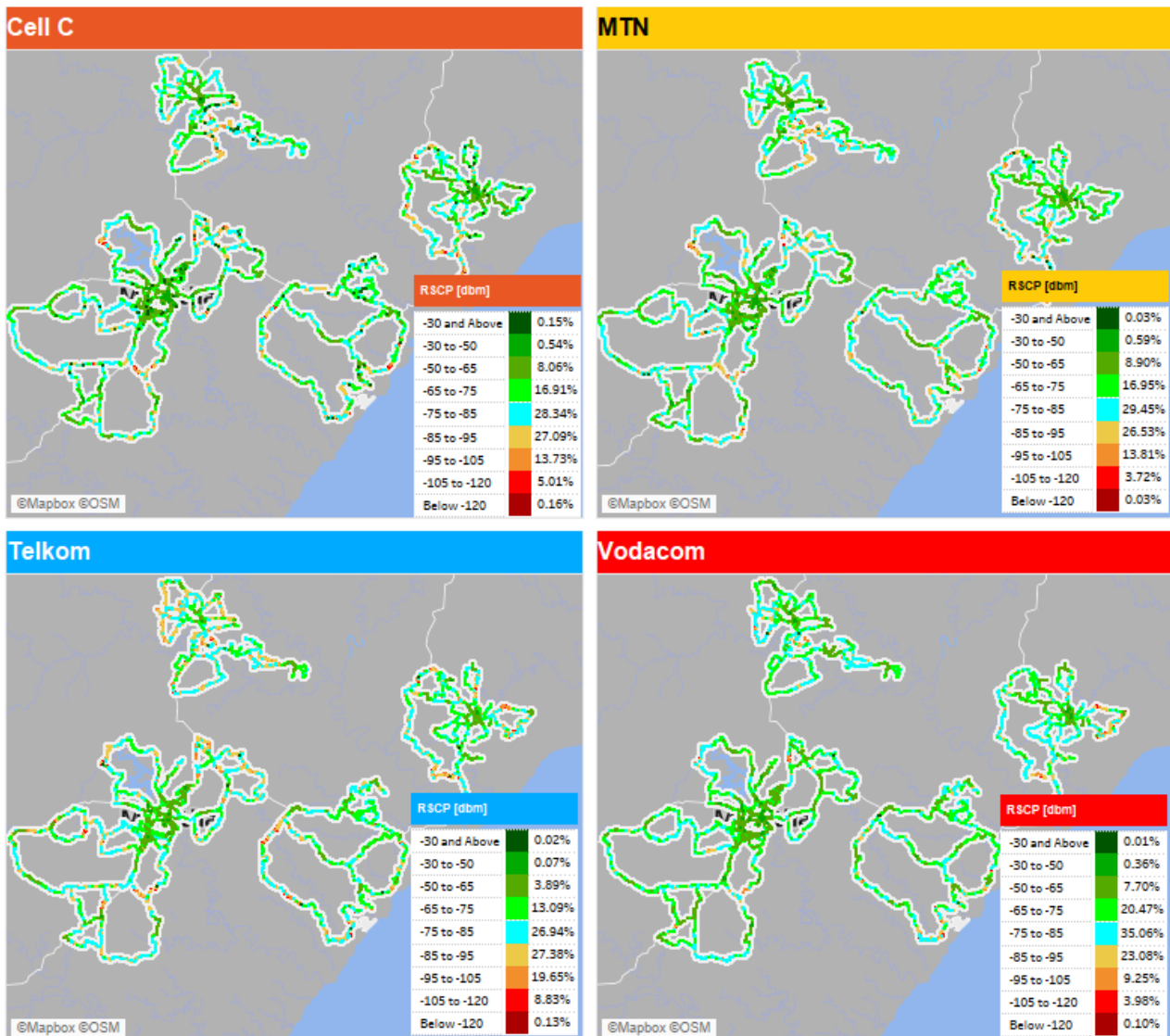


Figure 16. UMTS Coverage Maps

6.5. Appendix 4 UMTS Quality Map

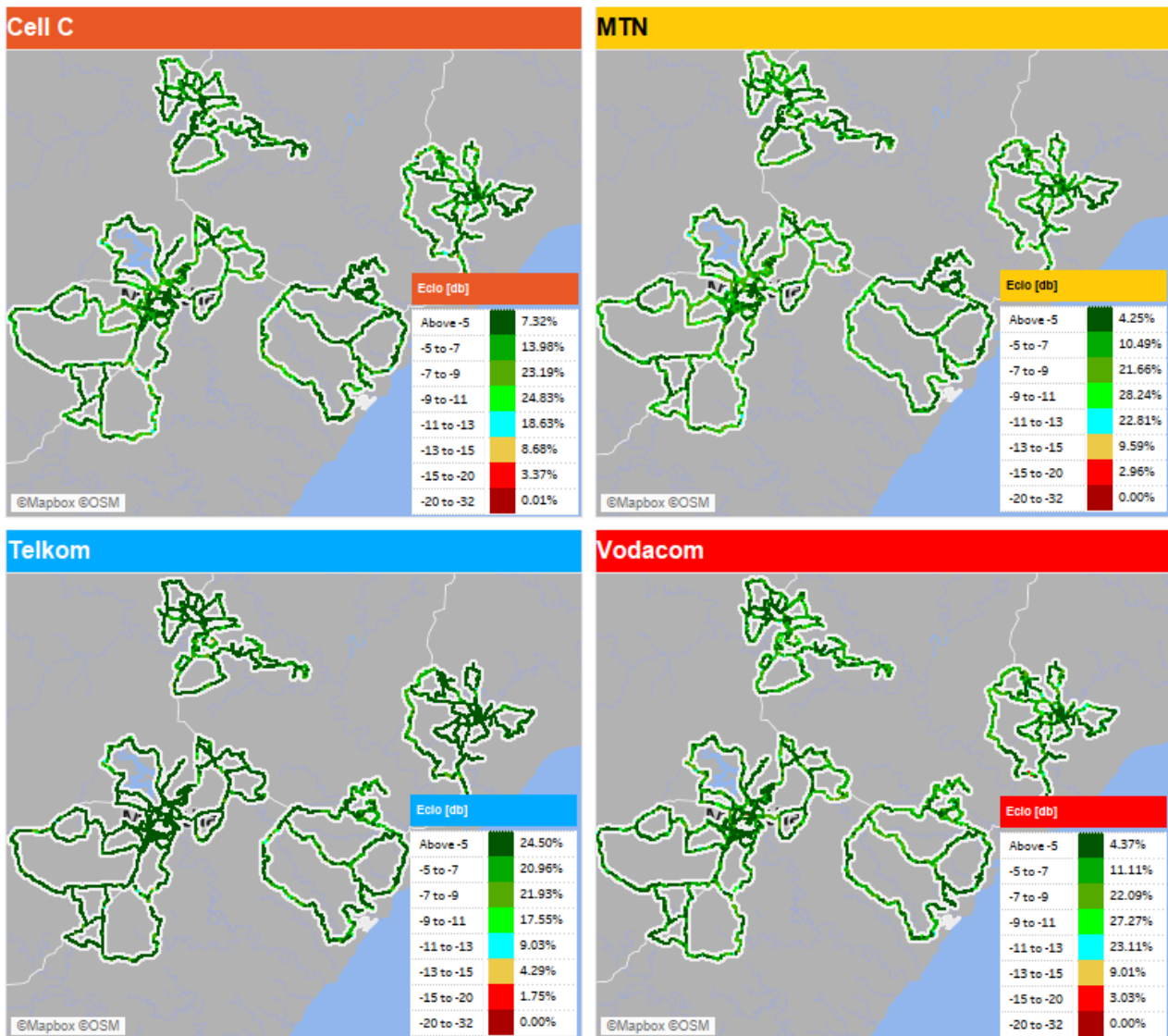


Figure 17. UMTS Quality Maps