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2018/2019 Quarter 4:

Voice Quality of Service

Report –

Eastern Cape Province

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List of Abbreviations

CSFB	Circuit Switched Fall Back
CSSR	Call Setup Success Ratio
DCR	Drop Call Ratio
GSM	Global System for Mobile Communications
ICASA	Independent Communications Authority of South Africa
KPI	Key Performance Indicator
LTE	Long-Term Evolution
R&S	Rohde & Schwarz
MOS	Mean opinion score
POLQA	Perceptual Objective Listening Quality Analysis
UMTS	Universal Mobile Telecommunications Service
VoLTE	Voice over Long-Term Evolution

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1. Executive Summary

The Independent Communications Authority of South Africa (ICASA) contracted ATIO Corporation (Pty) Ltd 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 out in the period of 12 December 2018 to 23 January 2019, covering a total distance of 3121 kilometres.

The purpose of performing 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.

A vehicle equipped with Rohde and Schwarz Smart Benchmarker II measurement tool including 24 mobile phones was used to collect data in mobility conditions. The four Key Performance Indicators (KPIs) used to evaluate QoS are Retainability, Accessibility, 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, DCR should be less than 3% and CSSR should be greater than 98%. Call Setup Time must be less than 20 seconds and the score for Speech Quality must be greater than 3.

The overall results show that all the operators achieved less than 98% CSSR values and thus failed to meet the Accessibility target. Vodacom is the only operator that met the overall Drop Call Ratio target of less than 3% as per the Authority's target.

MTN and Vodacom were the only operators that met the target for overall Speech Quality.

All operators met the Call Setup Time target according to the End-User and Subscribers Service Charter Regulation of 2016.

2. Introduction

ICASA's mission is to ensure that all South Africans have access to a wide range of high-quality communication services at affordable prices[1]. The Authority ensures the quality of service through its Quality of Service (QoS) monitoring activities. In order to monitor the QoS, ICASA contracted ATIO Corporation (Pty) Ltd 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.

The QoS monitoring was conducted in the following areas within the District Municipalities; Buffalo City, Amathole and Chris Hani. The selected areas include East London, Mdantsane, Dimbaza, Lady Frere and Dutywa. The areas consist of major towns, townships, farm areas, rural areas, major road arteries, economic activity nodes and areas of previous complaints. Figure 1 depicts the routes which were driven in the Eastern Cape Province.

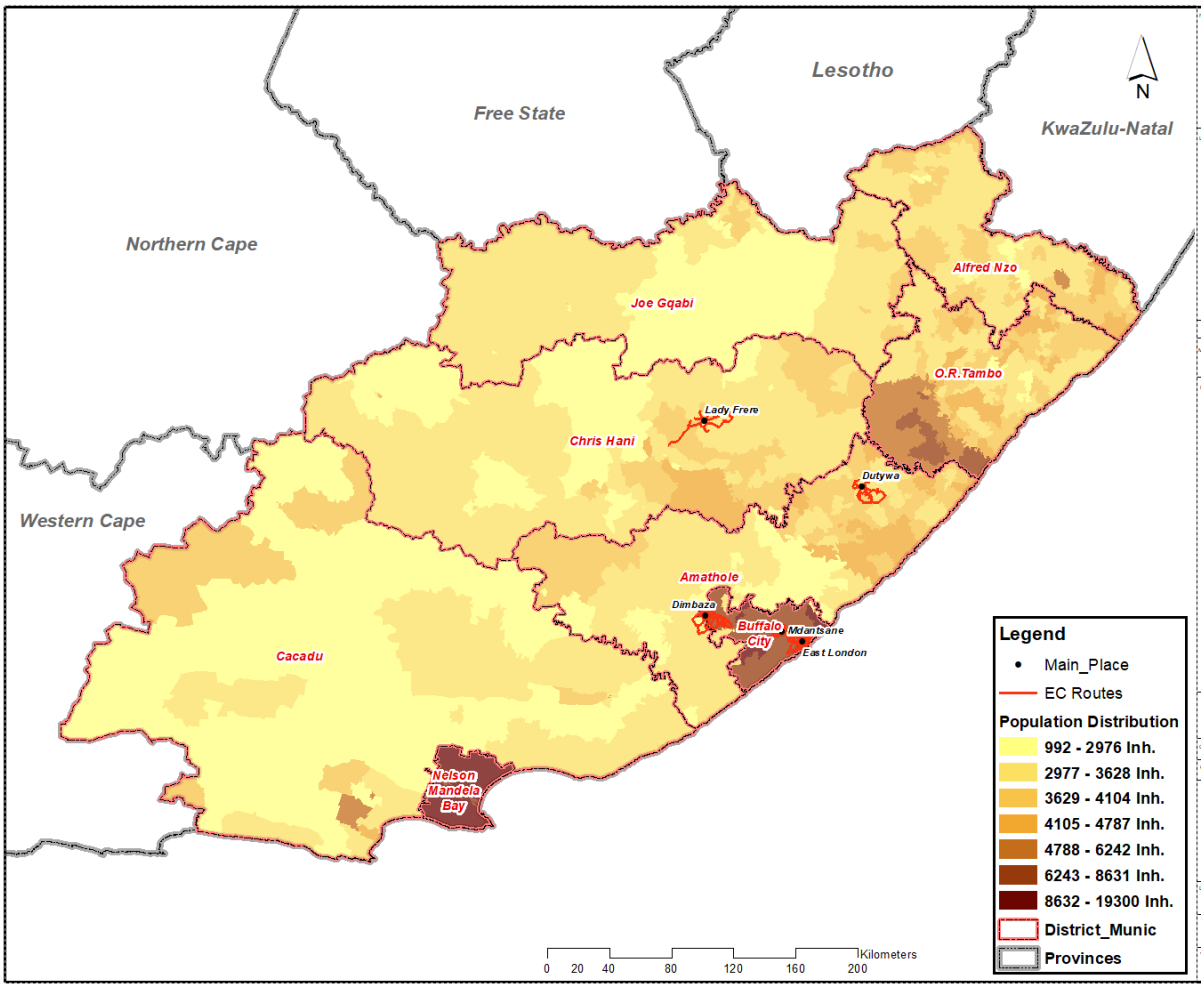


Figure 1. Eastern Cape Province route map

[1] **ICASA Strategic Plan 2016/17-2021**

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. These parameters are described briefly below:

a) Call Accessibility is defined as a percentage and is a measure of the number of times a user is able to successfully establish a call as a percentage 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 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.

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 caries the call. It is measured using Drop Call Ratio (DCR).

d) Speech Quality is the condition of conversational speech without noise and echo interference.

3. Methodology

A minimum of 120 test samples per network operator were collected, except in the areas where services were limited on most parts of the drive test route. 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 a particular time of the day.

Voice test setup consisted of two categories which are short call (accessibility) and long call (retainability) and each category required two items of end-user equipment (UE) i.e. call initiating side (A-side) and call receiving side (B-side). This setup results in four UEs per operator resulting in sixteen UEs for four operators in one drive test vehicle. The Call Window was set up as follows: Call duration + 30 seconds (for the setup and release phases) + 30 seconds (for the minimum pause interval). The default call duration was set at 120 seconds for Long Call and results in 180 seconds call window and call duration for Short Call was set at 10 seconds resulting in 70 seconds call window. The audio quality of speech samples was evaluated using the HD-voice capable and ITU standardized POLQA wideband algorithm.

The devices were set to measure the best available technology and barred from making VoLTE calls, thus in the areas where operators had LTE they performed Circuit Switched Fall Back (CSFB) calls. CSFB allows terminal/mobile phones connected on LTE to use GERAN or UTRAN to connect to the CS domain mainly for voice calls.

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

3.1. Short & Long Call

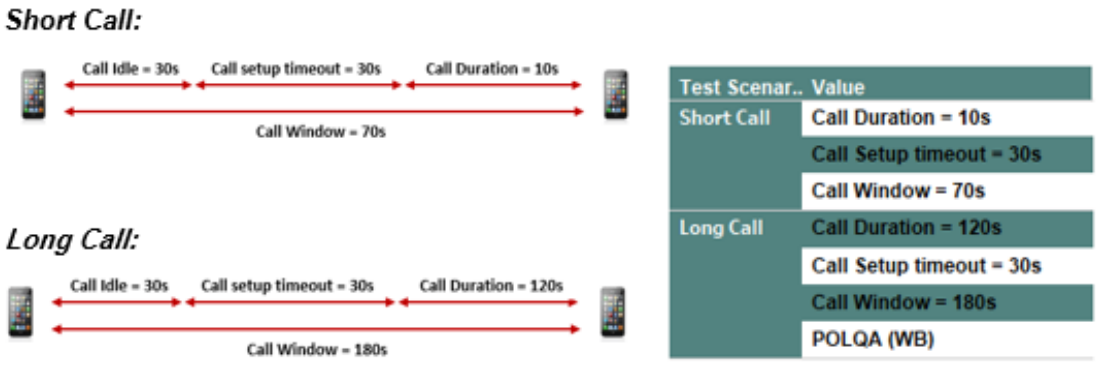


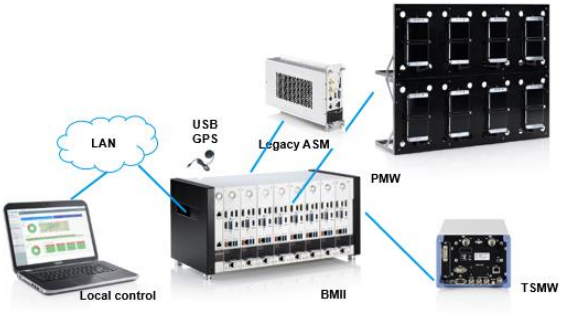
Figure 2. Call Window

Figures 2 depicts the call window for both Short Call and Long Calls scenarios together with call stages.

3.2. Equipment test setup and configuration

3.2.1.System used

The Test Equipment utilised was the R&S SwissQual Benchmarker II platform with Sony XZ Premium smartphones installed inside the car using the R&S Phone Mount Walls.



3.2.2.Device Used

The Sony XZ Premium Smartphone was selected as the measurement UE for Voice and Data Services. It uses the Qualcomm Snapdragon 835 chipset and supports the following technologies; GSM, WCDMA, LTE & LTE-A.

3.2.3.Device Specification

Table 1 depicts device specification:

Table 1: Device Specification

Technology	Info
Data:	LTE-A Pro Cat 16 (1000/150 Mbit/s), HSDPA+ (4G) 42.2 Mbit/s, HSUPA 5.76 Mbit/s, UMTS
GSM:	850, 900, 1800, 1900 MHz
UMTS:	800, 850, 900, 1700/2100, 1900, 2100 MHz
LTE (FDD):	Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 17, 19, 20, 26, 28, 29, 32
LTE (TDD):	Bands 38, 39, 40, 41
Processor:	Octa-core, 2450 MHz, Kryo 280 and ARM Cortex-A53, 64-bit
System chip:	Qualcomm Snapdragon 835 MSM8998
Qualipoc version:	18.0.0.63

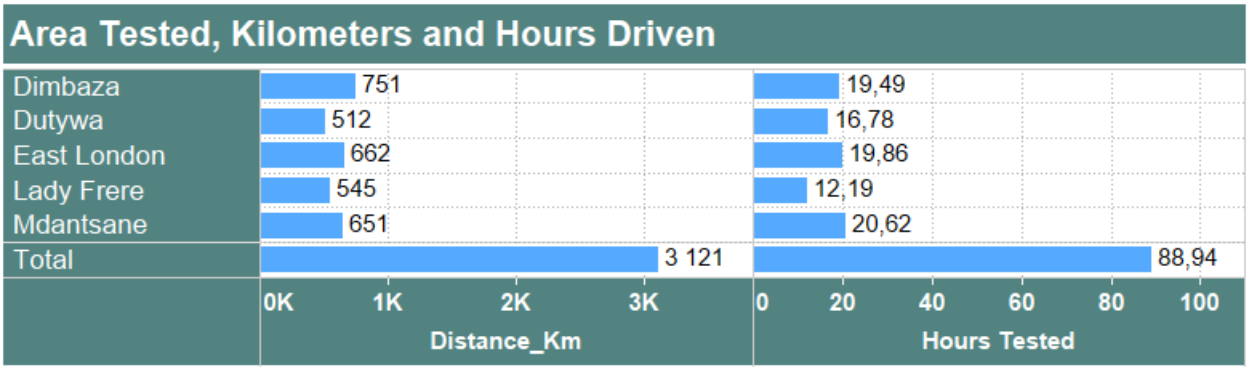
3.3. Route selection

The areas and routes that were tested are shown in Table 2 including the dates driven. The distance travelled, and active measurements time are shown in Table 3:

Table 2: Test timelines for areas covered

Routes and Dates			
District	**Area**	**Date**	**Test Type**
Amathole	Dutywa	2018/12/12	Phase 1
		2019/01/11	Phase 2
	Dimbaza	2018/12/18	Phase 1
		2018/12/19	Phase 1
		2019/01/14	Phase 2
		2019/01/15	Phase 2
Buffalo City	East London	2018/12/16	Phase 1
		2019/01/18	Phase 2
	Mdantsane	2018/12/20	Phase 1
		2019/01/15	Phase 2
		2019/01/16	Phase 2
		2019/01/17	Phase 2
		2019/01/19	Phase 2
Chris Hani	Lady Frere	2019/01/12	Phase 1
		2019/01/23	Phase 2

Table 3: Area Tested, Kilometers and Hours Driven per area



3.4. Measurement parameters and targets

3.4.1.Targets

According to the End User and subscriber Service Charter Regulations of 2016, the following targets have been set as the measurement parameters for the following services:

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 take 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.[2]

3.4.2.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:

CSSR = Y/X *100

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

3.4.3.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:

DCR= D/S*100

Where, D represents the number of dropped calls and S is number of successful calls established

3.4.4.Call Setup Time [s]

Call Setup Time refer to the time interval from the moment 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.

[2] **https://www.icasa.org.za/uploads/files/39898_1-4_Icasa.pdf**

3.4.5.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. Measurements made use of the POLQA Algorithm which compares the reference signal received from the transmitting side against an equivalent sample on the receiving side.

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: Dutywa, Dimbaza, East London, Mdantsane and Lady Frere.

4.1. Voice KPI Results

Table 4: Overall voice KPI results

		MTN	Vodacom	Cell C	Telkom
Short Call	Call Attempt	4351	4560	4389	4500
	Call Failed	215	149	238	250
	Successfull Attempts	4136	4411	4151	4250
	Call Dropped	4	1	4	1
	Call Complete	4132	4410	4147	4249
	Call Setup Success Rate [%]	95,06	96,73	94,58	94,44
	Call Setup Time [s]	6,58	5,80	5,06	7,29
Long Call	Call Attempt	1931	1834	1958	1857
	Call Failed	190	83	239	122
	Successfull Attempts	1741	1751	1719	1735
	Call Dropped	90	33	95	55
	Call Complete	1651	1718	1624	1680
	Call Drop Rate [%]	5,17%	1,88%	5,53%	3,17%
	POLQA MOS	3,45	3,68	2,76	2,81

Table 4 shows overall voice measurement results for both Short and Long Calls scenarios. CSSR and Call Setup Time were measured in a Short Call scenario. The DCR and POLQA MOS KPI's were measured in a Long Call scenario. Results which are coloured in red indicate that the operator did not meet the target set by the Authority. Appendix 1 shows operator results per route per phase tested.

From Table 4 above, it can be observed that all operators failed to achieve the Call Setup Success Ratio target as per regulations. All operators were, however, were able to meet the Call Setup

Time target. Vodacom is the only operator that met the Drop Call Ratio target. It can also be seen from the table that only MTN and Vodacom met the speech quality target of above 3.

4.1.1.Voice KPIs per Area

Table 5 shows voice call measurement results for each route per operator. Dimbaza and Dutywa were the areas where all operators experienced poor performance with none of them meeting the target of both the CSSR and DCR.

Table 5: Summary of results per Area

		Dimbaza	Dutywa	East London	Lady Frere	Mdantsane
Call Setup Success Rate - [%]	MTN	90,95%	94,89%	97,77%	99,20%	93,85%
	Vodacom	95,00%	93,39%	98,74%	95,84%	99,53%
	Cell C	89,95%	87,41%	98,63%	96,19%	99,42%
	Telkom	89,81%	87,03%	98,16%	96,07%	99,72%
Drop Call Ratio [%]	MTN	4,45%	5,37%	3,46%	2,86%	8,76%
	Vodacom	3,28%	3,99%	0,25%	0,42%	1,44%
	Cell C	8,72%	12,50%	1,99%	4,15%	2,14%
	Telkom	4,15%	6,80%	1,99%	1,63%	1,72%
Call Setup Time [s]	MTN	6,96	6,51	6,06	5,91	7,26
	Vodacom	5,99	5,99	5,50	6,05	5,64
	Cell C	6,33	5,65	4,27	4,98	4,38
	Telkom	7,41	9,22	6,37	7,34	6,68
POLQA MOS	MTN	3,32	3,26	3,62	3,61	3,43
	Vodacom	3,57	3,66	3,77	3,41	3,87
	Cell C	2,57	2,58	2,95	2,79	2,84
	Telkom	2,82	2,43	2,99	2,64	2,98

4.1.2.Call Accessibility (Short call)

Table 6 shows number of samples collected per area for Short Call scenario.

Table 6: Short Call sample size per Area

		Dimbaza	Dutywa	East London	Lady Frere	Mdantsane
Call Attempt	MTN	950	783	988	622	1 008
	Vodacom	1 000	832	1 030	625	1 073
	Cell C	925	810	1 022	603	1 029
	Telkom	991	794	1 033	611	1 071
Call Failed	MTN	86	40	22	5	62
	Vodacom	50	55	13	26	5
	Cell C	93	102	14	23	6
	Telkom	101	103	19	24	3
Call Dropped	MTN	0	2	2	0	0
	Vodacom	0	0	0	0	1
	Cell C	3	0	0	1	0
	Telkom	0	0	0	1	0
Call Complete	MTN	864	741	964	617	946
	Vodacom	950	777	1 017	599	1 067
	Cell C	829	708	1 008	579	1 023
	Telkom	890	691	1 014	586	1 068

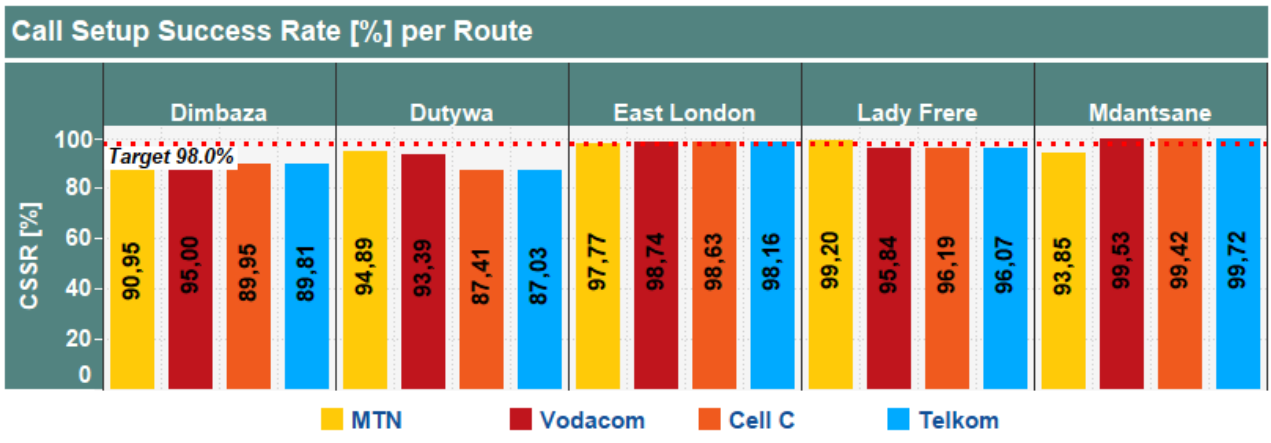


Figure 3. CSSR KPI per Area

Figure 3 shows that all operators did not meet 98% CSSR target in both Dimbaza and Dutywa areas. MTN is the only operator that did not meet the CSSR target in East London and Mdantsane. MTN is also the only operator that met the CSSR target in Lady Frere.

4.1.3.Drop Call Ratio (Long call)

Table 7 shows number of samples collected per area for Long call scenario.

Table 7: Long Call samples per Area

		Dimbaza	Dutywa	East London	Lady Frere	Mdantsane
Call Attempt	MTN	452	334	418	249	478
	Vodacom	411	334	407	263	419
	Cell C	462	374	420	278	424
	Telkom	442	336	414	257	408
Call Failed	MTN	70	36	13	4	67
	Vodacom	15	33	5	27	3
	Cell C	95	86	17	37	4
	Telkom	56	42	11	12	1
Call Dropped	MTN	17	16	14	7	36
	Vodacom	13	12	1	1	6
	Cell C	32	36	8	10	9
	Telkom	16	20	8	4	7
Call Complete	MTN	365	282	391	238	375
	Vodacom	383	289	401	235	410
	Cell C	335	252	395	231	411
	Telkom	370	274	395	241	400

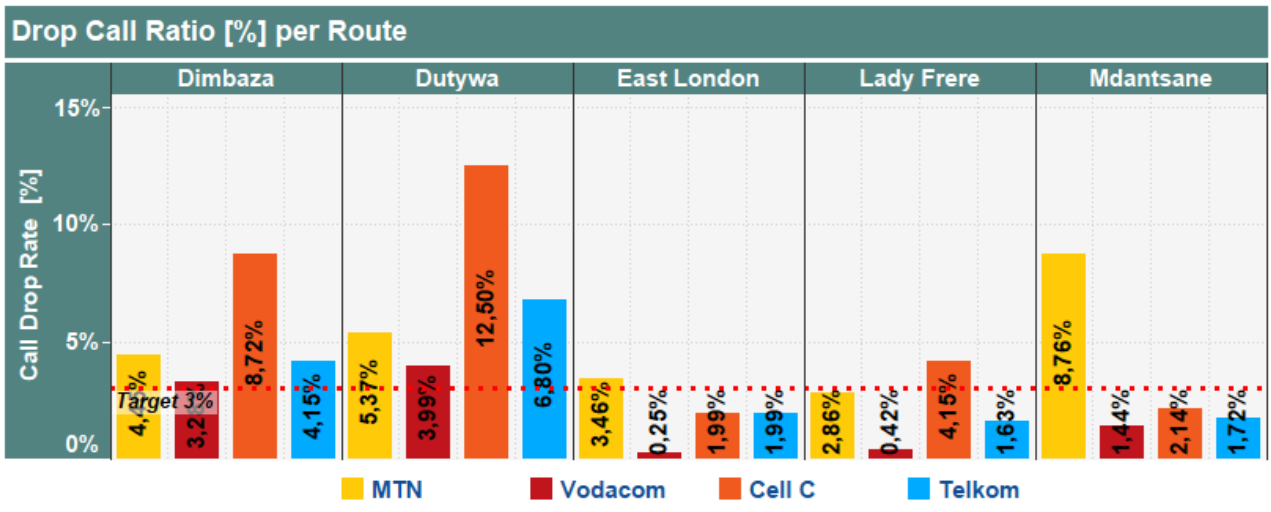


Figure 4. DCR KPI per Area

Figure 4 shows that Vodacom, Cell C, Telkom met DCR target in East London and Mdantsane whilst MTN met the target only in Lady Frere. Telkom and Vodacom also met the target in Lady Frere. All operators failed to meet the DCR target in Dimbaza and Dutywa areas.

4.1.4.Voice Call Setup Time (Short call)

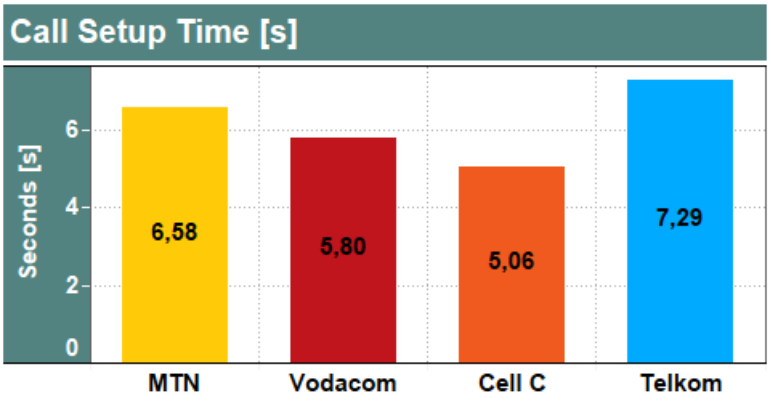


Figure 5. Call Setup Time [s] KPI Overall

Figure 5 shows the overall results for Call Setup Time. Cell C had the lowest overall Call Setup Time, followed by Vodacom, MTN and Telkom in ascending order.

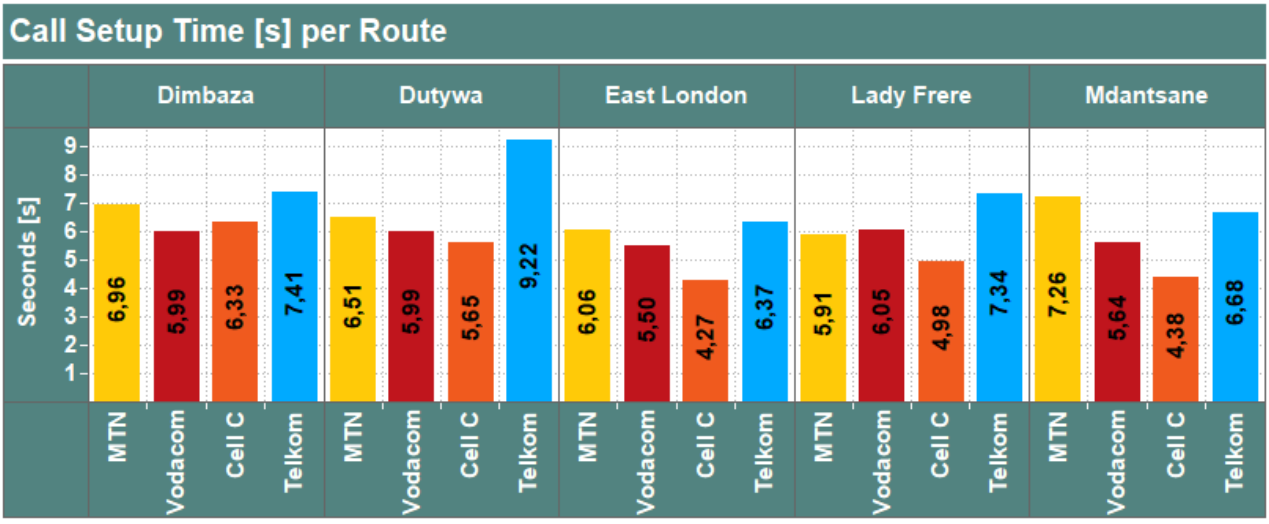


Figure 6. Call Setup Time [s] KPI per area

Figure 6 shows that all operators met the Call Setup Time target of less than 20 seconds as per the End-User and Subscribers Service Charter Regulations of 2016.

4.1.5.POLQA MOS (Long call)

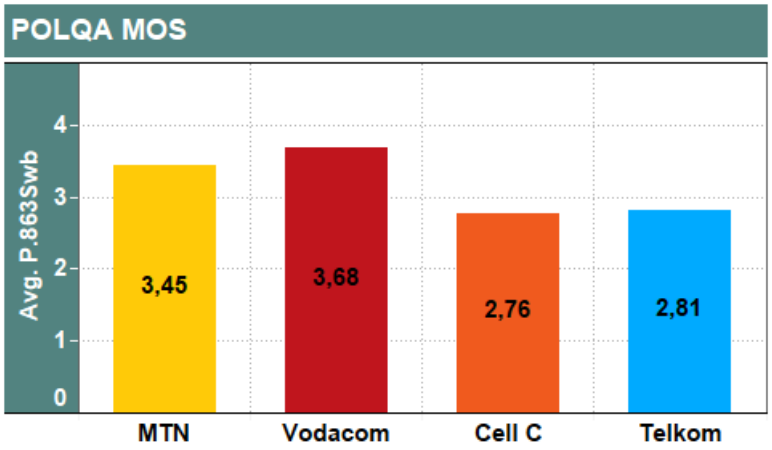


Figure 7. Speech quality overall results

Figure 7 shows that Vodacom achieved best Speech Quality followed by MTN, Cell C and Telkom in the descending order. Cell C and Telkom did not meet the target for Speech Quality.

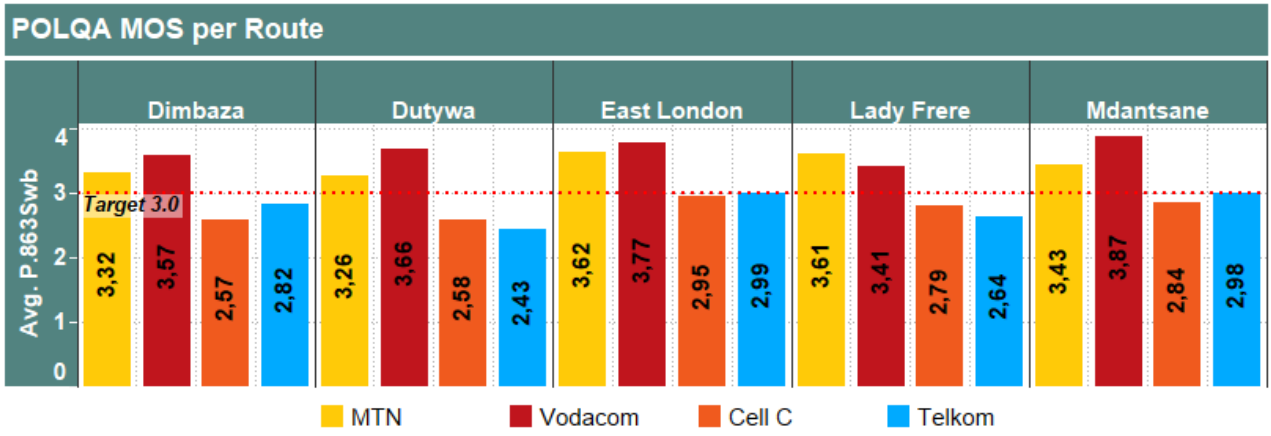


Figure 8. Speech Quality per Area

Figure 8 depicts speech quality results per tested area. MTN and Vodacom achieved an average MOS of over 3 in all the tested areas, thus meeting the Authority's target. Cell C and Telkom failed to meet the target for Speech Quality in all tested areas.

4.1.6. Radio Technology (Long call)

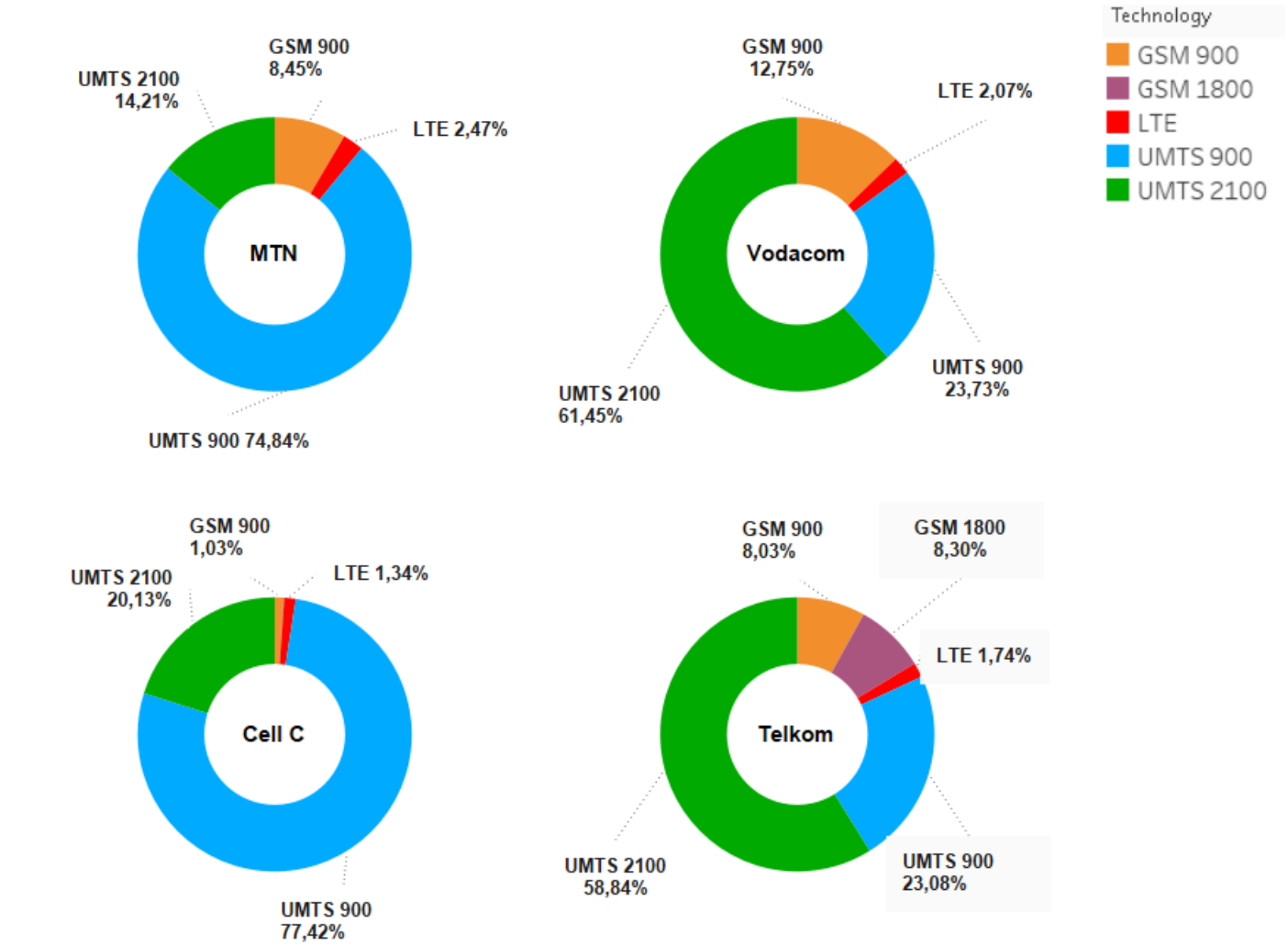


Figure 9 Radio technology

Figure 9 shows the distribution of the serving technology during the drive test. The serving technology distribution is based on the device used and the network parameter configuration which varies with the mobile operators. All operators' serving technology was mainly on UMTS technology, with MTN and Cell C predominantly on U900 whilst Vodacom and Telkom are on U2100.

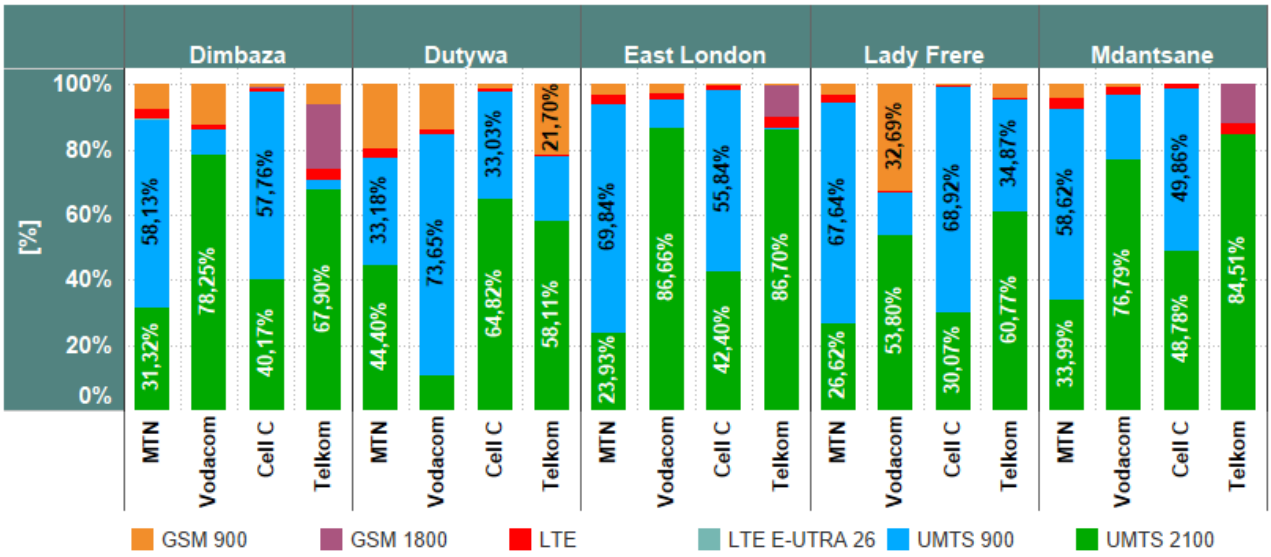


Figure 10 Radio technology per Area

Figure 10 shows the distribution of the serving technology during the drive test per Area.

4.1.7.CSFB (Short call)

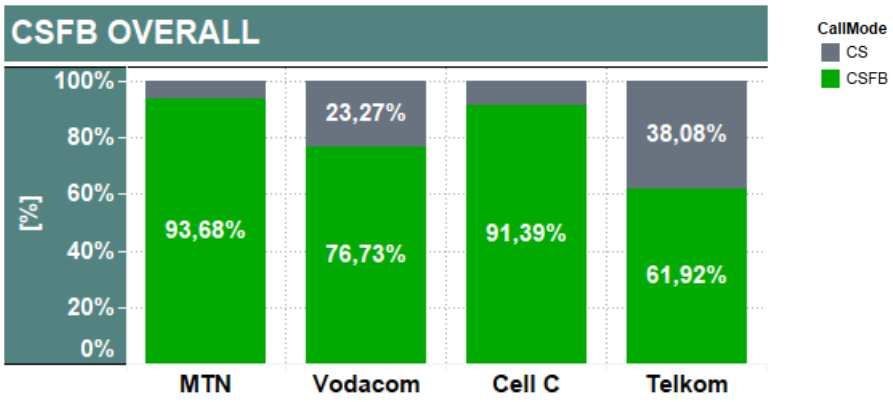


Figure 11. CSFB Overall stats

Figure 11 shows percentage of calls that were attempted on traditional networks (CS Calls) as well as the ones initiated on LTE network and fell back to UMTS/ GSM (CSFB Calls).

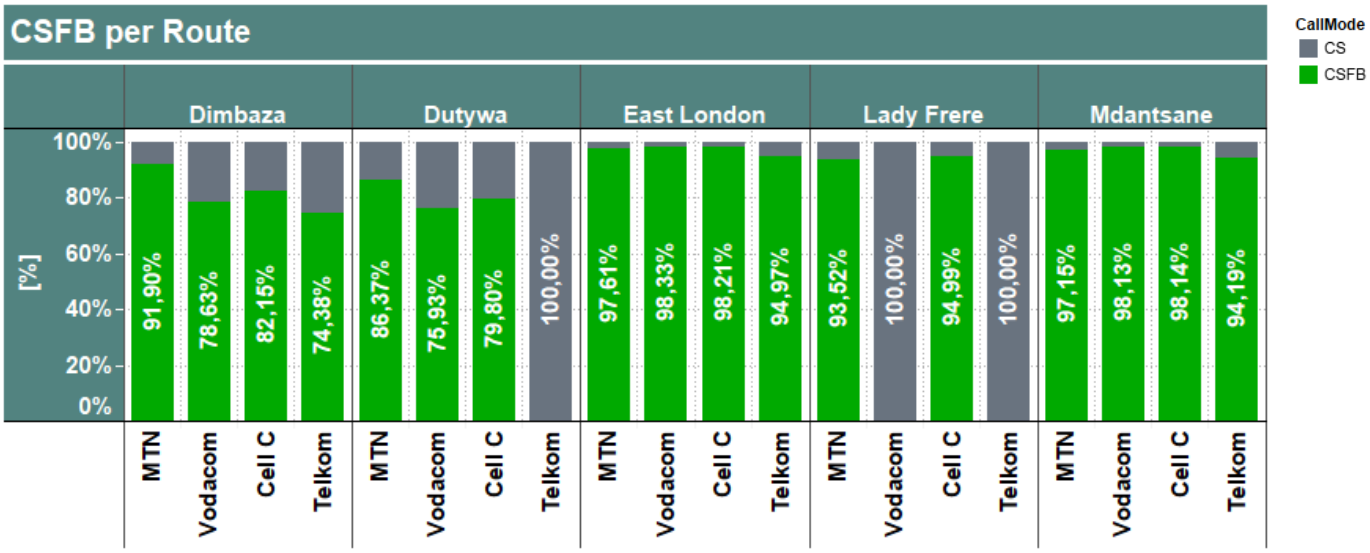


Figure 12. CSFB per Area

Figure 12 shows the breakdown of CS and CSFB calls per route. Vodacom and Telkom are seen with no CSFB samples in Lady Frere and Telkom does not have any CSFB samples in Dutywa as well. This may be an indication that the operators do not have LTE coverage in those areas.

4.1.8.Roaming statistics (Long call)

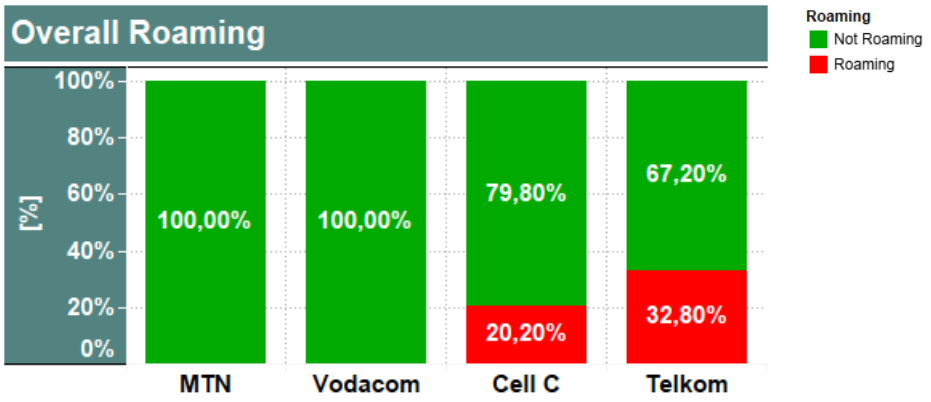


Figure 13. Overall Roaming percentages

Figure 13 shows overall roaming samples for each operator. Cell C and Telkom are seen with some roaming samples, with Telkom having the highest percentage of roaming.

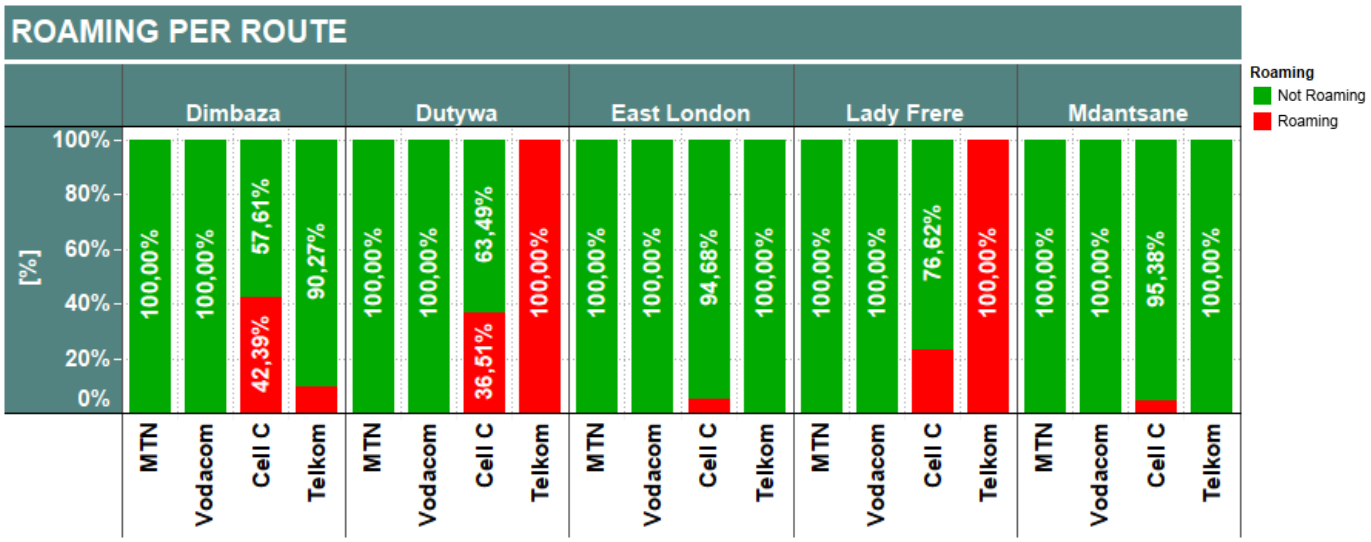


Figure 14. Roaming percentages per Area

Figure 14 shows Roaming status per operator per route. Telkom was seen with roaming samples in Dutywa and Lady Frere, these were the areas without Telkom coverage. Cell C had roaming samples in some part of Dimbaza and Dutywa areas.

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. All operators had poor performance in Dimbaza and Dutywa, none of them met the Call Setup Success Ratio and Drop Call Ratio targets.

As we benchmark the operators, the results show that in terms of overall Call Setup Success Ratio, all operators scored less than 98% CSSR values, thus failed to meet the Accessibility target. At an area level, Vodacom, Cell C and Telkom met the target in East London and Mdantsane whilst MTN only met the target in Lady Frere.

All operators except Vodacom, failed to meet the overall Drop Call Ratio target of less than 3%, thus failed to meet the Accessibility target. MTN and Vodacom were the only operators that met the target for Speech Quality in the overall results. All operators achieved Call Setup Time target according to the End-User and Subscribers Service Charter Regulation of 2016.

Vodacom had high number of samples on the GSM technology as compared to other operators followed by Telkom, MTN and Cell C in descending order.

Telkom had roaming samples in Lady Frere and Dutywa whilst some parts of Dimbaza, Lady Frere and Dutywa were observed to have Cell C roaming samples.

6. Appendices

6.1. Appendix 1: Detailed test results by Phase

Table 8: Call Setup Success Rate (CSSR) per Area – Phase 1 & 2

		Dimbaza		Dutywa		East London		Lady Frere		Mdantsane		Total
		Phase 1	Phase 2	Phase 1	Phase 2	Phase 1	Phase 2	Phase 1	Phase 2	Phase 1	Phase 2	
Call Attempt	MTN	493	457	379	404	436	552	321	301	505	503	4351
	Vodacom	506	494	391	441	469	561	322	303	565	508	4560
	Cell C	479	446	382	428	468	554	318	285	543	486	4389
	Telkom	510	481	385	409	471	562	319	292	564	507	4500
Call Setup	MTN	474	390	369	374	424	542	318	299	449	497	4136
	Vodacom	485	465	368	409	463	554	304	295	564	504	4411
	Cell C	454	378	352	356	462	546	313	267	540	483	4151
	Telkom	467	423	330	361	461	553	308	279	562	506	4250
Call Setup Success Rate [%]	MTN	96,15%	85,34%	97,36%	92,57%	97,25%	98,19%	99,07%	99,34%	88,91%	98,81%	95,06%
	Vodacom	95,85%	94,13%	94,12%	92,74%	98,72%	98,75%	94,41%	97,36%	99,82%	99,21%	96,73%
	Cell C	94,78%	84,75%	92,15%	83,18%	98,72%	98,56%	98,43%	93,68%	99,45%	99,38%	94,58%
	Telkom	91,57%	87,94%	85,71%	88,26%	97,88%	98,40%	96,55%	95,55%	99,65%	99,80%	94,44%

Table 9: Drop Call Ratio (DCR) per Area – Phase 1 & 2

		Dimbaza		Dutywa		East London		Lady Frere		Mdantsane		Total
		Phase 1	Phase 2	Phase 1	Phase 2	Phase 1	Phase 2	Phase 1	Phase 2	Phase 1	Phase 2	
Call Complete	MTN	193	172	123	159	177	214	124	114	182	193	1 651
	Vodacom	199	184	124	165	183	218	118	117	218	192	1 718
	Cell C	171	164	116	136	179	216	124	107	216	195	1 624
	Telkom	191	179	122	152	180	215	125	116	206	194	1 680
Call Dropped	MTN	10	7	8	8	7	7	2	5	31	5	90
	Vodacom	5	8	1	11	1	0	0	1	0	6	33
	Cell C	14	18	23	13	4	4	4	6	7	2	95
	Telkom	10	6	6	14	3	5	2	2	3	4	55
Drop Call Ratio [%]	MTN	4,93%	3,91%	6,11%	4,79%	3,80%	3,17%	1,59%	4,20%	14,55%	2,53%	5,17%
	Vodacom	2,45%	4,17%	0,80%	6,25%	0,54%	0,00%	0,00%	0,85%	0,00%	3,03%	1,88%
	Cell C	7,57%	9,89%	16,55%	8,72%	2,19%	1,82%	3,13%	5,31%	3,14%	1,02%	5,53%
	Telkom	4,98%	3,24%	4,69%	8,43%	1,64%	2,27%	1,57%	1,69%	1,44%	2,02%	3,17%

6.2. Appendix 2: Coverage maps

6.2.1.Technology Maps

6.2.1.1. East London

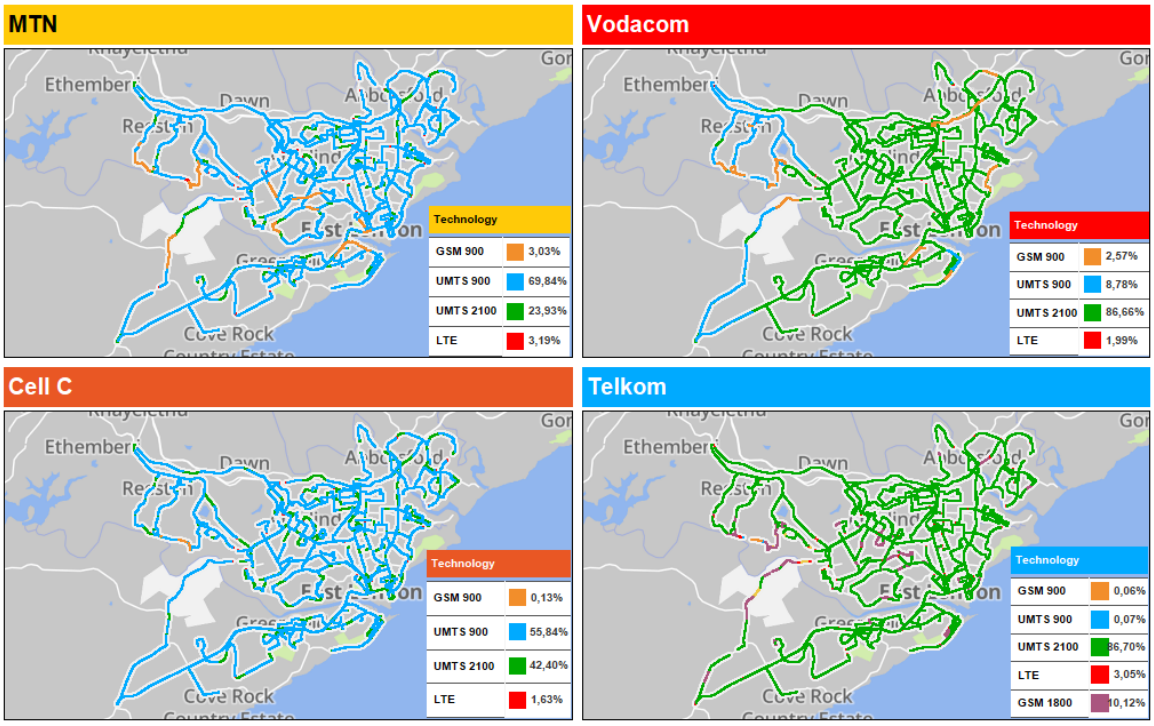


Figure 15. East LondonTechnology Map

6.2.1.2. Mdantsane

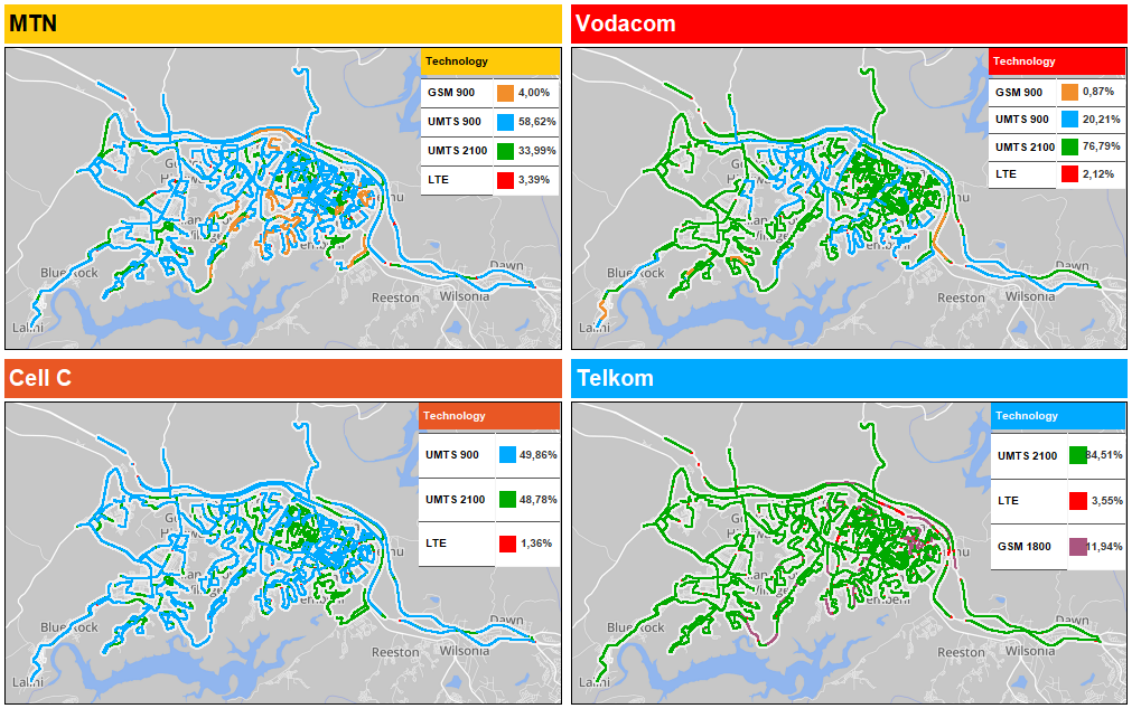


Figure 16. Mdantsane Technology Map

6.2.1.3. Dimbaza

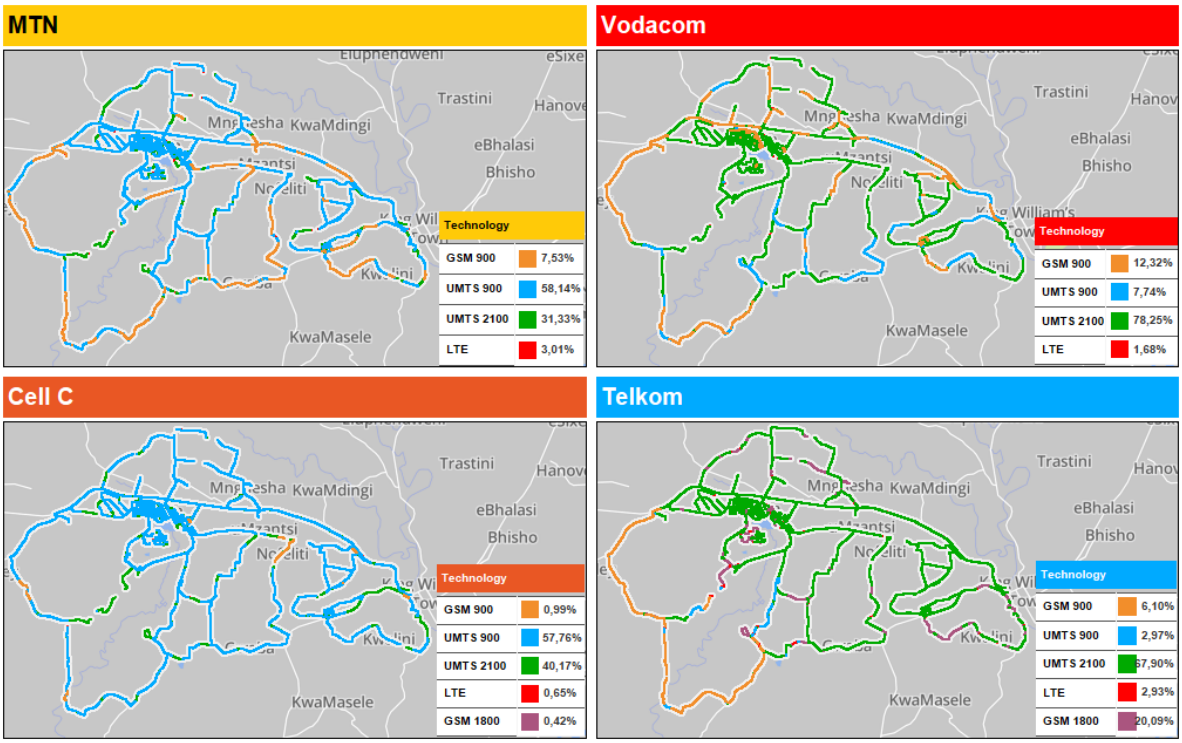


Figure 17. Dimbaza Technology Map

6.2.1.4. Dutywa

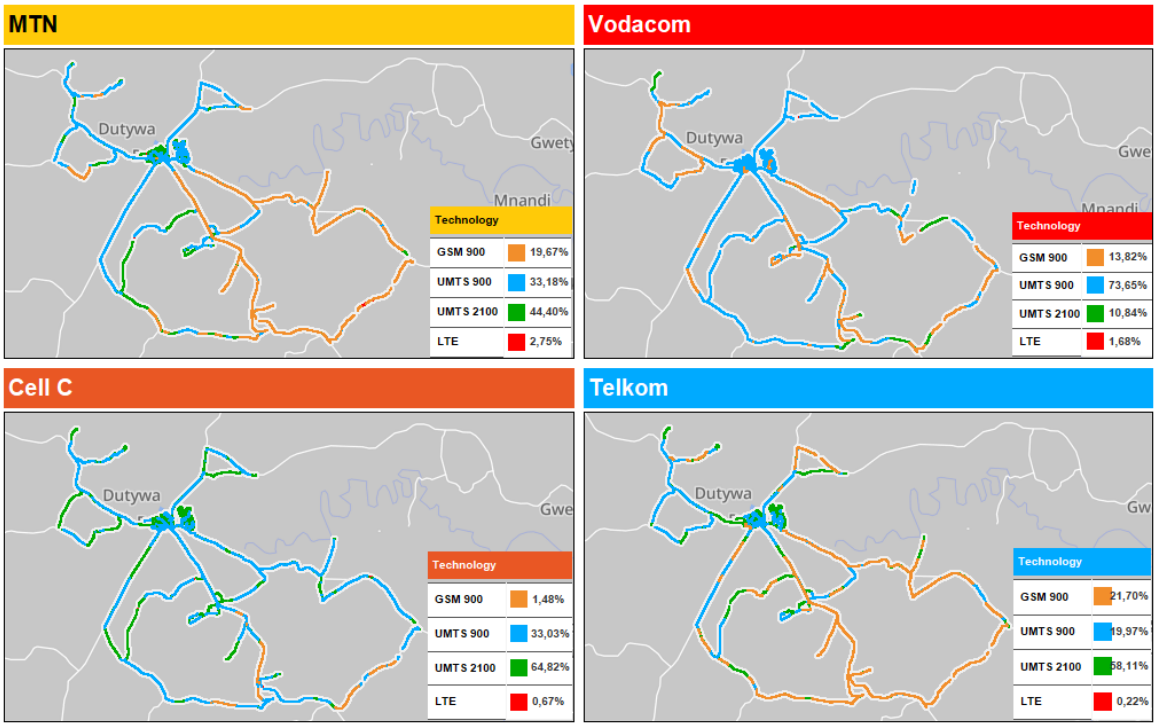


Figure 18. Dutywa Technology Map

6.2.1.5. Lady Frere

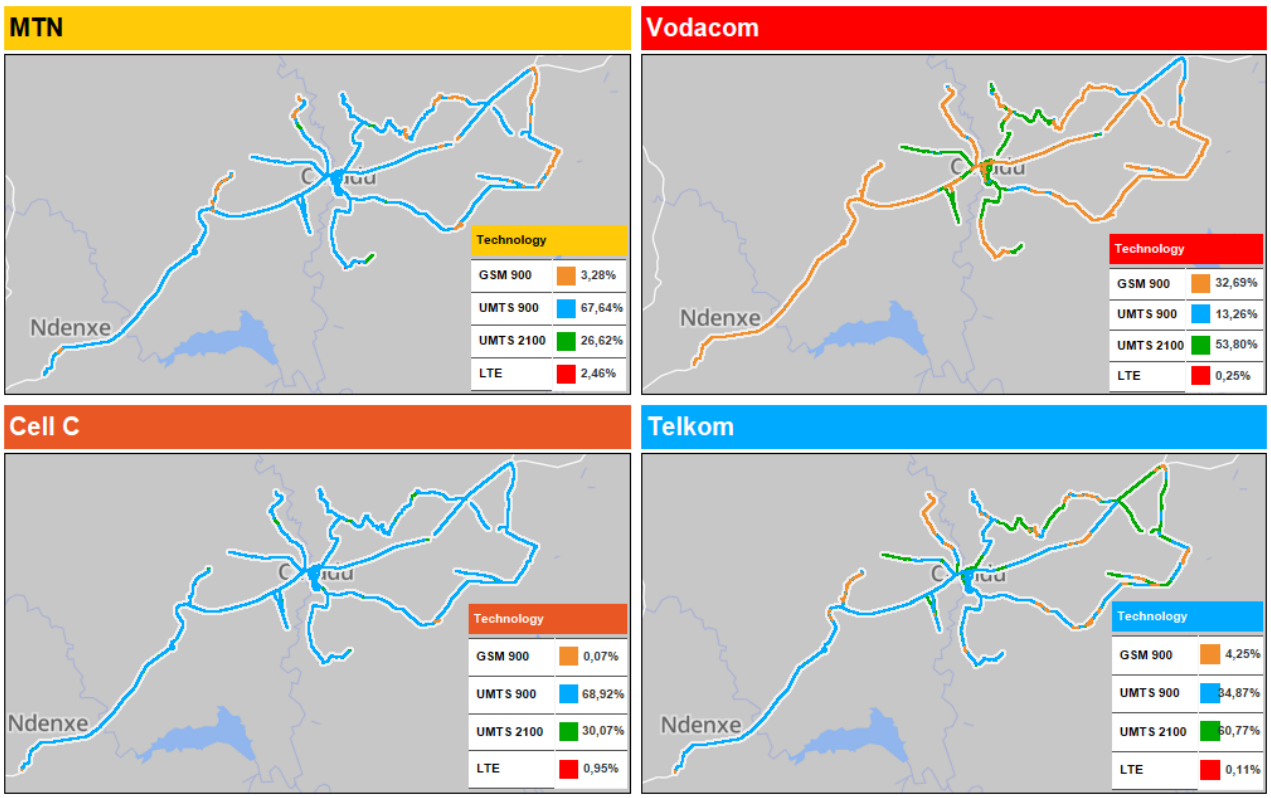


Figure 19. Lady Frere Technology Map

6.2.2. Call Failures

6.2.2.1. East London

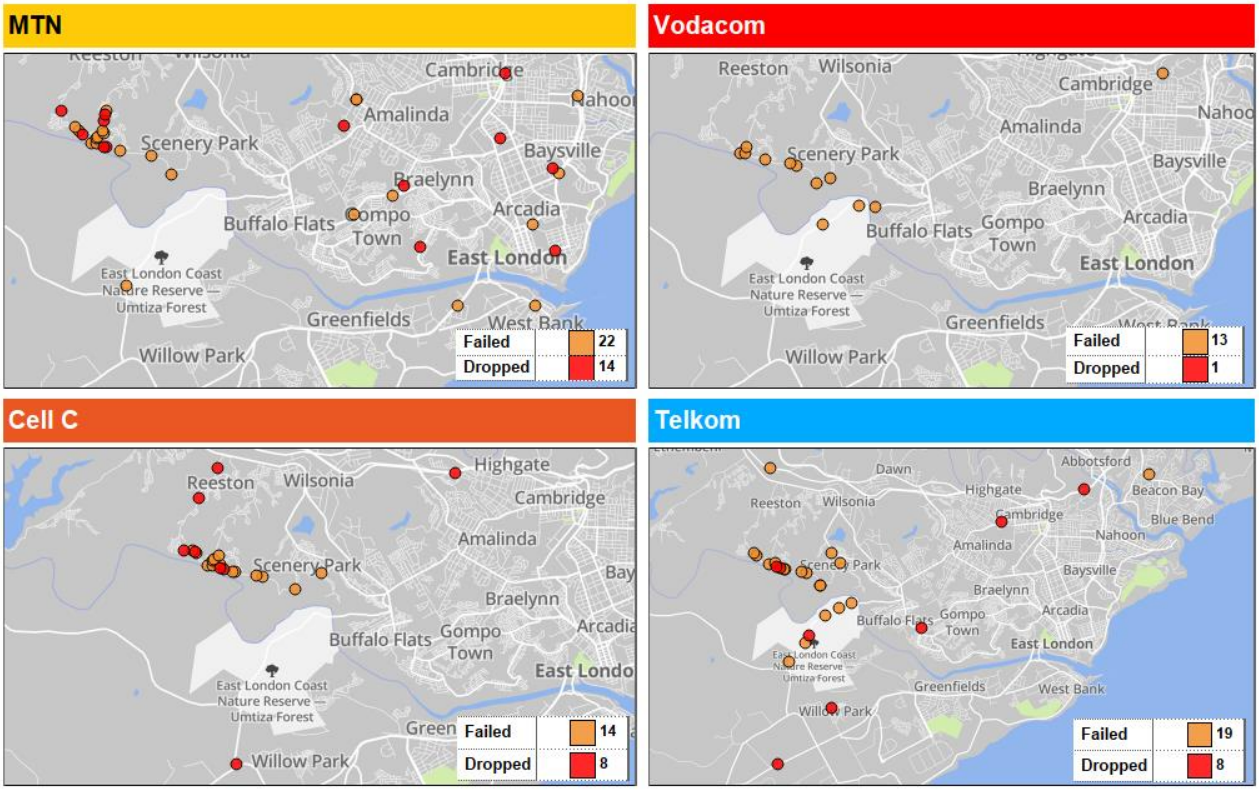


Figure 20. East London Call Failures

6.2.2.2. Mdantsane

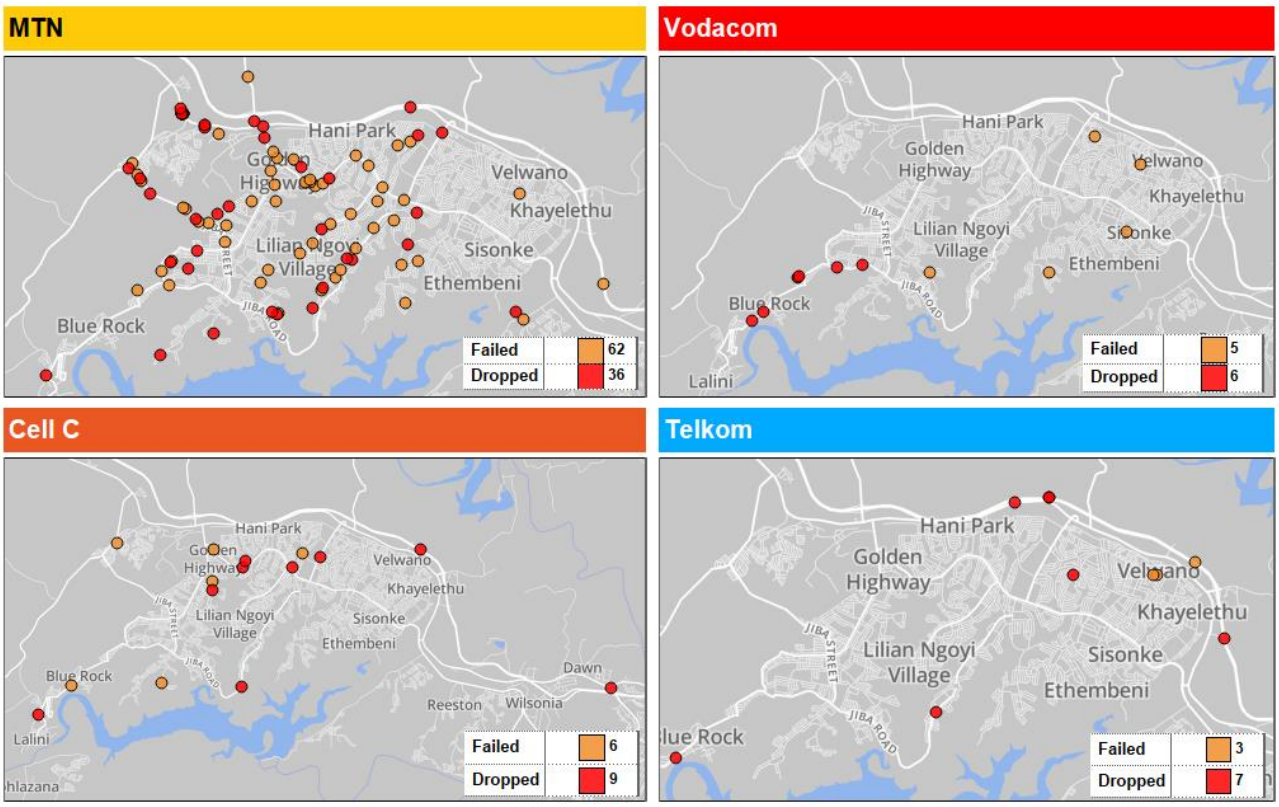


Figure 21. Mdantsane Call Failures

6.2.2.3. Dimbaza

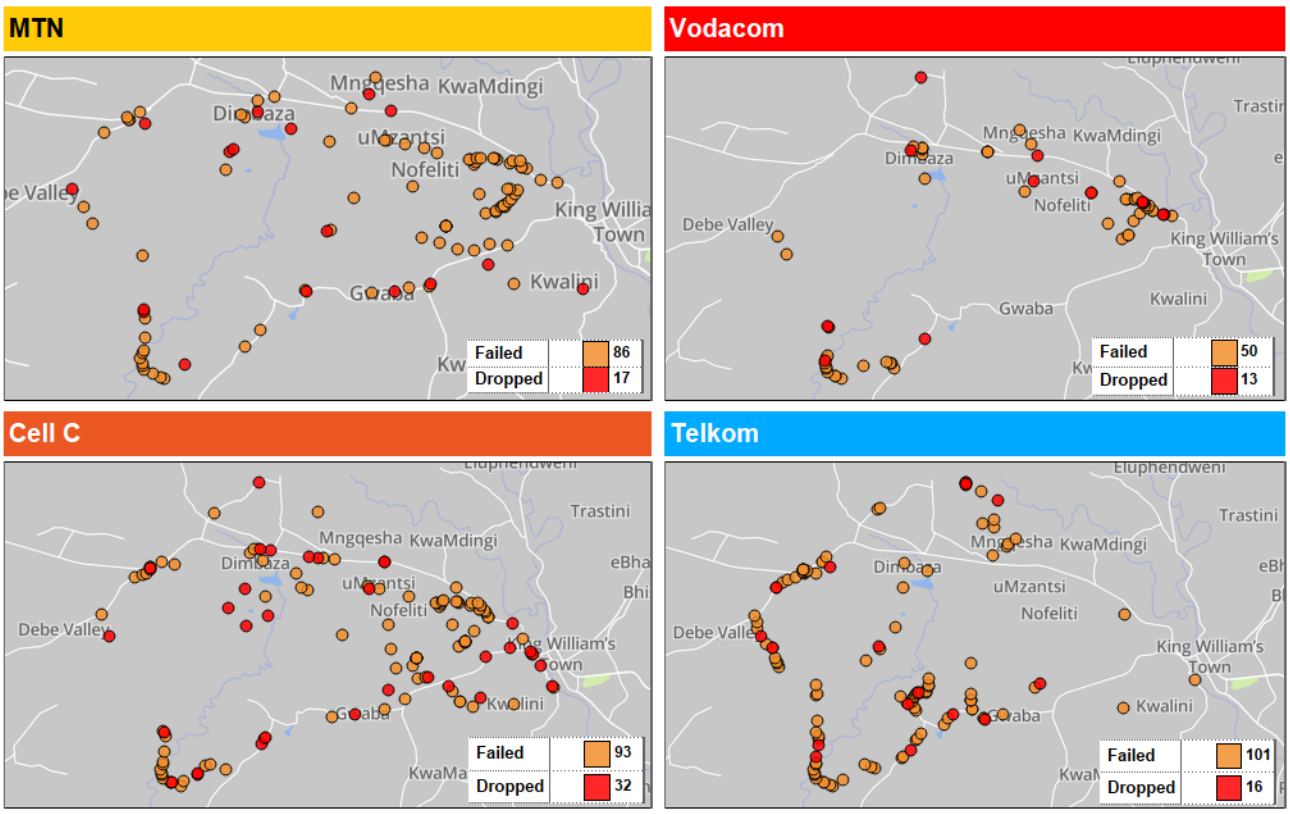


Figure 22. Dimbaza Call Failures

6.2.2.4. Dutywa

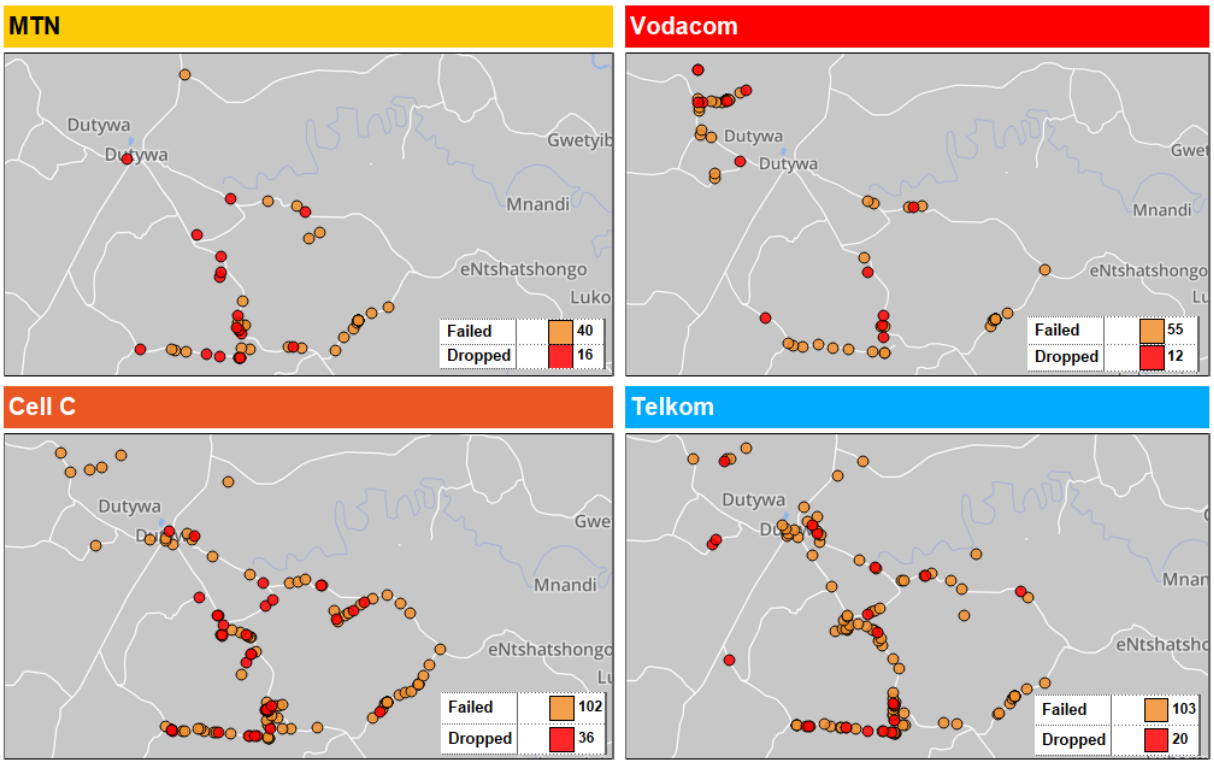


Figure 23. Dutywa Call Failures

6.2.2.5. Lady Frere

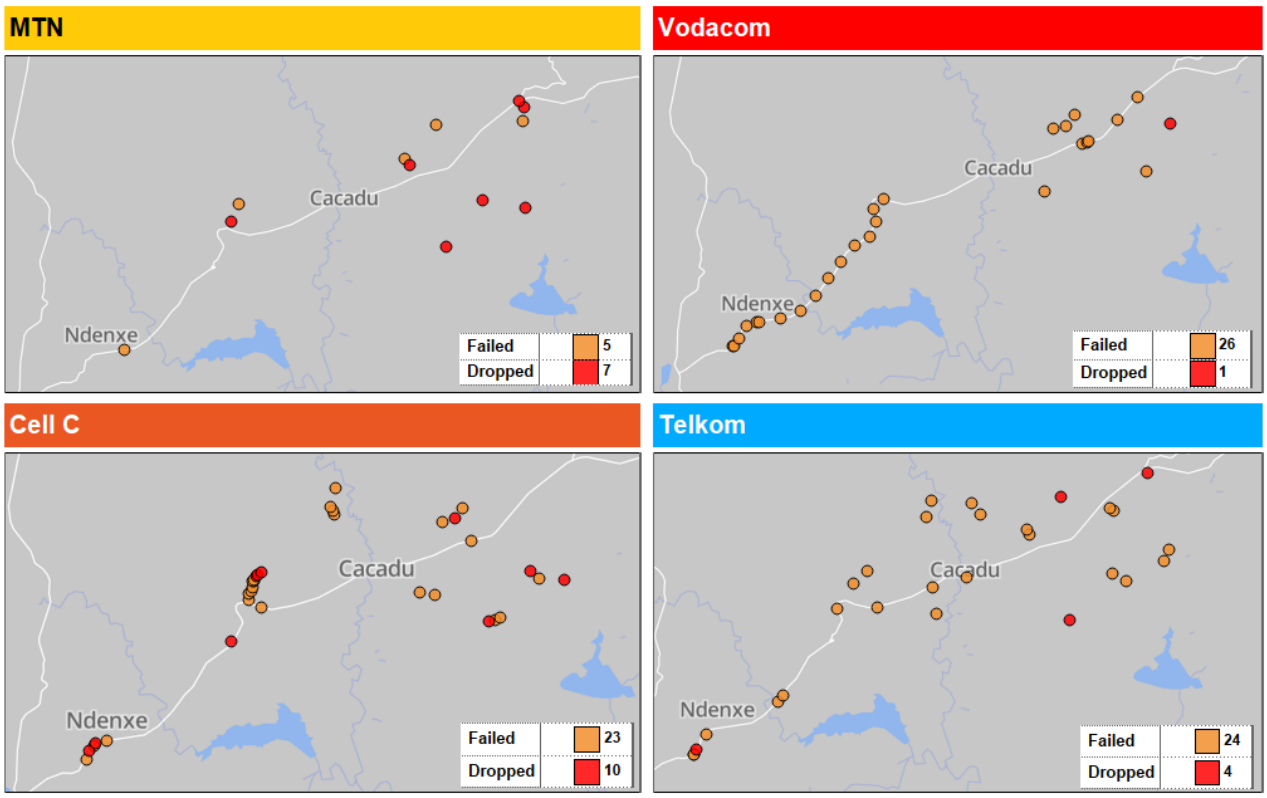


Figure 24. Lady Frere Call Failures

6.2.3.Roaming (Long call)

6.2.3.1. Cell C

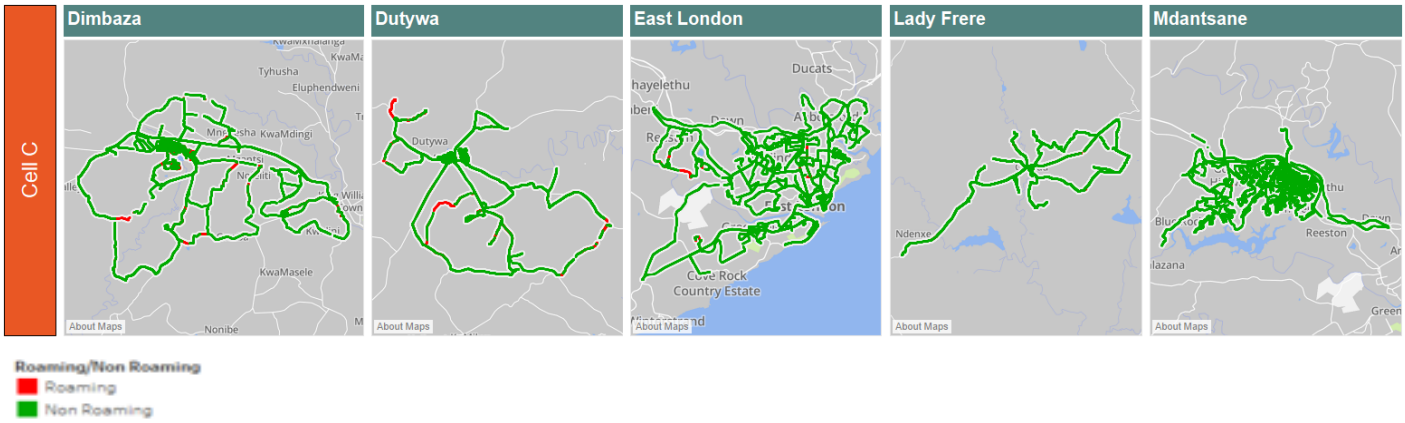


Figure 25. Cell C Roaming (Long Call)

6.2.3.2. Telkom

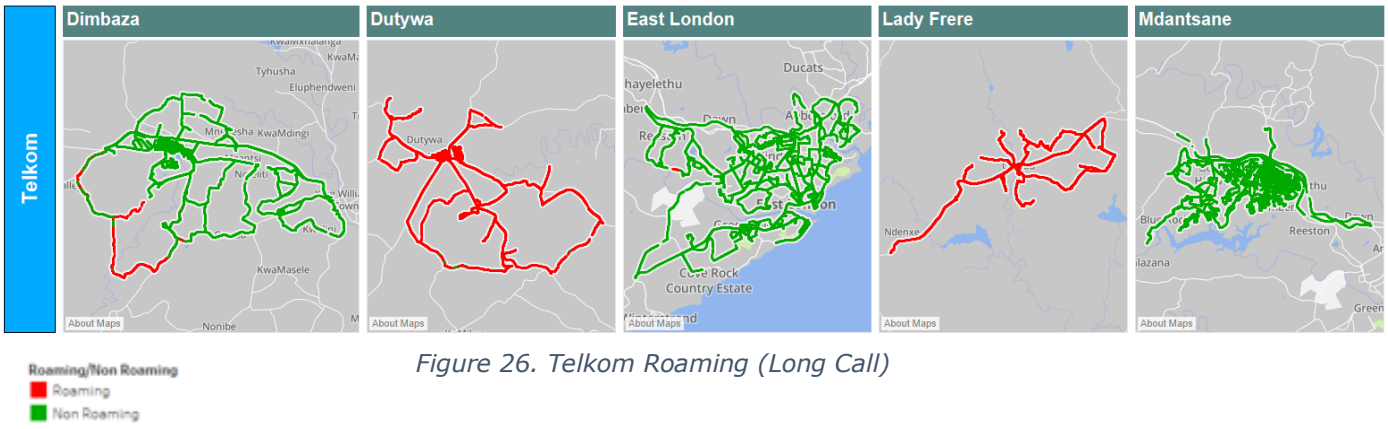


Figure 26. Telkom Roaming (Long Call)

6.3. Appendix 3: Mobile operators' feedback on the report

The detailed report was shared with the affected mobile operators in order for them to share their plans and remedial action to address issue of poor performance. The improvement plans and remedial actions are provided below.

6.3.1.Vodacom

Vodacom provided feedback and network improvement plans that are in place for the areas that were identified to be negatively affecting customer experience by the Authority's QoS monitoring report and shared the following plans and remedial actions:

- Dimbaza route – New sites are planned with the 2019/2020 budget.
- Dutywa route – A further site hardening combined with new battery rollout is in progress, there are new sites planned and will be implemented in 2020. Transmission capacity and outage to be addressed.
- East London route – There are plans for site hardening and to integrate new sites. Capacity enhancements has been completed as well as transmission stability improvement with self-provisioned transmission and better site availability with new battery rollout is in progress. LTE upgrades were completed in January 2019.
- Lady Frere route – There is a site hardening combined with new battery rollout in progress as well as capacity upgrade. Transmission capacity and outage will be addressed with Telkom. Self-provisioning is planned to facilitate LTE rollout in the area.
- Mdantsane route – There is a site hardening and new sites have been integrated in January and February. LTE rollout and further U900 upgrade have been implemented in January 2019, optimisation is in progress.

Furthermore, Vodacom is experiencing theft of feeders, cables and site wiring, batteries, generators, fuel and vandalism is a huge problem. However, there are a number of initiatives being undertaken by Vodacom to reduce the impact.

6.3.2.MTN

MTN provided feedback and network improvement plans that are in place for the areas that were identified to be negatively affecting customer experience by the Authority's QoS monitoring and shared the following plans and remedial actions:

- Dimbaza route – A new site planned to improve coverage in the area. The source of interference to be identified and a change of tilts on several serving cells to improve coverage.
- Dutywa route – A new site planned to improve coverage in the area and restore the site that was out.
- East London route – A new site planned to improve coverage in the area. The source of interference to be identified and path imbalance issues to be resolved.
- Lady Frere route – A new site planned to improve coverage in the area and diversity issues will be resolved.
- Mdantsane route – A new site planned to improve coverage in the area and planned adjustment of tilts on several serving cells to create dominance and resolve overshooting cells.

Furthermore, MTN plans to increase site count to resolve poor coverage and clear the uplink interference issues. However, MTN will optimise the existing sites to improve coverage in the meantime.

6.3.3.Cell C

Cell C attributes poor performance to tests currently underway to update system parameters in order to accommodate national roaming arrangement with the new roaming partner MTN . Cell C utters that the test period coincides with their major network optimising project which took place during the period of November 2018 to January 2019. However, Cell C's plans and remedies to improve the low performance areas include the following:

- Dimbaza route – There was a transmission issue that affected performance and was resolved on 24th and 27th January 2019, the area has since improved.
- Dutywa route – The test device roamed on Vodacom quite significantly and there was no seamless handover. Further optimisation is needed.

- East London route – There was a transmission issue that affected performance and was resolved on 24th and 27th January 2019, the area has since improved. This area forms part of the last batch of Cell C to MTN neighbour optimisation that was implemented in early December 2018.
- Lady Frere route – This area forms part of the last batch of Cell C to MTN neighbour optimisation that was implemented in early December 2018. Cell C to engage with the roaming partner.
- Mdantsane route – Cell C to engage with the roaming partner on issues experienced while roaming. Optimisation is needed to improve data performance and transmission upgrade plan will be implemented within the first half of 2019.

6.3.4.Telkom

Telkom views the test results as very significant and uses them as additional input to further improve the quality of the mobile network. Most call failures on the Telkom network were due to inadequate network coverage. This is being addressed by building additional sites in the tested areas to provide a more contiguous network coverage. Telkom's deployment plan within these areas are set out below:

- Dimbaza route – 2 sites are planned to be built.
- Dutywa route – 1 site is planned to be built.
- East London route – there are currently 73 sites On-Air and an additional 16 sites are planned to be built.
- Lady Frere route – Telkom did not plan any sites for Lady Frere for the current financial year. Deployment of sites in this area will be considered during the new financial year.
- Mdantsane route – there are currently 16 sites on-Air and an additional 2 sites are planned to be built.

In addition to building additional sites, other initiative to improve network and service quality is underway including LTE Carrier Aggregation, reframing of 2100 MHz spectrum for LTE, UMTS R99 parameter optimization, 256QAM modulation, etc.

Furthermore, Telkom has recently signed a new national roaming agreement with Vodacom, which is being implemented. Advantages of the new roaming agreement

includes roaming on 4G/LTE and seamless call handover between networks. This will significantly improve Telkom's overall network voice and data quality, especially in areas where it has limited or no network coverage.