

**Independent Communications Authority of South Africa** 

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# 2023/2024 Quarter 1:

# **Voice Quality of Service**

# Report

# **Gauteng Province**





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# List of Abbreviations

CD	Call Duration
CSFB	Circuit Switched Fall Back
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
MNO	Mobile Network Operators
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 Gauteng Province. The measurements were conducted between the 19<sup>th</sup> of June 2023 and the 15<sup>th</sup> of July 2023, covering a total distance of over 4056 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 are benchmarked against the QoS standard set by the Authority in the End-User and Service Subscriber Charter regulations of 2023. The measurements were conducted in areas and in circumstances where the 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 Gauteng Province are Alberton, Centurion, Johannesburg/Midrand, Mamelodi and Roodepoort.

Two vehicles, each equipped with Nemo Outdoor drive testing equipment, and eight (8) mobile phones were used to collect voice samples in mobility conditions. The four Key Performance Indicators (KPIs) used to assess the voice QoS were Call Accessibility, Call Retainability, Call Setup Time and Speech Quality or Mean Opinion Score (MOS). The Drop Call Ratio (DCR) is used to measure a user's ability to successfully complete a call and Call Setup Success Ratio (CSSR) measures a user's ability to make a phone call.

According to the End-User and Subscriber Service Charter Amendment Regulations of 2023, the average DCR should be less than or equal to 3% and the average CSSR must be 98% or higher. The average Call Setup Time must be 9 seconds or less, and the score for the average Speech Quality (MOS) for voice service should be equal to or greater than 3.

The results show that in terms of overall Call Setup Success Ratio, all operators achieved the 98% CSSR value, thus meeting the Accessibility target. All operators except Cell C achieved the Drop Call Ratio of 3% or less, thus meeting the Retainability target. All operators met the Call Setup Time target of 9 seconds or less. All operators met the overall Speech Quality Target of 3 or above.





## 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<sup>1</sup>. The Authority contracted Metro Global Telecom Services (Pty) Ltd. (MetroTelworks) to conduct drive testing in selected areas of the Gauteng Province. The test was focused on monitoring the mobile voice telephony service being offered by MTN, Vodacom, Cell C and Telkom within the Gauteng Province of South Africa.

The QoS monitoring was conducted in areas within the City of Ekurhuleni, City of Tshwane, and City of Johannesburg Metropolitan Municipalities. The areas of interest that were selected within these municipalities were Alberton, Centurion, Johannesburg/Midrand, Mamelodi and Roodepoort. The areas consist of major towns, townships, farm areas, rural areas, major road arteries, economic activity nodes and areas of previous complaints. Figure 1 shows the drive test routes covered during the drive-test period.



Figure 1. Gauteng Route Map with Population Distribution

<sup>&</sup>lt;sup>1</sup> ICASA Strategic Plan 2020/21-2024/25





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 teardown 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.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 assessed for each phase of measurements. 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 thighestime 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.

The 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 whilst the long calls were used to measure Call Retainability and Speech Quality.

Two vehicles, each equipped with a drive-test equipment were used to conduct measurements.

- Four test mobile phone in each vehicle were used in a long call scenario The test mobile phone per Operator in each vehicle was configured to call each other, i.e., call initiating side/call receiving side (A-side) in one vehicle and call receiving side/call initiating side (B-side) in another vehicle. Thus, replicating a realistic situation of Mobile-to-Mobile call test scenario in reality.
- Four test mobiles in each vehicle were used in a short call scenario. A single test mobile phone for each Operator was configured to make calls to the Operator's IVR system.

This set-up results in two mobile devices per operator per vehicle; bringing the total number of devices used for voice tests to eight per vehicle and a total of four devices 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. The short call duration was 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 6 to 7 samples being recorded during each call.

The devices were set to select the best available technology to allow for Circuit Switched Fall Back (CSFB). With this setup, in areas where operators had LTE, they performed Circuit Switched Fall Back (CSFB) calls to 3G/UMTS.





Voice testing was done in two phases with a measurement window gap of at least seven days in between both measurements to allow for any outages that may have been experienced in one phase to not negatively impact the overall results.

## 3.1. Equipment test setup and configuration

#### 3.1.1. System used.

The Test Equipment used was the Nemo Outdoor platform with 13 Samsung Galaxy **A52s 5G** smartphones installed inside each vehicle as shown in Figure 2.

- Four mobile devices were used for Short Call;
- Four mobile devices were used for Long Call; and
- Five mobile devices were <sup>2</sup>used for data test in each drive test car.

The mobile devices were configured to automatically select a mobile network and radio access technology.



Figure 2. Test Equipment

### 3.1.2. Device Description

The Samsung Galaxy A52s 5G Smartphone was selected as the measurement User Equipment (UE) for Voice Services. It supports the following technologies: 2G GSM, 3G WCDMA, 4G LTE FDD, 4G LTE TDD, 5G Sub6 FDD, 5G Sub6 TDD.

### 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.

<sup>&</sup>lt;sup>2</sup> Mobile devices were used to perform data tests and will be reported accordingly in a separate report.





#### Short Call:

	Call Idle = 30s Call setup timeout = 30s Call Duration = 10s		Test Scenar.	Value
_	Call Window = 70s	_	Short Call	Call Duration = 10s
				Call Setup timeout = 30s
				Call Window = 70s
Lor	a Call:		Long Call	Call Duration = 120s
				Call Setup timeout = 30s
	Call lole = 305 Call setup timeout = 305 Call Duration = 1205			Call Window = 180s
	Call Window = 180s			POLQA (WB)

#### Figure 3. Call Window Duration

## 3.1.4. Route selection

Measurement routes were selected to reflect the end-user distribution at different geographical locations in areas where there is a likely usage of mobile phones – areas in 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 from the three-district municipalities in Gauteng as indicated in Table 1.

#### Table 1. Test timeline for area covered.

Routes and Dates									
District	Area	Dates	Phase						
Ekurbuloni	Alberton	03/07/2023 - 04/07/2023	Phase1						
Ekultuletti	Alberton	12/07/2023 - 13/07/2023	Phase 2						
	Conturion	27/06/2023	Phase1						
City of Tobwana	Centunion	05/07/2023	Phase 2						
City of TShwane	Mamaladi	28/06/2023 - 29/06/2023	Phase1						
	Mameloui	06/07/2023	Phase 2						
	Johannesburg	19/06/2023 - 20/07/2023	Phase1						
City of	/Midrand	11/07/2023 - 12/07/2023	Phase 2						
Johannesburg	Poodopoort	29/06/2023 - 30/06/2023	Phase1						
	Roouepoon	07/07/2023	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.

## 3.2. Measurement parameters and targets

#### 3.2.1. Parameters

### 3.2.1.1. 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:

CSSR = Y/X \*100

Where, Y represents successful setup calls, and X is the total number of call attempts.

### 3.2.1.2. Drop Call Ratio [%]

Dropped Call Ratio (DCR) is the proportion of incoming and outgoing calls, which, once correctly established and having been assigned a traffic channel, is 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 = number of dropped calls and S = number of successful calls established

#### 3.2.1.3. 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.

### 3.2.1.4. 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.

### 3.2.2. Targets

According to the End User and subscriber Service Charter Regulations of 2023, the following voice parameters' targets are defined as follows:

- 1. Call Setup Success Ratio Average Call Setup Success Ratio must be 98% or higher.
- 2. Call Setup Time Ratio Average Call Setup Time must be less than 9 seconds or less.
- 3. Drop Call Ratio Average Drop Call Ratio must be less than or equal to 3%.
- 4. Speech Quality Average Speech Quality of MOS should be equal to or 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: Alberton, Centurion, Johannesburg/Midrand, Mamelodi and Roodepoort.

## 4.1. KPI Results per Area

Table 3 shows a summary of the results per area. Detailed results are provided in the Appendix 1 and Appendix 2.

Table 3. Summary of KPI Results per Area

		Alberton	Centurion	Johannesburg /Midrand	Mamelodi	Roodepoort
	Cell C	98.23	99.41	98.60	96.16	98.81
Call Satur Success Patie [9/1	MTN	99.30	99.01	98.10	97.96	99.09
	Telkom	97.66	99.43	99.40	99.02	99.56
	Vodacom	98.87	99.61	99.49	99.68	99.24
	Cell C	0.70	2.81	3.05	5.00	5.28%
Drop Call Patia 19/1	MTN	0.00	2.10	2.45	1.94	1.47%
	Telkom	3.21	0.35	3.00	2.48	4.03%
	Vodacom	2.81	0.35	2.26	1.33	2.38%
	Cell C	5.28	4.98	5.29	3.97	5.17
Call Satur Time [c]	MTN	4.85	4.36	4.77	3.01	4.71
	Telkom	4.87	4.48	4.58	4.6	4.58
	Vodacom	3.3	2.96	2.05	2.9	3.16
	Cell C	3.87	3.89	3.85	3.84	3.86
	MTN	3.85	3.87	3.84	3.81	3.87
	Telkom	3.69	3.83	3.69	3.61	3.76
	Vodacom	3.65	3.84	3.73	3.73	3.73





## 4.1.1. Call Accessibility (Short Call)





Figure 4 shows that all operators met the 98% CSSR target in Centurion, Johannesburg/Midrand, and Roodepoort. MTN and Cell C failed to meet the CSSR target of 98% in Mamelodi, while Telkom failed the CSSR target in Alberton area.



#### Figure 5. CSSR KPI Overall Results – Short Call

Figure 5 shows that all operators achieved the overall CSSR target of 98%. There is statistically significant difference recorded between MTN and Vodacom, between MTN and Telkom, and between Vodacom and Cell C as well as Cell C and Telkom. Vodacom got the highest CSSR followed by Telkom, MTN and Cell C.





## 4.1.2. Drop Call Ratio (Long Call)



Figure 6. DCR KPI per Area - Long Call

Figure 6 shows the operator's Drop Call Ratio results per area. Vodacom and MTN met the target in all the tested areas. Cell C failed to meet the DCR target of less or equal to 3% in Mamelodi, Johannesburg/Midrand and Roodepoort. Telkom failed to achieve the DCR target in Alberton and Roodepoort



#### Figure 7. DCR KPI Overall Results – Long Call

Figure 7 Overall results show that MTN, Telkom and Vodacom met the overall DCR target of less than or equal to 3%. Cell C failed the to meet the overall DCR target. MTN's Overall DCR is the lowest followed by Vodacom, Telkom and Cell C. There is significant statistical difference recorded between the results of MTN and Cell C.





## 4.1.3. Call Setup Time (Short Call)



#### Figure 8. Call Setup Time[s] KPI per Area

Figure 8 shows all operators met the Call Setup Time target of 9 seconds or less in all the tested areas of Gauteng as per the End-User and Subscriber Service Charter Fourth Amendment Regulations 2023.



#### Figure 9. Call Setup Time[s] KPI Overall Results

Figure 9 shows the overall Call setup time results for the Gauteng Province. Vodacom had the lowest overall Call Setup Time followed by MTN, Telkom and Cell C.





## 4.1.4. POLQA MOS (Long Call)



#### Figure 10. Speech Quality per Area

Figure 10 depicts speech quality results per tested area. All Operators achieved an average POLQA MOS of at least three (3) in all the tested areas thus meeting the required speech quality target.



#### Figure 11. Speech Quality Results

Figure 11 shows the overall voice Speech Quality scores for each Operator in the Gauteng Province. All operators met the required speech quality target of a score of at least 3. Vodacom and Cell C achieved the best Overall Speech Quality followed by MTN and Telkom in descending order.





## 4.2. Radio Technology



#### Figure 12. Serving Radio Technology per Area

Figure 12 shows the distribution of the serving radio technology per area. Cell C, MTN & Vodacom showed significant presence of UMTS 900 for all areas.

Figure 13 shows the distribution of the overall serving technology during the drive test including the time the devices were in idle mode. All operators' serving technology during calls was mainly on UMTS technology, Telkom showed presence of most samples on UMTS 2100. MTN has the highest UMTS 900 presence followed by Cell C, Vodacom, and Telkom in a descending order.







#### Figure 13. Serving Radio Technology Overall Results

### 4.3. Comparison of the current results to previous results

Johannesburg was previously monitored in the financial year 2013/2014. Midrand was previously monitored in the financial year 2021/22, and Centurion in 2013/2014. The aim of conducting the recent QoS measurements in these areas was to assess the level of improvement that the operators promised in the previous financial years. The results show that there is consistent good performance from all operators in Centurion.

Only Retainability measurements were conducted in Centurion in 2013/2014 and measurements were conducted on three operators (Cell C, MTN, and Vodacom). All operators show good performance in terms of Retainability, with MTN showing a significant improvement.

In 2013/2014, Accessibility measurements were conducted on three operators (Cell C, MTN, and Vodacom) in Johannesburg CBD. In the financial year 2021/22, measurements were conducted in Midrand. The Johannesburg /Midrand shows improvement in terms of Accessibility for all operators; operators maintained the target of greater or equal to 98%. In terms of Retainability, Vodacom, and MTN maintained good performance.





In Mamelodi, Vodacom and Telkom maintained good performance in terms of Accessibility; Vodacom and Telkom met the target of greater or equal to 98%. In terms of Retainability, Vodacom, MTN, and Telkom maintained good performance.

It must be noted that the target for Accessibility was 95% in 2013/2014, this is before the revision of *End-User and Subscriber Service Charter Regulations of 2016 as well as that of End-User and Subscriber Service Charter Fourth Amendment Regulations 2023* which became effective in March 2023. Table 4 below summarises the previous and current results. Telkom was not yet included in the measurements during the financial year 2013/14.

			Acces	sibility (%	<b>b</b> )	Retainability (%)				
Area	Financial Year	Cell C	MTN	Telkom	Vodacom	Cell C	MTN	Telkom	Vodacom	
Conturion	23/24	99,41	99,01	99,43	99,61	2,81	2,10	0,35	0,35	
Centunion	13/14	-	-	-	-	1,58	4,84	-	0,40	
Johannesburg /Midrand	23/24	98,60	98,10	99,40	99,49	3,05	2,45	3,00	2,26	
Midrand	20/21	99,50	99,67	99,66	99,66	2,08	1,65	2,10	0,84	
Johannesburg CBD	13/14	93,42	96,41	-	98,74	-	-	-	-	
	23/24	96,16	97,96	99,02	99,68	5,00	1,94	2,48	1,33	
Mamelodi	17/18	98,76	99,74	99,02	98,66	0,29	0,27	0,27	1,11	

### Table 4 Comparison of previous results

# 5. Conclusion

This section provides a summary and key finding 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 assessed. Below are the highlights: -

- Call Setup Success Ratio (CSSR): In terms of CSSR results per area; all four operators met the 98% CSSR target in Centurion, Johannesburg/Midrand, and Roodepoort routes; Telkom failed to meet the CSSR target in Alberton; Cell C and MTN failed to meet the target in Mamelodi. Overall results for the five routes show that all four operators met the CSSR target.
- Drop Call Ratio (DCR): In terms of CSSR results per area; Vodacom and MTN met the target in all areas; Telkom failed to achieve the target in two tested areas (Alberton and Roodepoort) and Cell C failed to achieve the target in three tested areas (Mamelodi, Johannesburg/Midrand





and Roodepoort). In terms of overall results, Cell C is the only operator that failed the overall DCR target.

- **Speech Quality (MOS)**: All operators met the required speech quality target of a score of at least 3 in each specific area. Cell C achieved the best Overall Speech Quality of 3.86 followed by MTN at 3.85, Vodacom at 3.73 and Telkom at 3.78, respectively.
- Call Setup Time (CST): All operators achieved the target according to End-User and Subscriber Service Charter Fourth Amendment Regulations 2023. Vodacom has the shortest overall Call Setup Time with an average of 2.79s followed by MTN at 4.37s, Telkom at 4.62s and Cell C at 4.97s.

# 6. Appendices

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

### 6.1.1. Vodacom

Vodacom provided feedback and network improvement despite meeting the overall targets in all tested areas. The plans were provided as follows:

- Centurion: Vodacom highlighted the area, a new development, that experienced poor coverage. There is a new site, planned to be implemented in financial year 2024.2025, to improve the coverage in the drive test area. Furthermore, frequency optimisation which was conducted in quarter 3 of 2023 and the L700 upgrades will be conducted in quarter 1 of 2024.
- Midrand: The area experienced loadshedding stage 6 when measurements were conducted. Backup on the serving site has since been increased. Cluster optimisation has been completed and L700 rollout including Sectorisation will be implemented in quarter 1 of 2024. A new site was implemented in October 2023.
- Mamelodi: Few serving sites were out of service during the benchmarking period causing interference and congestion which affected data performance KPI's, particularly downlink throughput. The remedial action includes a planned new site to be implemented in financial year 2024/2025, permanent backup power and the L700 upgrades which will be conducted in quarter 1 of 2024.

## 6.1.2. MTN

MTN provided feedback and indicated that most negative events (call setup failures and dropped calls) in Gauteng are due to site availability issues in the network. Vandalism and power outages (load shedding) remain the greatest challenge to MTN, which negatively impacts the quality of service in the network. MTN shared that they are embarking on a national project to improve network resilience with regard to site standby time during the unprecedented loadshedding, improving transmission capacity during rerouting where possible and bolstering site resistance due to vandalism. The findings and plans were provided as follows:

• Centurion: MTN will immediately perform antenna optimization and increase power ate identified sites to improve the coverage in the location of the dropped calls.





- Johannesburg/Midrand: MTN analysis revealed that a number of serving sites were temporary down at the time of the drive test. The
  issues on the site have now been resolved and coverage restored in the area. MTN also experienced poor coverage in some areas
  because of site availability problems within the network. The problems on serving sites have been resolved and coverage has since been
  restored.
- Mamelodi: Five dropped calls experienced in Mamelodi were mainly due to temporary availability of the serving sites. MTN indicated that a network planning team will investigate the possibilities of building another site in the area to improve coverage. In areas where blocked calls we experience, azimuth change will be implemented to resolve the coverage issues.

#### 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 services to its subscribers by engaging with its national roaming service provider to improve coverage in areas identified with poor performance. The plans to address poor performance were provided as follows:

- Alberton: Cell C will investigate the possibility of uplink interference in one of the sites. Site Availability issues will be escalated to the national roaming partners or managed network service provider.
- Johannesburg/Midrand: The issues of poor coverage and site availability in the area have been escalated to the national roaming/managed network service provider.
- Mamelodi: Poor radio frequency (RF) coverage and quality were experienced in the area. Poor performance indicators are addressed via service tickets to roaming partner. Site availability has been escalated to the national roaming/managed network service provider.
- Roodepoort: Multiple drop calls experienced were due to a destination that was out of order. Errors of destination out of order to test number have been resolved.





### 6.1.4. Telkom

Telkom's response to the report indicated that it views the Authority's test results as very significant and uses them as additional input to further improve the quality of the mobile network. Furthermore, Telkom indicated that measurements were conducted during Eskom stage 6 load shedding which affected availability of sites.

- Alberton: Most failures were caused by congestion and poor quality on the GSM network. Telkom was in the process of shutting down its GSM network across the country (Gauteng was finally switched-off on 2 September 2023), and it was to be expected that the few remaining GSM cells will congest, resulting in poor radio frequency (RF) quality. There is a total of twenty-two (22) sites planned in the area; seventeen (17) sites are in acquisition phase, three (3) sites in build phase and two (2) in lease agreement phase.
- Mamelodi: Nine (9) failures occurred on the roaming partner's network because two (2) Telkom sites in the area experienced availability issues during the drive test. There is a total of thirty-three (33) sites planned in the area; twenty (20) sites are in acquisition phase, five (5) sites in build phase, seven (7) in lease agreement phase and one in site quality acceptance phase.
- Johannesburg/Midrand: Dropped calls in the area were caused by overshooting calls with poor RF conditions and this will be addressed through network optimization to reduce service impact during load shedding. Seventy-one (71) sites are planned to improve network performance in the area; forty-three (43) sites are in acquisition phase, nine (9) sites in build phase, seventeen (17) sites in lease agreement phase, one in site quality acceptance phase and one site in site replanning phase.
- Roodepoort: There is a total of thirty-three (33) sites planned in the area; twenty-four (24) sites are in acquisition phase and nine (9) sites in build phase.
- Centurion: There is a total of twenty-seven (27) sites planned in the area; eighteen (18) sites are in acquisition phase and three (3) sites in build phase, six (6) in lease agreement phase.





# 6.2. Appendix 1: Detailed Test results per Phase

#### Table 5. CSSR and Call Setup Time - Phase 1 and Phase 2

-		Alberton		Cent	urion	Johannesburg/Midrand		Mamelodi		Roodepoort		Grand
		Phase 1	Phase 2	Phase 1	Phase 2	Phase 1	Phase 2	Phase 1	Phase 2	Phase 1	Phase 2	Total
	Cell C	823	873	834	863	1,339	1,226	996	799	905	867	9,525
Call Attomat	MTN	822	881	844	867	1,354	1,227	1,013	798	901	863	9,570
	Telkom	844	907	861	902	1,392	1,269	1,045	795	941	898	9,854
	Vodacom	851	915	873	905	1,481	1,284	1,060	812	947	902	10,030
	Cell C	17	13	5	5	8	28	64	5	12	9	166
Call Failed	MTN	3	9	10	7	23	26	37	0	10	6	131
	Telkom	28	13	3	7	4	12	11	7	3	5	93
	Vodacom	13	7	3	4	5	9	2	4	8	6	61
	Cell C	97.93	98.51	99.40	99.42	99.40	97.72	93.57	99.37	98.67	98.96	98.26
Call Setup Success	MTN	99.64	98.98	98.82	99.19	98.30	97.88	96.35	100.00	98.89	99.30	98.63
Ratio [%]	Telkom	96.68	98.57	99.65	99.22	99.71	99.05	98.95	99.12	99.68	99.44	99.06
	Vodacom	98.47	99.23	99.66	99.56	99.66	99.30	99.81	99.51	99.16	99.33	99.39
	Cell C	5.28	5.28	4.94	5.01	5.33	5.25	4.1	3.82	5.12	5.22	4.97
Call Satur Tima [a]	MTN	4.80	4.89	4.39	4.32	4.75	4.79	3.04	2.97	4.71	4.71	4.37
	Telkom	4.84	4.90	4.50	4.47	4.51	4.66	4.57	4.64	4.58	4.57	4.62
	Vodacom	3.38	3.23	2.96	2.96	1.09	3.16	2.92	2.88	3.19	3.12	2.79





#### Table 6. (DCR) and POLQA MOS - Phase 1 and Phase2

		Alberton Centurion		urion	Johannesb	urg/Midrand	Mamelodi		Roodepoort		Grand	
		Phase 1	Phase 2	Phase 1	Phase 2	Phase 1	Phase 2	Phase 1	Phase 2	Phase 1	Phase 2	Total
	Cell C	139	147	138	147	225	201	151	129	148	136	1,561
Call	MTN	125	141	120	118	187	181	137	121	140	132	1,402
Completed	Telkom	135	145	136	147	226	207	153	129	136	137	1,551
	Vodacom	139	146	139	147	229	213	171	130	148	146	1,608
	Cell C	1	1	5	3	3	10	12	2	4	11	52
Call Dropped	MTN	0	0	2	3	1	8	4	1	2	2	23
	Telkom	5	4	0	1	5	8	4	3	3	8	41
	Vodacom	4	4	1	0	4	6	2	2	5	2	30
	Cell C	0.72	0.68	3.62	2.04	1.33	4.98	7.95	1.55	2.70	8.09	3.33
Drop Call	MTN	0.00	0.00	1.67	2.54	0.53	4.42	2.92	0.83	1.43	1.52	1.64
Ratio [%]	Telkom	3.70	2.76	0.00	0.68	2.21	3.86	2.61	2.33	2.21	5.84	2.64
	Vodacom	2.88	2.74	0.72	0.00	1.75	2.82	1.17	1.54	3.38	1.37	1.87
	Cell C	3.88	3.86	3.89	3.89	3.88	3.81	3.75	3.93	3.89	3.84	3.86
	MTN	3.84	3.86	3.89	3.84	3.87	3.81	3.76	3.86	3.88	3.85	3.85
	Telkom	3.67	3.71	3.85	3.81	3.78	3.58	3.63	3.58	3.84	3.66	3.72
	Vodacom	3.61	3.68	3.85	3.83	3.74	3.7	3.77	3.68	3.72	3.73	3.73





# 6.3. Appendix 2 Technology Maps



Figure 14. Radio Technology Maps





## Appendix 3. UMTS Coverage Maps



Figure 15. UMTS Coverage Map Plot





## 6.4. Appendix 4 UMTS Quality Maps



Figure 16. UMTS Eclo Map Plot