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# **Quality of Service Report: Northern Cape Province 2017/2018 Quarter 4**

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## **List of Abbreviations**

CD	Call Duration
CSSR	Call Setup Success Ratio
DCR	Drop Call Ratio
GSM	Global System for Mobile Communications
IVR	Interactive Voice Response
WCDMA	Wideband Code Division Multiple Access
MOC	Mobile Originating Call
KPI	Key Performance Indicator

## **EXECUTIVE SUMMARY**

The Authority conducted 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 voice services being offered by the operators in Northern Cape Province. The measurements were carried out in the period of 22<sup>nd</sup> January to 05<sup>th</sup> February 2018. The total distance covered was over 2500 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 are 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 major towns, townships, farm areas, rural areas, major road arteries, economic activity nodes and areas of previous complaints. The sampled areas include Kuruman, Upington, Springbok, Kamiesberg and Calvinia.

A vehicle equipped with TEMS Symphony measurement tool was used to collect data by driving through areas of interest. The two Key Performance Indicators (KPIs) used to assess QoS are Retainability and Accessibility. The Drop Call Ratio (DCR) parameter is used to measure Retainability and Call Setup Success Ratio (CSSR) parameter measures Accessibility.

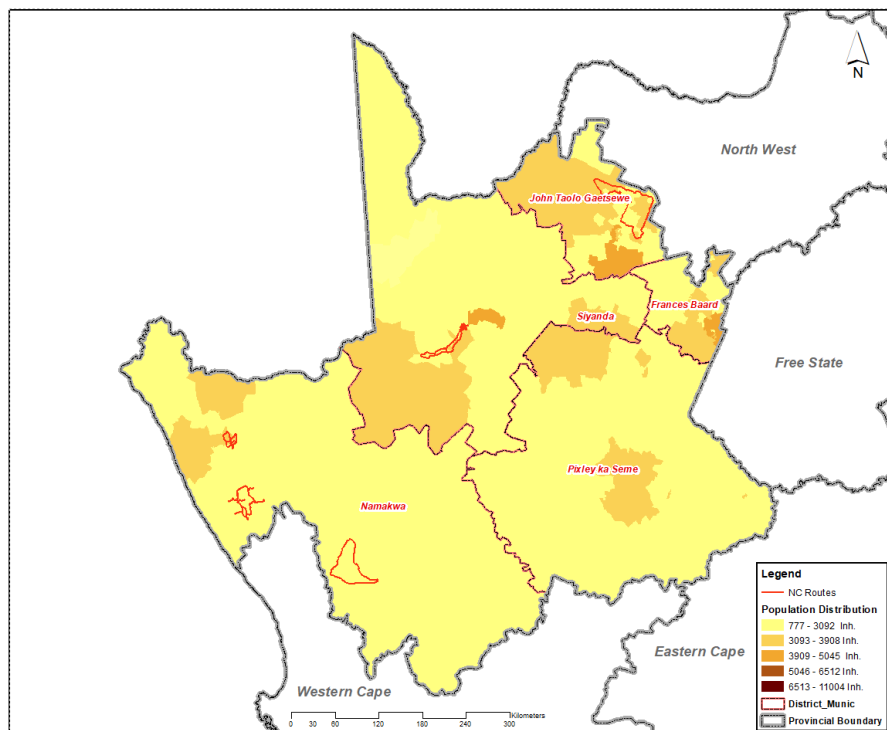
According to the End-User and Subscriber Service Charter regulations of 2016, DCR should be less than 3% and CSSR should be greater than 98%.

The results show that in terms of overall Call Setup Success Ratio, all operators achieved less than 98% CSSR target respectively, thus failed to meet the Accessibility target. In terms of the overall Drop Call Ratio, all operators did not achieve less than 3% in DCR values and thus failed to meet the Retainability target.

## 1 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 ensures the quality of service through its Quality of Service (QoS) monitoring activities. The Authority conducted QoS monitoring of the GSM voice telephony service being offered by Cell C, MTN, Vodacom and Telkom within Northern Cape Province of South Africa.

The Northern Cape is the largest province in South Africa, taking up nearly a third of the country’s land area. It is bordered by Namibia and Botswana to the north, and also by the North West, Free State, Eastern Cape and Western Cape provinces. The Northern Cape is rich in minerals, has fertile agricultural land in the Orange River Valley and the interior Karoo relies on sheep farming. It covers an area of 372 889 km<sup>2</sup> and it is the least populous of South Africa’s provinces with a population of 1 193 780. Other important towns include Upington, Springbok, Kuruman, De Aar and Sutherland<sup>2</sup>.



**Figure 1: Northern Cape Province Route Map**

<sup>1</sup>ICASA Strategic Plan 2016/17-2021

<sup>2</sup><https://municipalities.co.za/provinces/view/7/northern-cape>

The QoS monitoring was conducted in the areas within John Taolo Gaetsewe District Municipality, Siyanda District Municipality and Namakwa District Municipality. The selected areas include Kuruman, Upington, Springbok, Kamiesberg and Calvinia. The areas consist of major towns, townships, farm areas, rural areas, major road arteries, economic activity nodes and areas of previous complaints.

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 Retainability and Accessibility parameters.

- a) 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<sup>3</sup>. It is measured using Drop Call Rate (DCR).
- b) Accessibility is defined as the percentage of the number of times a user is rejected due to the unavailability of system resources when attempting to place a call. It is measured using Call Setup Success Rate (CSSR).

## **2 METHODOLOGY**

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 selected routes and particular time of the day. It is therefore not a true representation of the mobile service provider's overall network performance.

### **2.1 Drive-test equipment**

The drive test was carried out using a test kit comprised of TEMS Symphony 7.7 software and hardware, eight Samsung Galaxy Note 4 (SM-N910F) mobile devices, a laptop computer and a TEMS Probe Controller 1.9. The mobile devices were configured to automatically select mobile network and radio access technology.

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<sup>3</sup> Annexure B.2 of ETSI EG 202 057-3

## 2.2 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 (e.g. urban, suburban, major towns, rural towns, township, farm areas, highways, tourism areas and major roads).

The selected five areas in which the QoS measurements were conducted are within the district municipalities as indicated in Table 1 below:

**Table 1: Selected routes and dates**

Test Type	Municipality	Route Name	Dates
Accessibility and Retainability	John Taolo Gaetsewe District Municipality	Kuruman	22/01/2018 02/02/2018 03/02/2018
	Siyanda District Municipality	Upington	23/01/2018 01/02/2018
	Namakwa District Municipality	Springbok	24/01/2018 31/01/2018
		Kamiesberg	25/01/2018 30/01/2018
		Calvinia	26/01/2018 29/01/2018

## 2.3 Equipment test setup and configuration

Table 2 shows the test plan and configurations of the drive-test equipment.

**Table 2: Test plan and configurations**

<b>Configuration</b>	<b>Explanation</b>
Antennas	Tests were carried out from a moving vehicle with roof-mounted antennas. The antennas were arranged in a well-defined fixed way. A minimum distance between antennas is maintained to contain RF influence on an acceptable level. The coupling loss between two mobile handsets was a minimum of 40.5 dB <sup>4</sup> .
Band	The bands tested for voice were GSM (900 and 1800 MHz) and WCDMA (900 and 2100 MHz). The bands scanned were GSM (900 and 1800 MHz) and WCDMA 2100 MHz
Call Samples	A minimum of 120 test samples per network operator were collected except in the areas where services were limited on most part of the drive test route. Test drives were planned to ensure, as far as practicable, that the results adequately reflect the QoS perceived by customers for the period under review.  The drive test was designed to be representative of the population relative to the traffic of the network. Measurements were scheduled to reflect accurately the traffic variations over the hours of a day, and user's behavior <sup>5</sup> .
Call Type and Window Call	Long calls and short calls were used. Voice telephony was tested in the Mobile Originating Call (MOC) direction. The following call durations were used: <ul style="list-style-type: none"> <li>• CD1: 10 seconds for call setup testing;</li> <li>• CD2: 120 seconds for typical tests, default call duration;</li> </ul> Call Window: Call Duration + 30 seconds, (for the setup and release phases) + 30 seconds (for the minimum pause. Interval), for the default call duration this results in 180 seconds <sup>6</sup> .

<sup>4</sup> Section 6.3 of ETSI TS 102 250-4 V.1.1.2 (2003-10)

<sup>5</sup> Section 4.8 of ETSI EG 202 057-3 V1.1.1 (2005-04)

<sup>6</sup> Section 4.2.1 of ETSI TS 102 250-5 V1.2.1 (2005-05)



Equipment	The equipment used for testing was the TEMS Symphony 7.7 equipped with Samsung Galaxy Note S4 (SM-N910F), PCTEL EXFlex Scanner and Dell Latitude with TEMS Probe Controller 1.9.2.
KPI <sup>7</sup>	The measurements focused on the following network parameters: (i) Dropped Call Ratio (DCR); (ii) Call Set-up Success Ratio (CSSR)
Log files	The log files for each test case were stored in different locations with different names. The log files were recorded per network operator.
Mobile terminal used	The test calls were terminated on each operator's test platform or IVR system.
Network tested	Cell-C, MTN, Vodacom and Telkom.
SIM cards	Test SIM cards provided by each operator were used during the drive test.
Vehicle used	A Toyota Hilux Double Cab van equipped with drive-test equipment was used. All the road traffic rules were observed during the drive test. The speed was maintained to an average of 60 km/h in town and built-up areas, and an average of 100 km/h on highways.

## 2.4 Statistical significance

The purpose of statistical analysis is to present the statistical accuracy of reported KPIs. This means that one can be "relatively sure" that the results represent the reality (true population mean) and that they did not occur by chance. Statistical theory provides tools to assess the statistical significance of measurement observations with a given sample count and standard deviation.

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<sup>7</sup> End-User and Subscriber Service Charter Regulations of 2016

## **2.5 Measurement parameters and targets**

### **2.5.1 Parameter targets**

The Average Drop Call Ratio should be less than 3% over 6 months' period and Average Call Setup Success Ratio must be greater than 98% over six months' period as per the "End-User and Subscriber Service Charter Regulations of 2016".

### **2.5.2 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, is dropped or interrupted prior to the deliberate completion by the user<sup>8</sup>.

The formula to calculate DCR is shown below:

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

where D represents the number of dropped calls and S is the number of successful call attempts

### **2.5.3 The 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<sup>9</sup>.

The formula to calculate CSSR is shown below:

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

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

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<sup>8</sup> End-User and Subscriber Service Charter Regulations of 2016

<sup>9</sup> End-User and Subscriber Service Charter Regulations of 2016

### 3 RESULTS AND ANALYSIS

This section provides a summary of the mobile operator’s performance results based on the drive test route in the test areas:

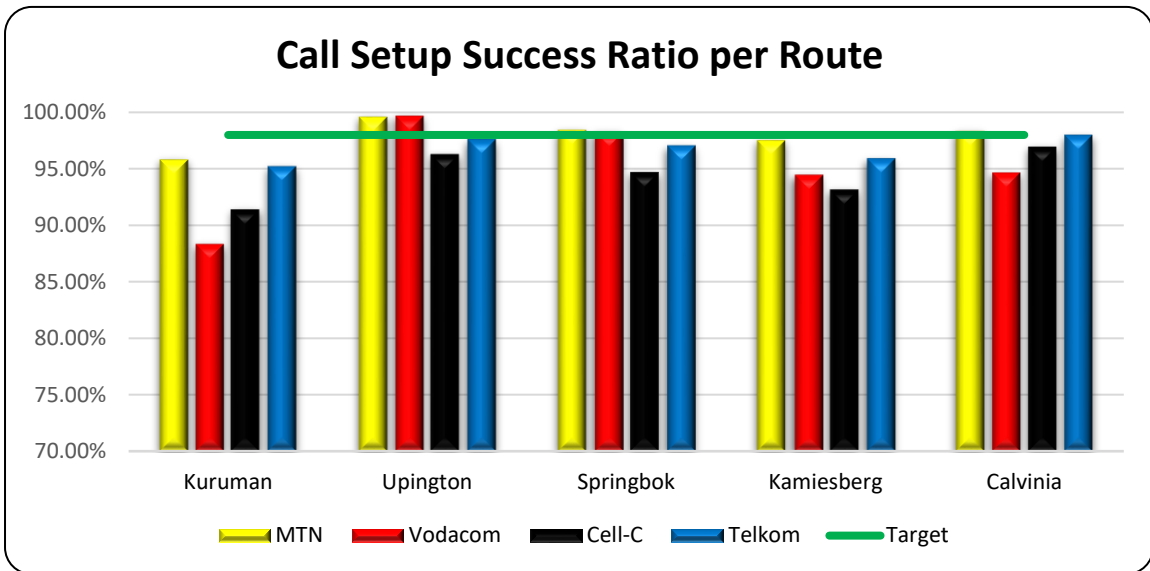
#### 3.1 Accessibility and Retainability measurements

**Table 3: Summary of results**

Route Name	Operator	CSSR (%)	DCR (%)
<b>Kuruman</b>	Telkom	95.19%	3.48%
	Cell C	91.40%	2.20%
	Vodacom-SA	88.33%	3.23%
	MTN-SA	95.80%	2.16%
<b>Upington</b>	Telkom	97.60%	1.22%
	Cell C	96.26%	3.79%
	Vodacom	99.65%	1.90%
	MTN	99.56%	0.59%
<b>Springbok</b>	Telkom	97.03%	3.93%
	Cell C	94.66%	3.46%
	Vodacom	98.23%	2.35%
	MTN	98.42%	2.61%
<b>Kamiesberg</b>	Telkom	95.89%	8.60%
	Cell C	93.14%	9.47%
	Vodacom	94.43%	12.84%
	MTN	97.51%	7.12%
<b>Calvinia</b>	Telkom	97.95%	4.90%
	Cell C	96.90%	3.27%
	Vodacom	94.65%	6.58%
	MTN	98.31%	5.68%
<b>Overall results for the above 5 areas</b>	Telkom	96.74%	4.30%
	Cell C	94.10%	4.13%
	Vodacom	94.94%	4.93%
	MTN	97.93%	3.39%

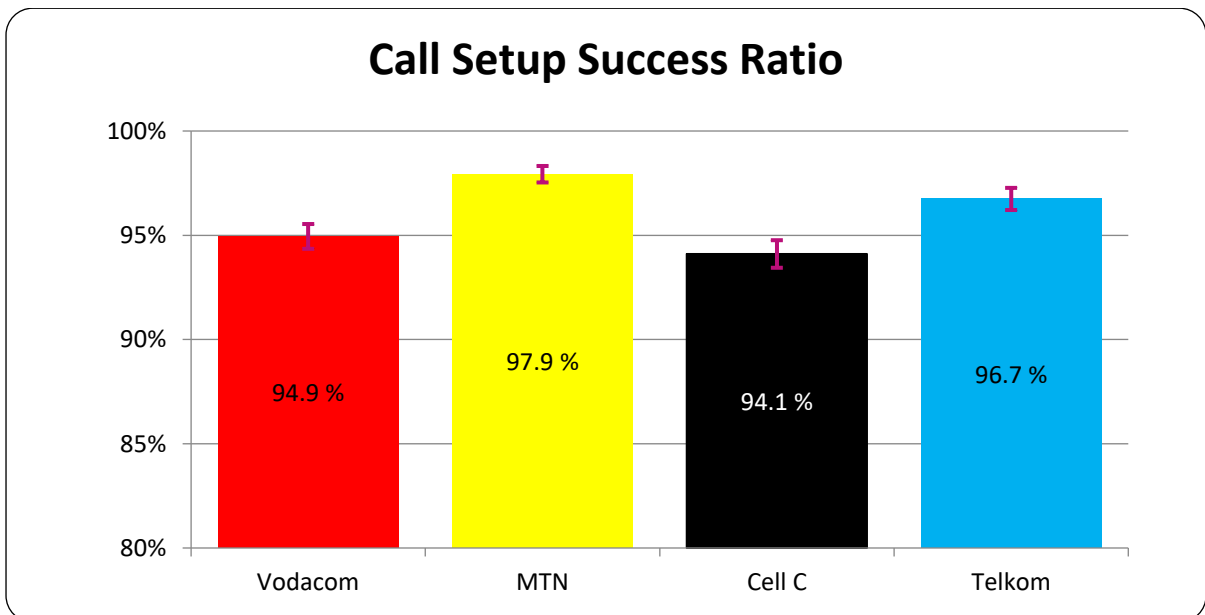
Table 3 shows the voice call measurement results in each route as an overall for all areas for all the operators. Detailed results are presented in Appendix 6.

**3.1.1 Call Setup Success Ratio (CSSR)**



**Figure 2: Call Setup Success Ratio (CSSR) per Route**

Figure 2 shows that MTN met the 98% CSSR target in three areas and Vodacom in two areas. MTN met the CSSR target in Upington, Springbok and Calvinia. Vodacom met the CSSR target in Upington and Springbok. Cell C and Telkom achieved less than 98% CSSR in all five areas.

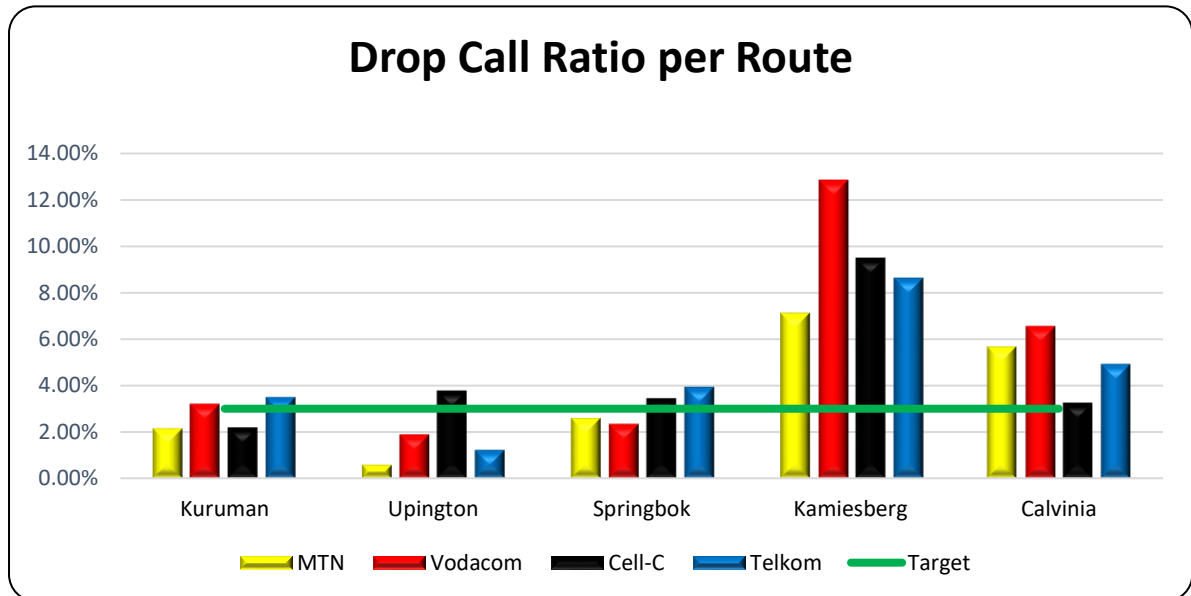


**Figure 3: Overall Call Setup Success Ratio with Statistical Significance**

Figure 3 shows that MTN’s CSSR is the highest, followed by Telkom, Vodacom and Cell C in descending order respective. All operators did not meet the ICASA’s CSSR target of above 98% as per “End-User and Subscribers Service charter

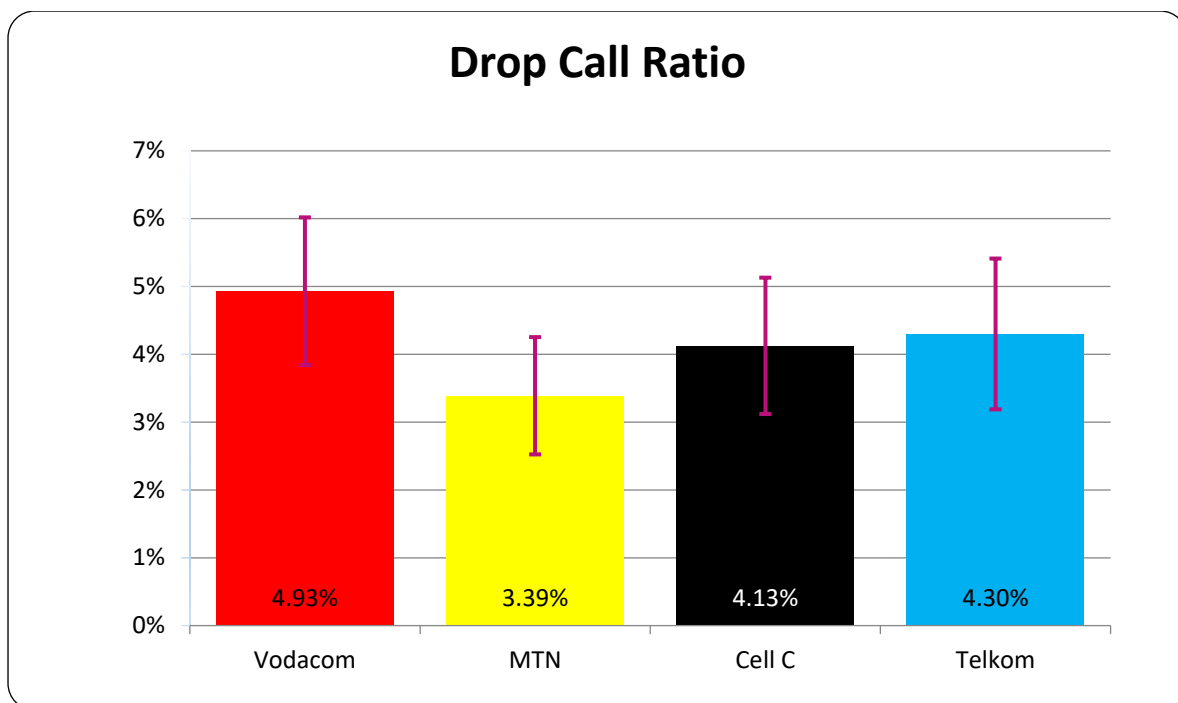
regulations of 2016". MTN's results show statistical significant difference in relation to other operators results. There is no statistical significant difference between Vodacom and Cell C results. Telkom results show a statistically significant difference to the other operators results.

**3.1.2 Drop Call Ratio (DCR)**



**Figure 4: Drop Call Ratio (DCR) per Route**

Figure 4 shows that all operators failed to meet the 3% DCR target in Calvinia and Kamiesberg. MTN met the target in three areas; Kuruman, Upington and Springbok. Vodacom met the target in two areas; Upington and Springbok. Cell C met the target only in Kuruman and Telkom only in Upington. Vodacom recorded the highest DCR value of 12.84% in Kuruman and MTN recorded the lowest DCR value of 0.59% in Upington.

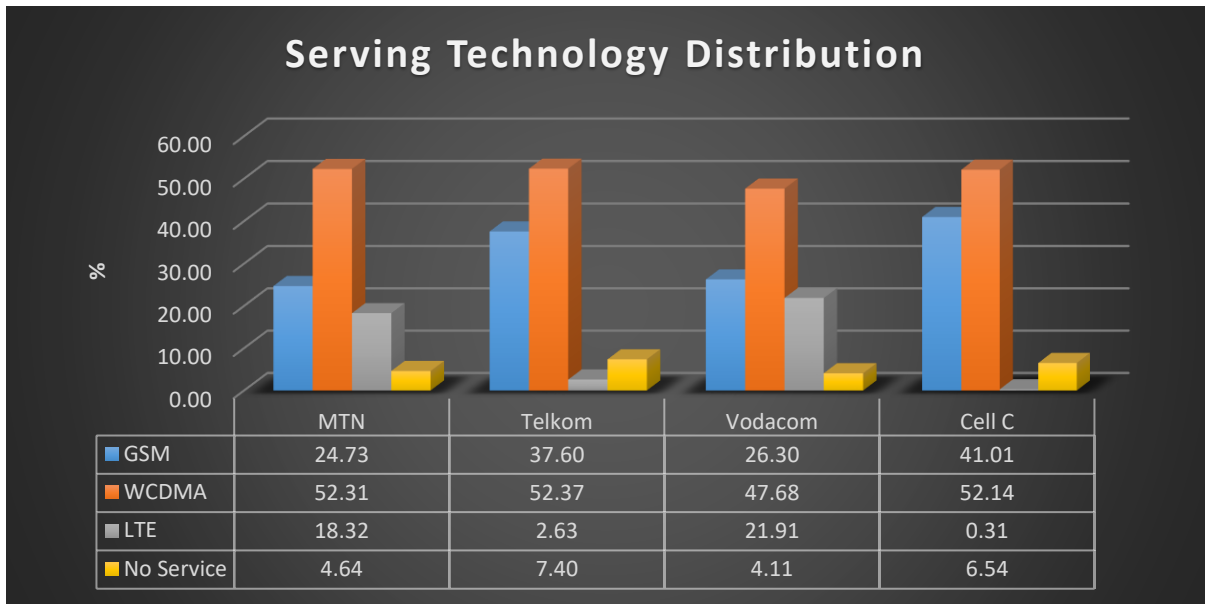


**Figure 5: Total Drop Call Ratio with Statistical Significance**

Figure 5 shows that MTN’s DCR is the lowest followed by Cell C, Telkom and Vodacom in ascending order respectively. All operators failed to meet the 3% DCR target. There was no statistically significant difference in results between all operators. The highest recorded DCR was Vodacom’s with 4.93% and MTN was the lowest with 3.39%.

### 3.2 Analysis of the serving technology

Figure 6 shows the statistical distribution of the serving technology during the drive test. The serving technology distribution were based on the device used and the network parameter configuration which varies with the mobile operators. MTN and Vodacom serving technology distribution was mainly on WCDMA technologies, while Cell C and Telkom distribution was on both GSM and WCDMA technologies.



**Figure 6: Technology Distribution**

The maps in Appendix 6.3.1 show the geographic areas where the radio access technology was selected by the mobile device.

#### **4 CONCLUSION**

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

The results indicate that the end user’s quality of service and operators’ network performance varies significantly on per location basis.

The results show that in terms of overall Call Setup Success Ratio, all operators achieved less than the 98% CSSR values and thus failed to meet the Accessibility target. In terms of the overall Drop Call Ratio, all operators did not achieve the less than 3% in the DCR values and thus failed to meet the Retainability target.

## 5 APPENDICES

### 5.1 Appendix A: Detailed test results

Table 4: Drop call ratio (DCR) per Route

Route Name	Operator	Phase 1			Phase 2			Total		
		Call Established	Call Dropped	DCR (%)	Call Established	Call Dropped	DCR (%)	Call Established	Call Dropped	DCR (%)
Kuruman	Telkom	139	1	0.72%	148	9	6.08%	287	10	3.48%
	Cell C	199	4	2.01%	210	5	2.38%	409	9	2.20%
	Vodacom	207	11	5.31%	258	4	1.55%	465	15	3.23%
	MTN-SA	245	0	0.00%	219	10	4.57%	464	10	2.16%
Upington	Telkom	188	1	0.53%	58	2	3.45%	246	3	1.22%
	Cell C	173	7	4.05%	144	5	3.47%	317	12	3.79%
	Vodacom	184	5	2.72%	132	1	0.76%	316	6	1.90%
	MTN	193	0	0.00%	145	2	1.38%	338	2	0.59%
Springbok	Telkom	130	5	3.85%	150	6	4.00%	280	11	3.93%
	Cell C	133	4	3.01%	156	6	3.85%	289	10	3.46%
	Vodacom-SA	140	4	2.86%	115	2	1.74%	255	6	2.35%
	MTN	143	3	2.10%	164	5	3.05%	307	8	2.61%
Kamiesberg	Telkom	126	12	9.52%	95	7	7.37%	221	19	8.60%
	Cell C	112	13	11.61%	131	10	7.63%	243	23	9.47%
	Vodacom	118	18	15.25%	139	15	10.79%	257	33	12.84%
	MTN-SA	143	11	7.69%	166	11	6.63%	309	22	7.12%
Calvinia	Telkom	139	8	5.76%	106	4	3.77%	245	12	4.90%
	Cell C	137	4	2.92%	108	4	3.70%	245	8	3.27%
	Vodacom	133	10	7.52%	95	5	5.26%	228	15	6.58%
	MTN	146	7	4.79%	118	8	6.78%	264	15	5.68%



**Table 5: Call Setup Success Ratio (CSSR) per Route**

Route Name	Operator	PHASE 1				PHASE 2				TOTAL			
		Call Attempt	Call Setup	User Busy	CSSR (%)	Call Attempt	Call Setup	User Busy	CSSR (%)	Call Attempt	Call Setup	User Busy	CSSR (%)
Kuruman	Telkom	336	327	4	98.49%	424	386	7	92.57%	760	713	11	95.19%
	Cell C	677	588	13	88.55%	800	740	11	93.79%	1477	1328	24	91.40%
	Vodacom	449	418	0	93.10%	754	642	3	85.49%	1203	1060	3	88.33%
	MTN	528	500	3	95.24%	625	596	6	96.28%	1153	1096	9	95.80%
Upington	Telkom	561	550	0	98.04%	354	343	0	96.89%	915	893	0	97.60%
	Cell C	571	549	0	96.15%	366	352	1	96.44%	937	901	1	96.26%
	Vodacom	639	636	1	99.69%	497	495	0	99.60%	1136	1131	1	99.65%
	MTN	643	640	0	99.53%	504	502	0	99.60%	1147	1142	0	99.56%
Springbok	Telkom	454	434	4	96.44%	429	415	4	97.65%	883	849	8	97.03%
	Cell C	457	432	0	94.53%	442	419	0	94.80%	899	851	0	94.66%
	Vodacom	474	466	0	98.31%	546	534	2	98.16%	1020	1000	2	98.23%
	MTN	484	474	0	97.93%	527	520	1	98.86%	1011	994	1	98.42%
Kamiesberg	Telkom	454	434	5	96.66%	503	475	4	95.19%	957	909	9	95.89%
	Cell C	411	377	4	92.63%	383	356	3	93.68%	794	733	7	93.14%
	Vodacom	455	421	2	92.94%	499	478	0	95.79%	954	899	2	94.43%
	MTN	259	254	0	98.07%	467	452	2	97.20%	726	706	2	97.51%
Calvinia	Telkom	447	438	0	97.99%	333	326	0	97.90%	780	764	0	97.95%
	Cell C	450	437	0	97.11%	324	313	0	96.60%	774	750	0	96.90%
	Vodacom	508	478	0	94.09%	389	371	0	95.37%	897	849	0	94.65%
	MTN	527	521	0	98.86%	419	409	0	97.61%	946	930	0	98.31%

## **5.2 Appendix B: Summary of operators' feedback**

A summary of the response received from operators is provided below.

### **5.2.1 Cell C**

Cell C highlighted the lack of its own network coverage in some of the areas tested. In order to provide Cell C subscriber with good quality of service, Cell C relies on its national roaming arrangement with Vodacom in addition to its own network coverage.

Cell C's plans and remedies to improve the low performance areas include the following:

- Cell C has project plans for the future to have site roll-out, capacity and transmission routes improved and optimised in the low performing areas.
- Cell C is further testing seamless handover with its roaming partner Vodacom.
- Kuruman route – three sites are planned for 2018 and additional site in 2020.
- Upington route – six sites are planned for 2018 and 2 additional sites in 2020. Two sites upgrade in Kakamas and Keimoes planned for 2018/19.
- Kamiesberg – New site planned in Garies.
- Calvinia – Cell C relies on Vodacom roaming outside the towns.
- Springbok – two new sites planned in built-up areas.

### **5.2.2 MTN**

MTN did not provide a response within a time specified.

### **5.2.3 Telkom**

Telkom gave the following response to the Authority's draft report:

- ICASA's drive tests give a snapshot of network performance on the specific day and time and is not a true representation of the overall network performance. Nevertheless, Telkom views the test results as very significant and use them as additional input to further improve the quality of the mobile network.
- Out of all areas tested, Telkom has deployed a mobile network only in Upington. In all other tested areas, Telkom depends on its roaming partner for coverage.

- Telkom has planned six (6) sites in Upington and five (5) in Kuruman. These sites are awaiting integration, which will take approximately nine (9) months to deploy.
- In Calvinia, Kamiesberg and Springbok, Telkom has currently no sites planned and will depend on MTN to provide service to customers.

Telkom will continue to optimize the network to resolve quality related issues on both UMTS and GSM and continue to engage with its roaming partner regarding service improvements in the affected area.

#### **5.2.4 Vodacom**

Vodacom acknowledges that it is proving to be costly and difficult to provide adequate coverage in this area because of the sparse population, terrain and general lack of infrastructure; and shared the following remedial actions:

- Kuruman route – Plans for U900 layer addition to improve 3G coverage. New sites rollout and site sectorisation to be completed by June 2018.
- Upington route – Planned RF optimisation and U900 layer addition to improve coverage by March 2018.

Vodacom further noted the following:

- High percentage of these failures occurred outside of the Vodacom advertised coverage.

For the areas that are outside of coverage, Vodacom is waiting for budget to be allocated under Rural coverage and exploring other alternative solutions. These solutions will take a minimum of 6 months to be implemented.

5.3 Appendix C: Coverage maps

5.3.1 Serving technology maps

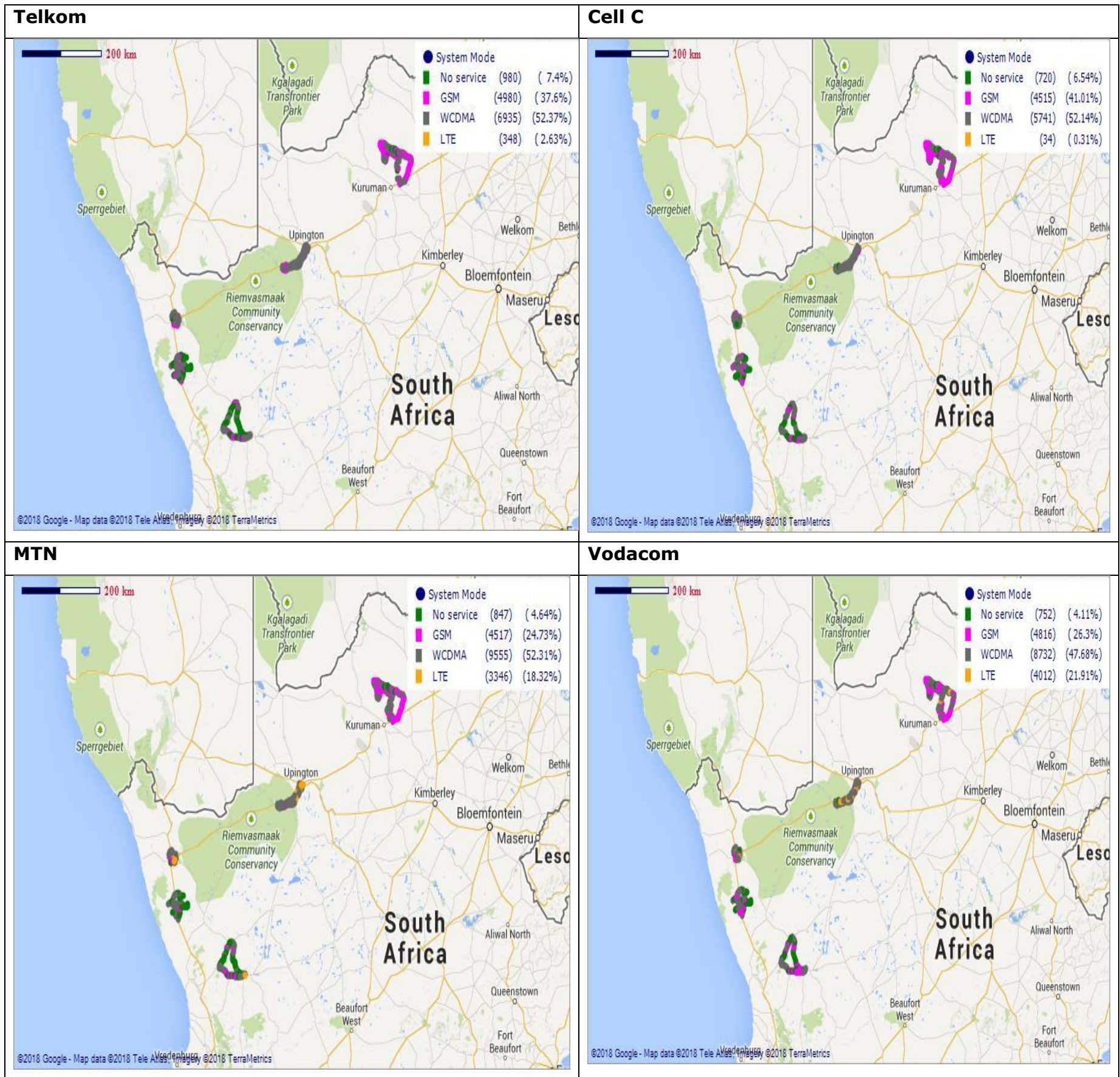


Figure 7: Northern Cape Province Serving Technology Plot

