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# **Quality of Service Report:**

## **North West Province**

### **2017/2018 Quarter 2**

# Contents

<b>EXECUTIVE SUMMARY .....</b>	<b>3</b>
<b>1 INTRODUCTION.....</b>	<b>5</b>
<b>2 METHODOLOGY.....</b>	<b>6</b>
2.1 Drive test equipment.....	6
2.2 Route Selection.....	7
2.3 Equipment test setup and configuration .....	7
2.4 Statistical significance.....	9
2.5 Measurement parameters and targets.....	10
2.5.1 Parameter Targets .....	10
2.5.2 Drop-Call Ratio.....	10
2.5.3 The Call Setup Success Ratio.....	10
<b>3 RESULTS AND ANALYSIS.....</b>	<b>11</b>
3.1 Accessibility and Retainability Measurements.....	11
3.1.1 Call Setup Success Ratio (CSSR) .....	12
3.1.2 Drop Call Ratio (DCR) .....	13
3.2 Analysis of the serving technology.....	14
<b>4 RESPONSES TO MEASUREMENT RESULTS FROM OPERATORS .....</b>	<b>15</b>
<b>5 CONCLUSION .....</b>	<b>15</b>
<b>6 APPENDIXES.....</b>	<b>16</b>
6.1 Appendix A: Drive Test Results KPI's.....	16
6.2 Appendix B: Summary of operators' responses.....	18
6.2.1 Cell C.....	18
6.2.2 MTN .....	18
6.2.3 Vodacom.....	19
6.3 Coverage Maps.....	21
6.3.1 Serving Technology Details.....	21

## **List of Acronyms**

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 offered by the mobile operators in North West Province. The measurements were carried out in the period 31 July to 22 August 2017 and covered a total distance of over 2500 km.

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 services are 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 Makapanstad, Moretele, Letlhabile, Ventersdorp and Potchefstroom.

A vehicle equipped with a 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 the 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 Telkom met the 98% CSSR target in Makapanstad but failed to meet the target in Moretele, Letlhabile, Ventersdorp and Potchefstroom. Cell C met the CSSR target in Potchefstroom but failed to meet the target in Makapanstad, Moretele, Letlhabile and Ventersdorp. Vodacom met the target in Ventersdorp and Potchefstroom but failed in Makapanstad, Moretele and Letlhabile. MTN met the CSSR target in all tested areas except for Moretele.

Telkom met the Retainability target of below 3% in four areas (Makapanstad, Moretele, Ventersdorp and Potchefstroom) except Letlhabile. Cell C failed to meet the target in four areas (Makapanstad, Moretele, Letlhabile and Ventersdorp), but met the target in Potchefstroom. Vodacom met the target in Ventersdorp and Potchefstroom but failed in Makapanstad, Moretele and Letlhabile. MTN failed to

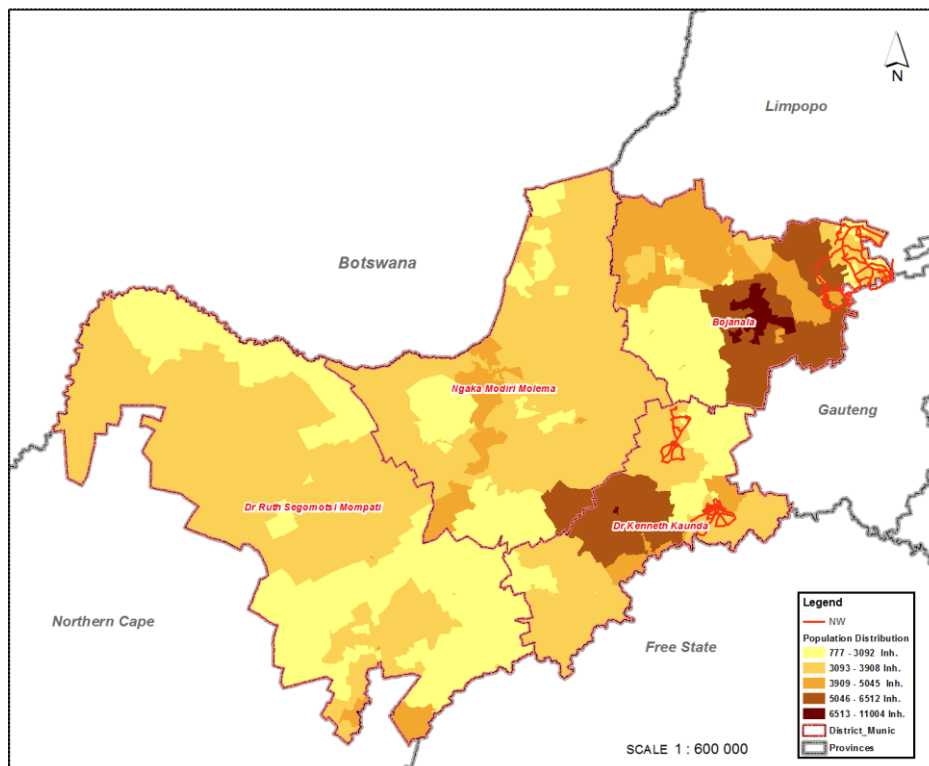
meet the DCR target in all areas (Makapanstad, Letlhabile, Ventersdorp and Potchefstroom) except Moretele.

In terms of the overall results of the areas covered in North West, all the operators' CSSR values were less than 98% and therefore they did not meet the Accessibility target. Only Telkom's DCR was below 3%, thus meeting the Retainability target. Cell C, MTN and Vodacom failed to meet the DCR 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 North West Province of South Africa.

North West covers an area of 104 882km<sup>2</sup> and has a population of 3 748 436. Mahikeng (previously Mafikeng) is the capital. The city lies near the Botswana border and forms a single urban area with its neighbouring town, Mmabatho. Potchefstroom and Klerksdorp are the biggest cities in the province. Other main towns are Brits, Rustenburg and Lichtenburg<sup>2</sup>. Figure 1 below shows the drive test routes covered during this period.



**Figure 1: North West Province Route Map**

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

<sup>2</sup> <http://www.localgovernment.co.za/provinces/view/8/north-west>

The QoS monitoring was conducted in the areas within Dr Kenneth Kaunda and Bojanala district municipalities. The selected areas include Makapanstad, Moretele, Letlhabile, Ventersdorp and Potchefstroom. 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 Ratio (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 Ratio (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 on the 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 ECG 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	District	Route Name	Dates
Accessibility and Retainability	Bojanala	Makapanstad	31/07/2017 15/08/2017 21/08/2017
		Moretele	01/08/2017 22/08/2017
		Letlhabile	02/08/2017 16/08/2017
	Dr Kenneth Kaunda	Ventersdorp	03/08/2017 17/08/2017
		Potchefstroom	04/08/2017 18/08/2017

## 2.3 Equipment test setup and configuration

Table 2 below 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 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 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. TEMS Discovery Device professional 12.0.4 was used to analyse the log files.
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 60km/h in town and built-up areas, and an average of 100km/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 number of 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 following test areas: Makapanstad, Moretele, Letlhabile, Ventersdorp and Potchefstroom.

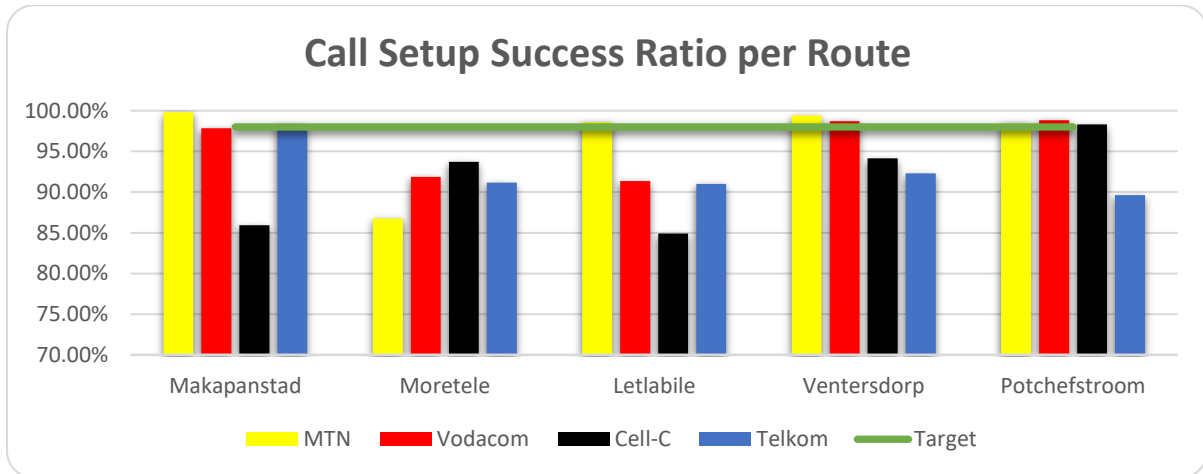
#### 3.1 Accessibility and Retainability Measurements

**Table 3: Summary of Results**

Route Name	Operator	CSSR	DCR
<b>Makapanstad</b>	Telkom	98.25%	0.33%
	Cell C	85.92%	4.29%
	Vodacom	97.84%	3.79%
	MTN	99.82%	3.25%
<b>Moretele</b>	Telkom	91.14%	0.96%
	Cell C	93.71%	3.21%
	Vodacom	91.85%	7.94%
	MTN	86.75%	0.89%
<b>Letlhabile</b>	Telkom	90.99%	4.42%
	Cell C	84.90%	5.00%
	Vodacom	91.34%	4.60%
	MTN	98.58%	4.38%
<b>Ventersdorp</b>	Telkom	92.29%	1.37%
	Cell C	94.16%	3.59%
	Vodacom	98.72%	1.01%
	MTN	99.42%	4.17%
<b>Potchefstroom</b>	Telkom	89.62%	2.91%
	Cell C	98.30%	1.39%
	Vodacom	98.83%	2.93%
	MTN	98.42%	3.19%
<b>Overall for the above 5 areas</b>	Telkom	92.31%	2.23%
	Cell C	91.40%	3.51%
	Vodacom	95.29%	3.74%
	MTN	96.01%	3.34%

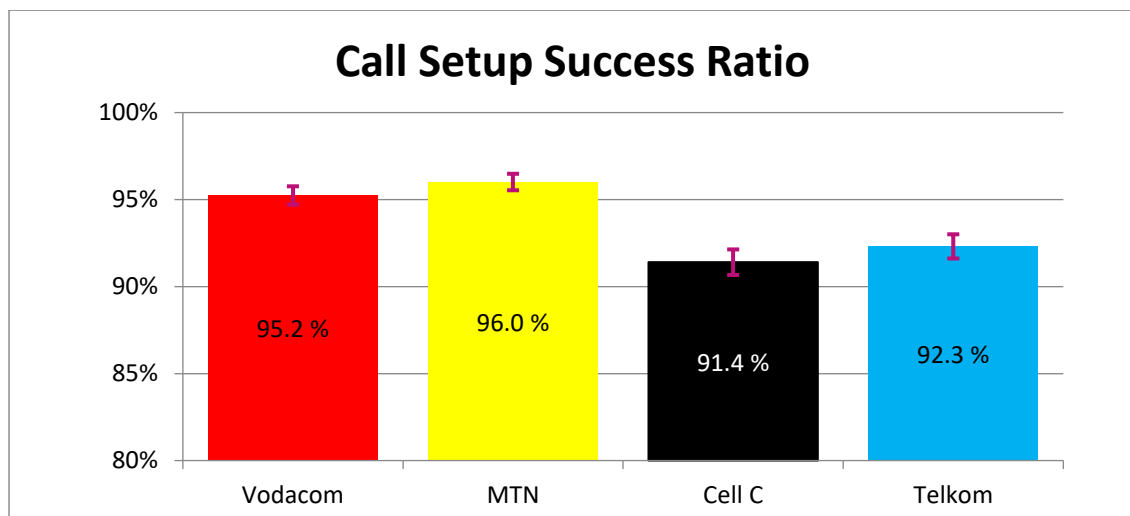
Table 3 above shows voice call measurement results in each route and as an overall for all areas for all the operators. Additional KPIs are presented in the Appendix 5.

### 3.1.1 Call Setup Success Ratio (CSSR)



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

Figure 2 above shows that Telkom met the 98% CSSR target in Makapanstad but failed to meet the target in Moretele, Letlhabile, Ventersdorp and Potchefstroom. Cell C met the CSSR target in Potchefstroom but failed to meet the target in Makapanstad, Moretele, Letlhabile and Ventersdorp. Vodacom met the target in Ventersdorp and Potchefstroom but failed in Makapanstad, Moretele and Letlhabile. MTN met the CSSR target in all tested areas except for Moretele.

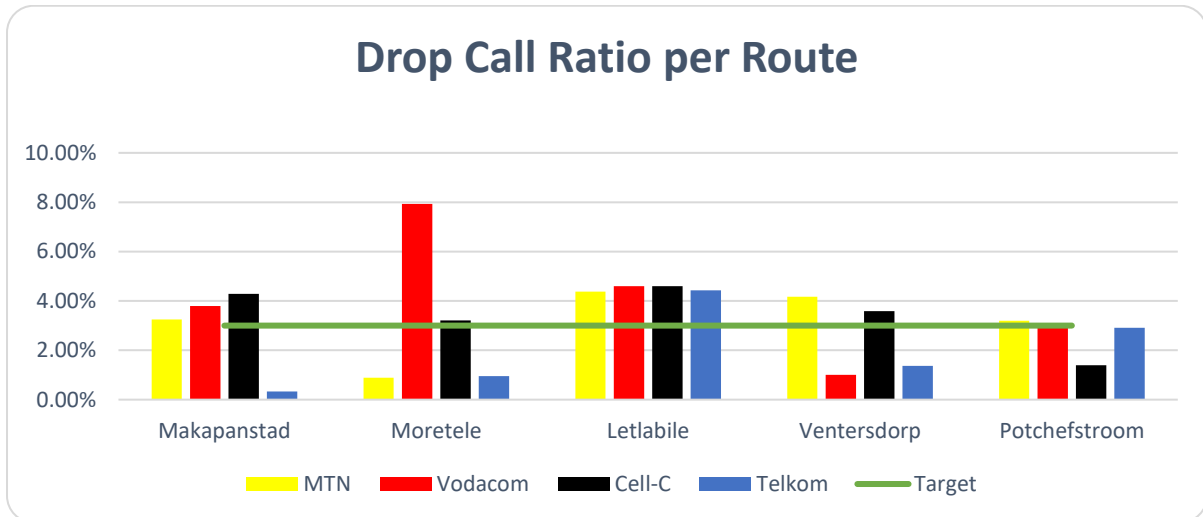


**Figure 3: Overall Call Setup Success Ratio with Statistical Significance**

Figure 3 above shows that MTN's overall CSSR is the highest, followed by Vodacom, Telkom and Cell C in a descending order. None of the operators met

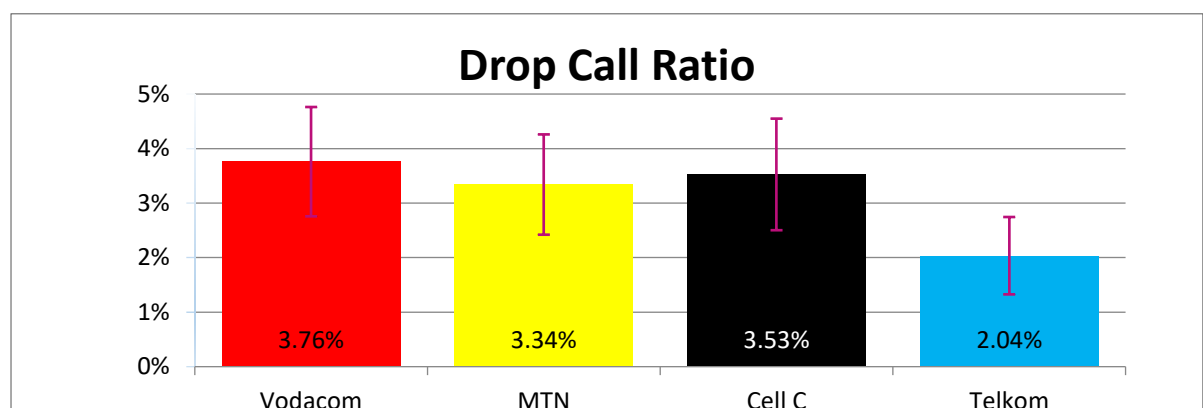
ICASA’s CSSR target of above 98% as per “End-User and Subscribers Service charter regulations of 2016”. There was no statistical significant difference between MTN and Vodacom results nor between Telkom and Cell C. MTN recorded the highest CSSR of 96.0% and Cell C was the lowest with 91.4%.

### 3.1.2 Drop Call Ratio (DCR)



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

Figure 4 above shows that Telkom met the below 3% DCR target in all areas (Makapanstad, Moretele, Ventersdorp and Potchefstroom) except Letlhabile. Cell C failed to meet the target in four areas (Makapanstad, Moretele, Letlhabile and Ventersdorp), but met the target in Potchefstroom. Vodacom met the target in Ventersdorp and Potchefstroom but failed in Makapanstad, Moretele and Letlhabile. MTN failed to meet the DCR target in all areas (Makapanstad, Letlhabile, Ventersdorp and Potchefstroom) except Moretele.

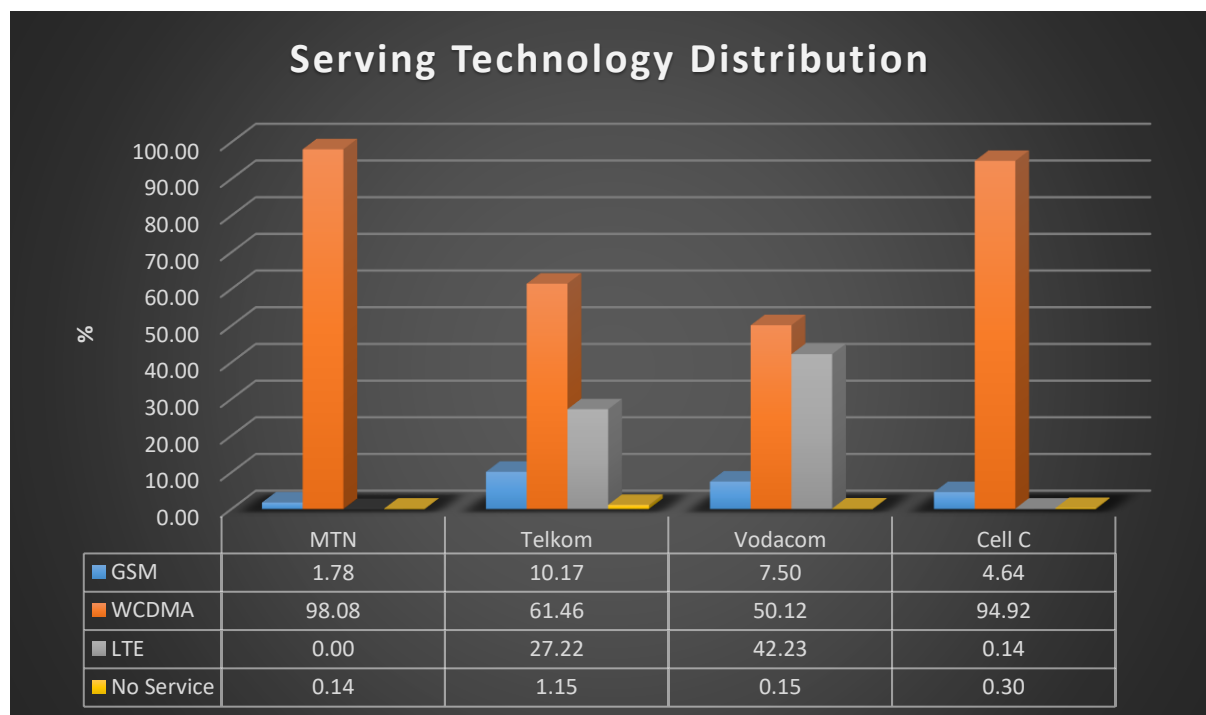


**Figure 5: Total Drop Call Ratio with Statistical Significance**

Figure 5 above shows that Telkom’s overall DCR is the lowest followed by MTN, Cell C and Vodacom in the respective ascending order. Only Telkom met ICASA’s 3% DCR target. There is no statistical significant difference recorded between Telkom, Cell C and MTN results. However, there is a statistical significant difference recorded between Telkom and Vodacom.

### 3.2 Analysis of the serving technology

The serving technology distribution were based on the devices used and the network parameter configuration which varies with the mobile operators. The percentage distribution represents the fraction sampling points, out of the total of sampling points for all results, where the system was on a radio access technology. Figure 6 below shows the statistical distribution of the serving technology during the drive test. Telkom, MTN and Cell C serving technology distribution was mainly on WCDMA while Vodacom distribution was on both WCDMA and LTE 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 RESPONSES TO MEASUREMENT RESULTS FROM OPERATORS**

A draft report similar to section 1, 2, 3, 5 and 6 of this report, was provided to operators for their comments. Also provided were the log files with all measurement results. The information enables operators to critically review the Authority's measurements and to give comments on that, as well as a network improvement plan. The responses from the operators are summarised in Appendix 6.2.

## **5 CONCLUSION**

This section provides the summary and 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 context.

The results indicate that the End-Users Quality of Service and operators' network performance varies significantly on per location basis.

It must be noted that the Authority experienced intermittent network coverage problems on the 22 August 2017 during the quarterly drive test around areas in Moretele, between 10h00 until 19h30.

Intermittent network coverage was experienced on two major network providers MTN and Vodacom. Both operators were immediately informed. Vodacom's and MTN's response was that they share most sites in the area and they both experienced major power failure in the area on the day of the drive test, thus affecting their transmission.

After benchmarking the operators, the results show that in terms of overall Call Setup Success Ratio, all operators' results were below the target of 98%, thus Accessibility target was not met. In terms of overall Drop Call Ratio, only Telkom met the DCR target of less than 3%, thus meeting the Retainability target. Cell C, MTN and Vodacom failed to meet the DCR target.



## 6 APPENDIXES

### 6.1 Appendix A: Drive Test Results KPI's

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
Makapanstad	Telkom	139	0	0.00%	164	1	0.61%	303	1	0.33%
	Cell C	113	6	5.31%	120	4	3.33%	233	10	4.29%
	Vodacom	131	2	1.53%	133	8	6.02%	264	10	3.79%
	MTN	128	0	0.00%	149	9	6.04%	277	9	3.25%
Moretele	Telkom	320	3	0.94%	0	0	0%	320	3	0.96%
	Cell C	156	5	3.21%	0	0	0%	156	5	3.21%
	Vodacom	189	15	7.94%	0	0	0%	189	15	7.94%
	MTN	224	2	0.89%	0	0	0%	224	2	0.89%
Lethabile	Telkom	183	1	0.55%	156	14	8.97%	339	15	4.42%
	Cell C	169	8	4.73%	151	8	5.30%	320	16	5.00%
	Vodacom	202	3	1.49%	124	12	9.68%	326	15	4.60%
	MTN	223	1	0.45%	142	15	10.56%	365	16	4.38%
Ventersdorp	Telkom	144	3	2.08%	148	1	0.68%	292	4	1.37%
	Cell C	122	4	3.28%	129	5	3.88%	251	9	3.59%
	Vodacom	155	0	0.00%	142	3	2.11%	297	3	1.01%
	MTN	150	4	2.67%	138	8	5.80%	288	12	4.17%
Potchefstroom	Telkom	130	2	1.54%	145	6	4.14%	275	8	2.91%
	Cell C	148	0	0.00%	140	4	2.86%	288	4	1.39%
	Vodacom	156	1	0.64%	151	8	5.30%	307	9	2.93%
	MTN	164	2	1.22%	149	8	5.37%	313	10	3.19%

**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 (%)
Makapanstad	Telkom	429	421	0	98.14%	598	588	0	98.33%	1027	1009	0	98.25%
	Cell C	365	345	0	94.52%	551	442	0	80.22%	916	787	0	85.92%
	Vodacom	412	401	0	97.33%	605	594	0	98.18%	1017	995	0	97.84%
	MTN	439	438	0	99.77%	650	649	0	99.85%	1089	1087	0	99.82%
Moretele	Telkom	657	630	0	95.89%	540	461	0	85.37%	1197	1091	0	91.14%
	Cell C	722	691	0	95.71%	582	531	0	91.24%	1304	1222	0	93.71%
	Vodacom	796	757	0	95.10%	720	629	7	88.22%	1516	1386	7	91.85%
	MTN	843	673	0	79.83%	750	709	0	94.53%	1593	1382	0	86.75%
Letlhabile	Telkom	634	568	0	89.59%	731	674	0	92.20%	1365	1242	0	90.99%
	Cell C	630	533	0	84.60%	668	569	0	85.18%	1298	1102	0	84.90%
	Vodacom	765	743	0	97.12%	683	576	4	84.83%	1448	1319	4	91.34%
	MTN	774	758	0	97.93%	845	838	0	99.17%	1619	1596	0	98.58%
Ventersdorp	Telkom	459	424	0	92.37%	527	486	0	92.22%	986	910	0	92.29%
	Cell C	511	455	0	89.04%	482	480	0	99.59%	993	935	0	94.16%
	Vodacom	540	535	0	99.07%	551	542	0	98.37%	1091	1077	0	98.72%
	MTN	535	533	0	99.63%	502	498	0	99.20%	1037	1031	0	99.42%
Potchefstroom	Telkom	514	449	0	87.35%	555	509	0	91.71%	1069	958	0	89.62%
	Cell C	532	516	0	96.99%	587	584	0	99.49%	1119	1100	0	98.30%
	Vodacom	593	585	0	98.65%	601	595	0	99.00%	1194	1180	0	98.83%
	MTN	583	576	0	98.80%	620	608	0	98.06%	1203	1184	0	98.42%

## **6.2 Appendix B: Summary of operators' responses**

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

### **6.2.1 Cell C**

Cell C highlighted the lack of its own networks' coverage in some of the areas tested. In these areas Cell C relies on national roaming arrangements with Vodacom's network. In summary, the poor performance was attributed to the following:

- Lack of seamless roaming/handover between the Cell C and Vodacom networks. Cell C relies on its national roaming arrangement with Vodacom in some of the areas specified in the Authority's report. Roaming provides coverage where Cell C's own network does not have coverage.

Cell C's plans and remedies in the low performance areas include:

- 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.
- New sites are planned to be built in poor performing areas.

### **6.2.2 MTN**

MTN submitted the following remedial action to address poor coverage and service quality in the areas:

- Makapanstad route – Down tilting has been done on one site in order to reduce pilot pollution on the 3G network.
- Lephalale route – Two new sites are planned to improve coverage.
- Letlhabile route – The operator is in the process of upgrading two sites, and an additional new site is awaiting integration. These improvements will improve capacity and coverage in the area.

- Ventersdorp route – Addition of a new site is being prioritised to address lack of coverage on the outskirts of the area. In addition, two other sites have undergone optimisation.
- Potchefstroom route – Three sites have been optimised and an additional new site is planned south of Wilgeboom.

Since the time the Authority conducted the drive tests, MTN has initiated a process to add three new sites and has upgraded two existing sites and conducted optimisation of six cells to address coverage and quality aspects.

### **6.2.3 Vodacom**

Vodacom submitted that it has reviewed the Authority report and shared the following remedial action to address poor coverage and quality of service in the areas:

- Moretele and Makapanstad – Two new sites are planned and projected on air date is in September 2018.
- Lethabile – eight new sites are planned and projected on air dates are in January, June and September 2018.
- There is no 3G coverage in the Tladistad, Kgomo-Kgomo and Makapanstad areas but sites are planned to resolve the QoS issues.

### **6.2.4 Telkom**

Telkom is generally pleased with the test results conducted in the North West Province. This was because Telkom was the only operator that met the Authority's KPI measurement for the overall Drop Call Ratio (DCR) of less than 3% in the tested areas, thus meeting the retainability target. The operator also highlighted the following in its response:

- As a fourth entrant in the mobile market, the operator depends on national roaming agreement with MTN to cater for areas with limited or no Telkom coverage. Telkom acknowledges that the roaming agreement is particularly

important as it doesn't have access to the 900 MHz frequency band, while Vodacom, MTN and Cell C has the 900 MHz spectrum.

- Telkom has already planned additional sites in both Makapanstad and Moretele areas, which are in the Initial Site Survey and Build phase. These additional sites will further improve coverage and quality of services.
- In Ventersdorp area, Telkom currently does not have any sites planned and will therefore continue to depend on the roaming partner to serve their customers.
- Telkom currently does not have any planned sites within the Letlhabile, Ventersdorp and Potchefstroom areas. However, Telkom will work on improving coverage in these areas through either planning more sites or engaging with their roaming partner to improve the quality of service provisioning to their customers.
- Telkom reiterated that their current Service Level Agreement with the roaming partner does not discriminate between Telkom and MTN customers in terms of the quality of service provisioning and applies on a national basis. Telkom therefore expects their customers to enjoy a similar QoS as experienced by MTN customers.

### 6.3 Coverage Maps

#### 6.3.1 Serving Technology Details

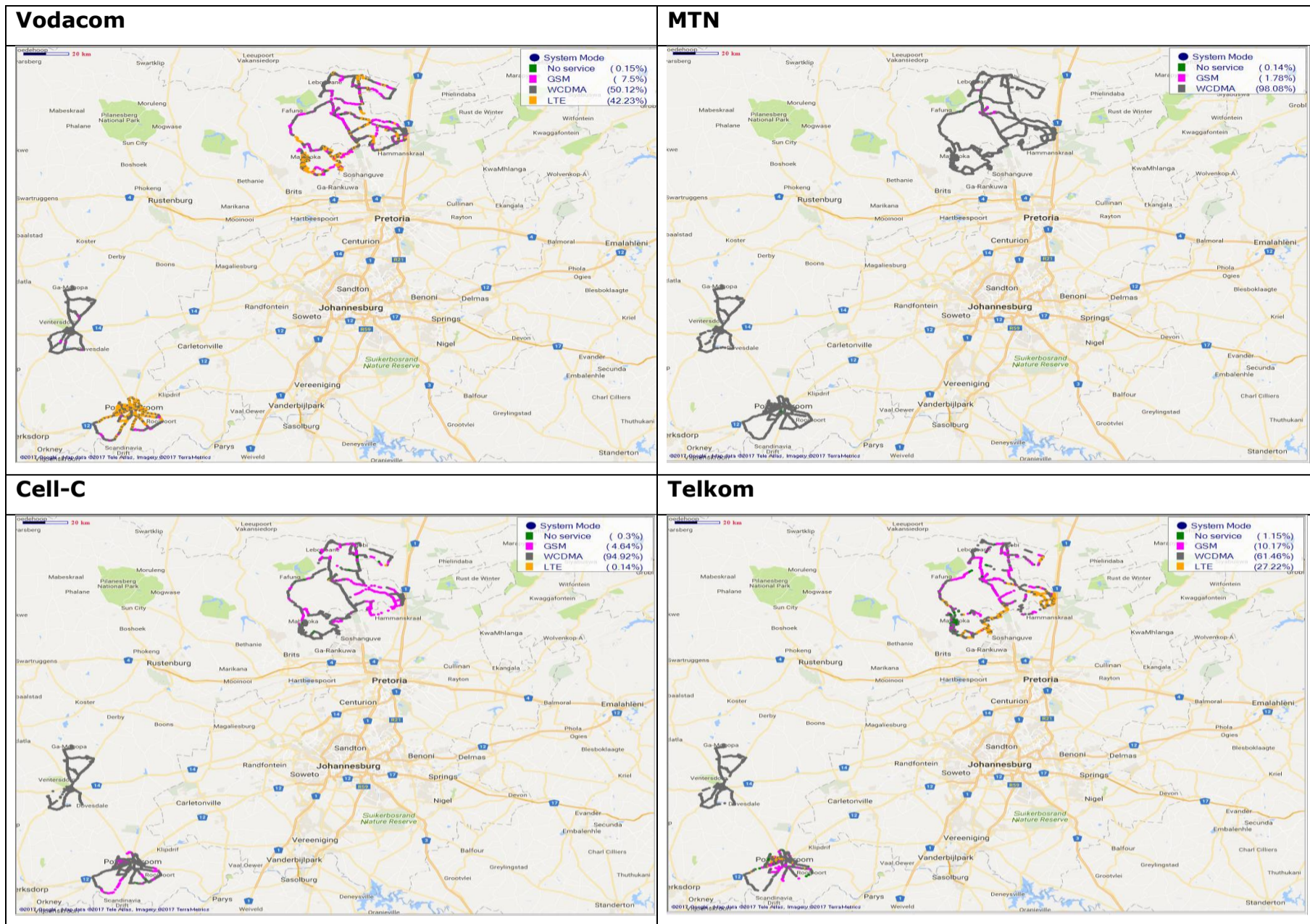


Figure 7: North West Province Serving Technology Plots