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2020/2021 Quarter 3:

Mobile Data Quality of Service

Report – Mpumalanga Province

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List of Abbreviations

GSM   Global System for Mobile Communications

ICASA   Independent Communications Authority of South Africa

KPI   Key Performance Indicator

LTE   Long Term Evolution

QoS   Quality of Service

UMTS   Universal Mobile Telecommunication Service

WCDMA   Wideband Code Division Multiple Access

1 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 data services offered by the mobile operators in Mpumalanga Province. The measurements were carried out in the period 19 to 30 October 2020, covering a total distance of over 1700 km.

The purpose of performing QoS measurements was to monitor and analyse the quality of mobile data service as experienced by the end user. The measurements were conducted in areas and in circumstances where mobile data services are likely to be accessed. The sampled areas include Boschfontein, Mbombela, Acornhoek, Bushbuckridge and Hazyview.

A vehicle equipped with Keysight Nemo Autonomous measurement tool including eight mobile phones were used to collect data in mobility conditions. Four Key Performance Indicators (KPIs) used to evaluate QoS for mobile data services are HTTP download throughput, FTP download throughput, FTP upload throughput and Latency. The devices were set to 4G (LTE) preferred mode during Phase 1 measurements (19 -23 October 2020) and 3G preferred mode measurements were conducted during Phase 2 (26 - 30 October 2020).

This report is structured as follows:

Section 2 of the report provides an introduction, the purpose of the benchmark and the areas selected for testing.

Section 3 the report provides quality control measures implemented throughout the testing process and selected test cases. The test cases were selected to align with accepted international best practice based on the SABS standard: SANS 1725-2:2019 End user related Quality of Service parameter definitions and measurements, Part 2: Mobile data services and the European Telecommunications Standards Institute (ETSI) TS 102 250-2 V2.5.1 standards.

Section 4 provides the customer experience oriented Key Performance Indicators (KPIs) results aggregated for the areas tested.

Section 5 the report provides the summarised findings of the results in all the tested areas.

In terms of overall results for 3G preferred, MTN leads in HTTP download and FTP upload throughput. MTN achieved the lowest overall Latency.

In terms of overall results, MTN leads in 4G HTTP download throughput, FTP download, FTP upload throughput and Latency.

The monitoring was based on the South African Bureau of Standards (SABS)

Standard SANS 1725-2:2019.

2 Introduction

ICASA's mandated is to regulate electronic communications, broadcasting and postal services in the public interest; and more specifically to ensure fairness and the plurality of views broadly representing the South African society as required in terms of the Constitution.[1] The Authority ensures quality of service through its Quality of Service (QoS) monitoring activities. The Authority conducted QoS monitoring of the mobile data service being offered by Cell C, MTN, Vodacom and Telkom within the Mpumalanga Province of South Africa.

Mpumalanga is the second-smallest province in South Africa after Gauteng, covering an area of 76 495 km² and has a population of 4 335 964 people. It is bordered by Swaziland and Mozambique to the east and Limpopo, Gauteng, Free State and KwaZulu-Natal within South Africa. Mbombela (previously Nelspruit) is the capital of the province and the administrative and business Centre of the Lowveld.[2] Other major cities and towns include eMalahleni, Standerton, eMkhondo, Malalane, Ermelo, Barberton and Sabie.

Figure 1 depicts the routes which were drive tested in the Mpumalanga Province.
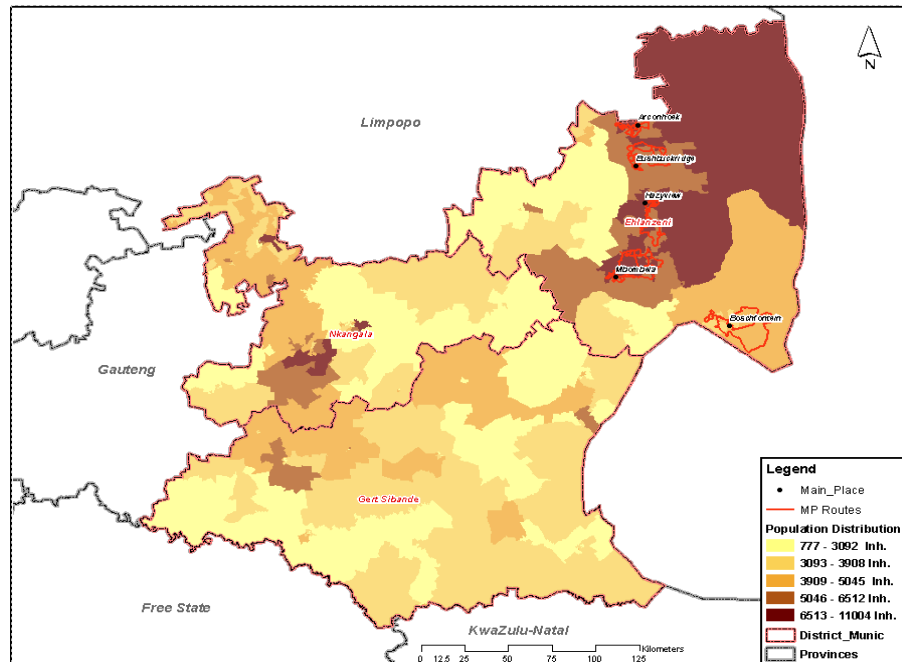
Figure 1. Mpumalanga Province Route Map

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[1] ICASA Strategic Plan 2020/21 – 2024/25

[2] http://www.localgovernment.co.za/provinces/view/6/mpumalanga

3 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 a particular time of the day.

Drive tests are planned to ensure, as far as practicable, that the results adequately reflect the QoS perceived by customers for the period under review. The drive tests are also designed to be representative of the population relative to the traffic of the network. Measurements are scheduled to reflect accurately the traffic variations over the hours of the day and the users' behaviour.

Phase 1 measurements were conducted in 4G-preferred mode. 4G preferred mode/scenario- results are based on an end-user whose user equipment (UE) is Long-Term Evolution (LTE) capable. These devices will select LTE as the serving technology where available and cascade down to UMTS in the absence of LTE and finally select GSM in the absence of both the LTE and UMTS.

Phase 2 measurements were conducted in 3G-preferred mode, i.e. the user equipment (UE) is set to select 3G as the best technology over 2G. The mobile device will revert to 2G in the absence of 3G.

3.1 Test Cases

Table 1 shows the sequence of tests within the methodology used. The mobile was always connected to the data network (PDP always on/always attached) between the different tests, a 10 second pause was added to allow the phone and the network to release any resources used on the previous test.

Table 1: Test Case Methodology Flow Cycle

ICASA BENCHMARKING DATA TESTING METHODOLOGY		
Test Number	**Test Type & Timeout**	**Technology**
		3G/4G Pref
System Band lock (4G or 3G)		
wait 10s		
1	**ICMP PAYLOAD PING 800 BYTES**	
	FILE TRANSFER DOWNLOAD 135s (4G Pref) and 93s (3G Pref)	FTP DL (3MB) -3G Pref FTP DL (5MB) -4G Pref
		wait 10s
2	**ICMP PAYLOAD PING 800 BYTES**	
	FILE TRANSFER UPLOAD 93s (4G Pref) and 51s (3G Pref)	FTP UL (1MB) – 3G Pref FTP UL (3MB) – 4G Pref
		wait 10s
3	**ICMP PAYLOAD PING 800 BYTES**	
	ICMP PING 32 BYTES	Ping (32 bytes) * 5 - www.sobasa.org.za
		wait 10s
4	**ICMP PAYLOAD PING 800 BYTES**	
	ICMP PING 32 BYTES	Ping (32 bytes) * 5 - www.google.co.za
		wait 10s
5	**ICMP PAYLOAD PING 800 BYTES**	
	YOUTUBE STREAMING 90 seconds	Video: YouTube 60sec
		wait 10s
6	**ICMP PAYLOAD PING 800 BYTES**	
	STATIC WEB BROWSING 30s (3G & 4G Pref)	HTTP Browsing: Kepler Mobile
		wait 10s
7	**ICMP PAYLOAD PING 800 BYTES**	
	STATIC WEB BROWSING 45s(4G Pref) & 30s(3G Pref)	HTTP Browsing: Kepler
		wait 10s
8	**ICMP PAYLOAD PING 800 BYTES**	
	LIVE WEB BROWSING 30s (3G & 4G Pref)	NEWS24
		wait 10s
9	**ICMP PAYLOAD PING 800 BYTES**	
	LIVE WEB BROWSING 30s (3G & 4G Pref)	GUMTREE
		wait 10s
10	**ICMP PAYLOAD PING 800 BYTES**	
	FILE TRANSFER DOWNLOAD 135s (4G Pref) and 93s (3G Pref)	HTTP DL (3MB) -3G Pref HTTP DL (5MB) -4G Pref
		wait 10s

3.2 Equipment test setup and configuration

3.2.1 System used

The drive test was carried out using a test kit comprised of four (4) Keysight Nemo Autonomous probes. Each probe has three Samsung Galaxy S8 (SM-G950F) mobile devices; 2 devices for voice service test and one for mobile data test. The mobile devices were configured to automatically select a mobile network and radio access technology based on the test category.

3.3 Route selection

The areas and routes that were tested are shown inTable 2 including the dates driven. The tests were conducted in 3G and 4G preferred modes.

Table 2: Areas tested

District	Route Name	Test Date
Ehlanzeni	Boschfontein	19/10/2020 26/10/2020
	Mbombela	20/10/2020 27/10/2020
	Acornhoek	21/10/2020 28/10/2020
	Bushbuckridge	22/10/2020 29/10/2020
	Hazyview	23/10/2020 30/10/2020

3.4 Test Overview

3.4.1 Measurement Environment

For this campaign, two main environments based on the SABS Standard for data[3], for measurement environments were tested. These tests covered the mobile user simulations. The drive tests align to categories D2, D4 and D5 of the specification.

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[3] SABS standard: SANS 1725-2:2019 End user related Quality of Service parameter definitions and measurements, Part 2: Mobile data services

These data collection environments are explained as follows:

Mobile Drive Test Scenario – Category D2, D4, and D5: The purpose of this scenario is to emulate a nomadic wireless user in mobile conditions. The location types covered by this test scenario were urban areas, rural areas, cities and towns.

3.4.2 Equipment test setup and configuration

Table 3. Test plan and configurations

Configuration	Explanation
Antennas	Device Antennas were used as per SANS 1725-2[4]
Technologies	GSM, UMTS and LTE
Measurement Time	The measurement drive test time was at least six (6) hours per route.
HTTP and FTP File sizes	**4G Preferred:** 5 MB file size for both HTTP and FTP Download and 3 MB for FTP Upload. **3G Preferred:** 3 MB file size for both HTTP and FTP Download and 1 MB for FTP Upload.
Equipment	The equipment used for testing was the Keysight Nemo Autonomous probe with 3 x Samsung Galaxy S8[5] (SM-G950F) phones in each probe.

KPI[6]	The measurements focused on the following network parameters:
	    (i) HTTP Download Throughput
	    (ii) FTP Download Throughput
	    (iii) FTP Upload Throughput
	    (iv) Latency/Ping

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. Nemo Analyzer was used to analyse the log files.

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[4] SANS 1725-2:2019 End user related Quality of Service parameter definitions and measurements, Part 2: Mobile data services

[5] Samsung Galaxy S8 is a Cat 9, Android smartphones for the simultaneous measurement of cellular voice and cellular data services. It was bundled in a Nemo Drive Test tool kit, has special software and firmware designed specifically for drive tests.

[6] SABS standard: SANS 1725-2:2019 End user related Quality of Service parameter definitions and measurements, Part 2: Mobile data services

Network tested	Cell C, MTN, Vodacom and Telkom.
SIM cards	ICASA's test SIM cards SIM cards provided by each operator were used during the drive test.
Vehicle used	A Ford Everest 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.

3.4.3 Data service benchmarking

Packet switched/Data service benchmark testing is more complex than voice benchmark testing as there are many applications running on the data bearer, compared to only one in the case of circuit-switched (voice). It is therefore common practice to conduct tests using several applications or protocols. Table 4 lists the test types used in the benchmark program. These are widely used by operators and regulators world wide to measure the basic factors which affect users' experience of data, speed and latency (or response).

For FTP Download and upload throughput as well as HTTP Download throughput, ETSI Method A is used in this report[7]. ETSI Method A defines trigger points which are as independent as possible from the service used, therefore representing a more generic view (payload throughput). HTTP Download throughput (ETSI Method A) parameters used, whereby the start trigger point for the Mean Data Rate for Web browsing is either the reception of the first packet containing data content.

Table 4: Service Test Case

Test Case	Key Measurements	Test Description
32-byte ICMP Ping	Round trip time or latency, in milliseconds	Latency/RTT (Round Trip Time) is the time required for a packet to travel from a source to a destination and back. It measures the delay on a network at a given time. Testing was conducted to two servers: 1. www.sobasa.org.za accesses the server hosted

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[7] ETSI TS 102 250-2: Speech and multimedia Transmission Quality (STQ); QoS aspects for popular services in mobile networks; Part 2: Definition of Quality of Service parameters and their computation

		at TERACO, where all MNOs have direct peering access, making this an "Independent Server" 2. www.google.co.za
HTTP	Download throughput	HTTP Download Throughput – is the rate at which data is transferred from the server to the user using HTTP protocol and is measured in kbps. Majority of downloading and uploading to the internet is currently done using the HTTP protocol and tests were done to test the throughput speeds that users may experience when using these services. The HTTP testing files were downloaded between the server and the device to measure the throughput performance.
FTP	File transfer throughput Download and upload throughput speeds are measured	FTP Download/Upload Throughput – is the rate at which data is transferred from/to the server from/to the user using FTP protocol and is measured in kbps. A reference file is downloaded/uploaded from the test server to the users' device to measure download throughput, using the FTP 'get' command and FTP protocol. A reference file is uploaded from the users' device to the test server to measure upload throughput, using the FTP 'put' command and FTP protocol.

4 Overall Results

This section provides a summary of the mobile operator's performance results based on the drive test routes in the following test areas: Boschfontein, Mbombela, Acornhoek, Bushbuckridge and Hazyview. It must be noted that the results below are the average of only successful tests.

3G and 4G preferred measurements were conducted in all five areas.

4.1 3G Mobile Drive Test Results

4.1.1 3G Preferred Summary Results

Table 5 shows the overall results obtained per KPI for 3G Preferred testing in Boschfontein, Mbombela, Acornhoek, Bushbuckridge and Hazyview.

Table 5: 3G Preferred overall results

		Cell C	MTN	Telkom	Vodacom
Latency (ms)	Google	86.62	72.41	95.67	78.77
	Sobasa	94.60	77.09	177.02	80.53
HTTP	HTTP Mean Throughput DL [Mbps]	6.28	10.10	5.20	6.86
FTP (Mbps)	FTP Mean Throughput UL [Mbps]	2.61	2.73	2.09	2.37

In Table 5, the values in the green blocks indicate which operator is leading in that KPI. The results show that MTN is leading in all 5 KPIs.

The following sections provide graphical view of the overall results obtained/highlighted in Table 5.
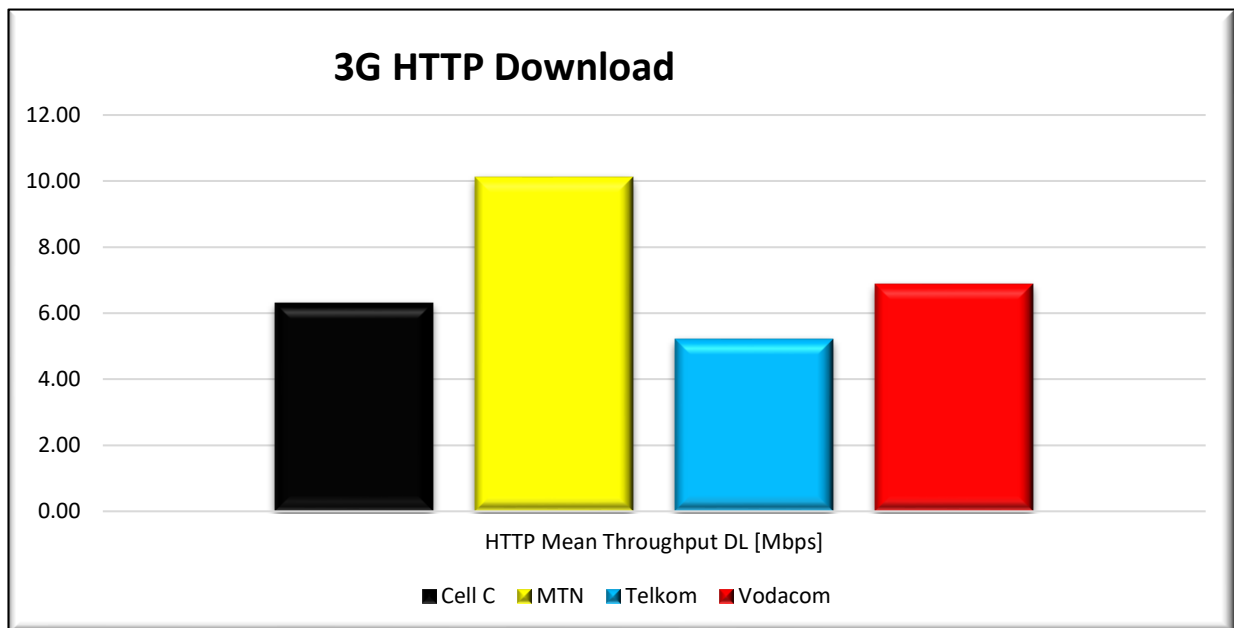
Figure 2. 3G Preferred Overall HTTP Download

Figure 2 shows that MTN leads in HTTP download throughput, followed by Vodacom, Cell C and Telkom in a descending order.
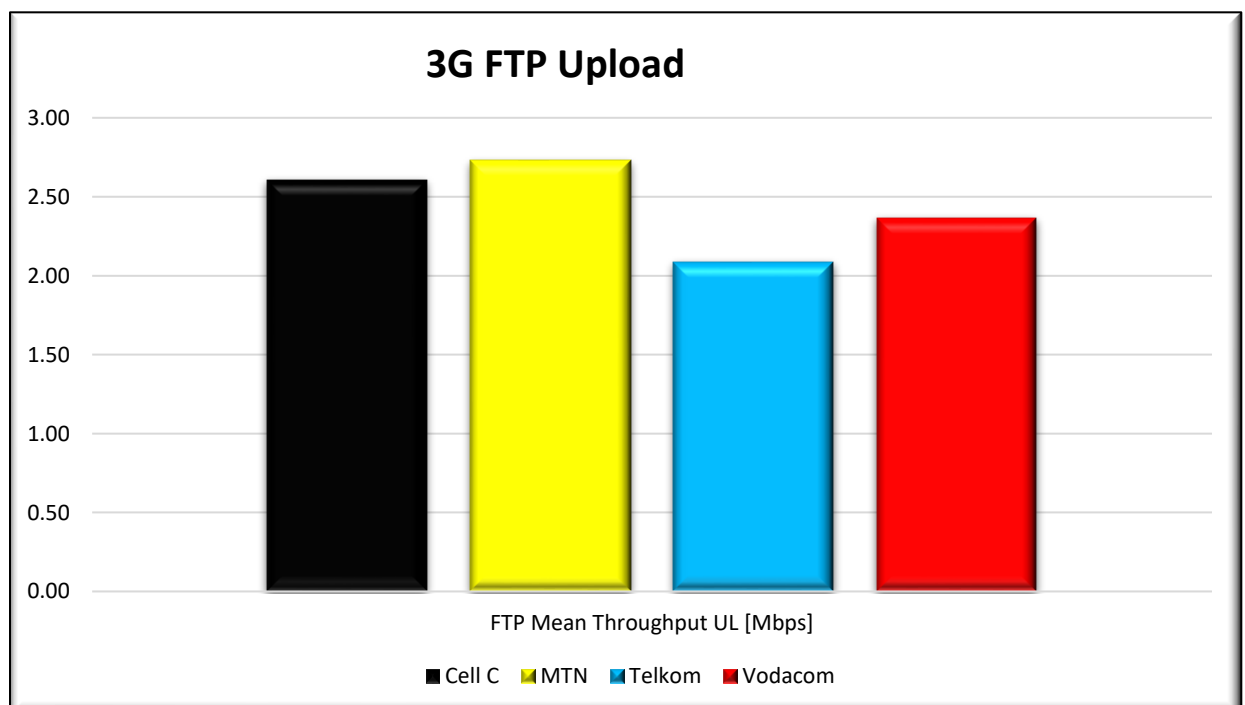

Figure 3. 3G Preferred Overall FTP upload Throughput

Figure 3 shows that MTN leads in FTP upload throughput, followed by Cell C, Vodacom and Telkom in a descending order.

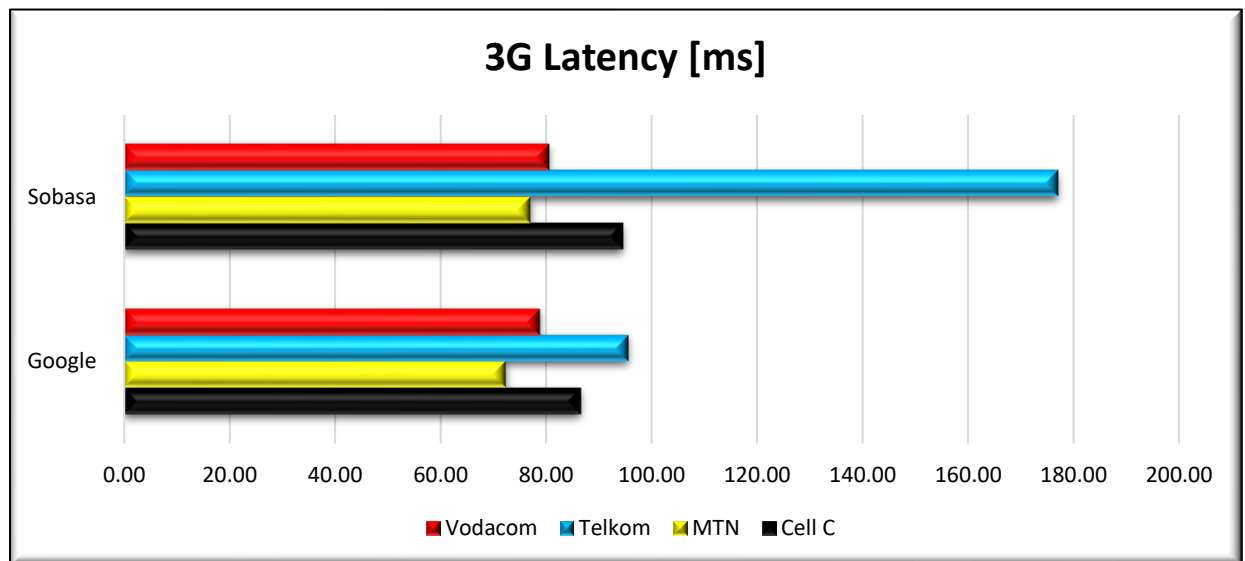*4.1.1.2   3G Latency results*

3G Latency [ms]

Figure 4. 3G Overall Latency per server

Figure 4 shows that MTN achieved the best latency results for both the ftp servers (www.sobasa.org.za) and google server (www.google.co.za), followed by Vodacom, Cell C and Telkom.

4.1.1.3   3G Preferred Results per area

Table 6: 3G Preferred overall results

Route Name	Operator	HTTP Download (Mbps)	FTP Upload (Mbps)	Latency (ms)
Boschfontein	Cell C	6.16	2.75	64.18
	MTN-SA	10.82	2.71	87.70
	Telkom	7.16	2.48	176.71
	VodaCom-SA	8.82	2.65	124.74
Mbombela	Cell C	6.55	2.49	61.27
	MTN-SA	7.72	2.68	86.88
	Telkom	5.24	1.68	121.43
	VodaCom-SA	5.21	2.45	80.82
Acornhoek	Cell C	6.99	2.59	97.76
	MTN-SA	10.06	2.79	83.65
	Telkom	4.99	1.94	89.22
	VodaCom-SA	6.64	2.29	97.57
Bushbuckridge	Cell C	4.53	2.37	92.39
	MTN-SA	9.76	2.64	63.94
	Telkom	3.63	2.15	140.17
	VodaCom-SA	6.97	2.20	76.02

Hazyview	Cell C	7.15	2.84	67.05
	MTN-SA	12.15	2.81	52.08
	Telkom	4.97	2.19	98.87
	VodaCom-SA	6.67	2.23	51.51
Overall results for the above 5 areas	Cell C	6.28	2.61	76.53
	MTN-SA	10.10	2.73	74.85
	Telkom	5.20	2.09	125.28
	VodaCom-SA	6.86	2.37	86.13

Table 6 shows mobile data measurements results per route per operator and the overall areas tested. The latency results include an average of both the ping tests to Google and www.sobasa.org.za. MTN leads in HTTP download throughput in all 3G preffered tested areas, as well as the HTTP download throughput overall results. MTN leads in FTP upload for 3G preferred in Mbombela, Acornhoek and Bushbuckridge, as well as the FTP upload throughput overall results followed by Cell C. Cell C has the lowest Latency in Boschfontein and Mbombela; MTN in Acornhoek and Bushbuckridge; Vodacom in Hazyview. MTN achieved the lowest overall Latency.

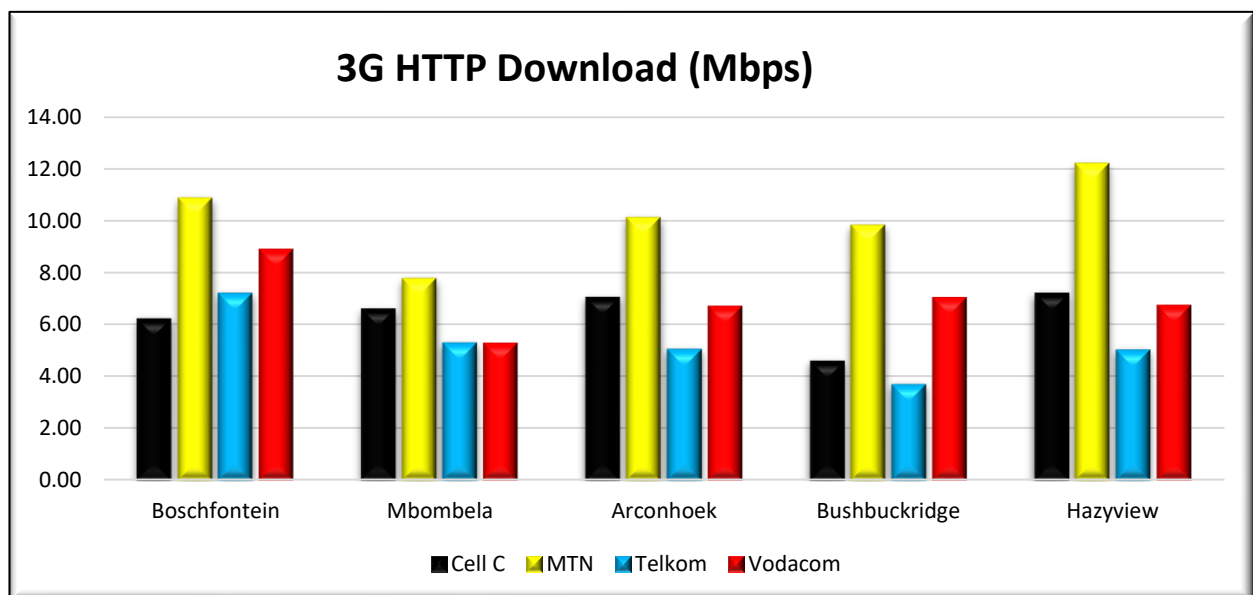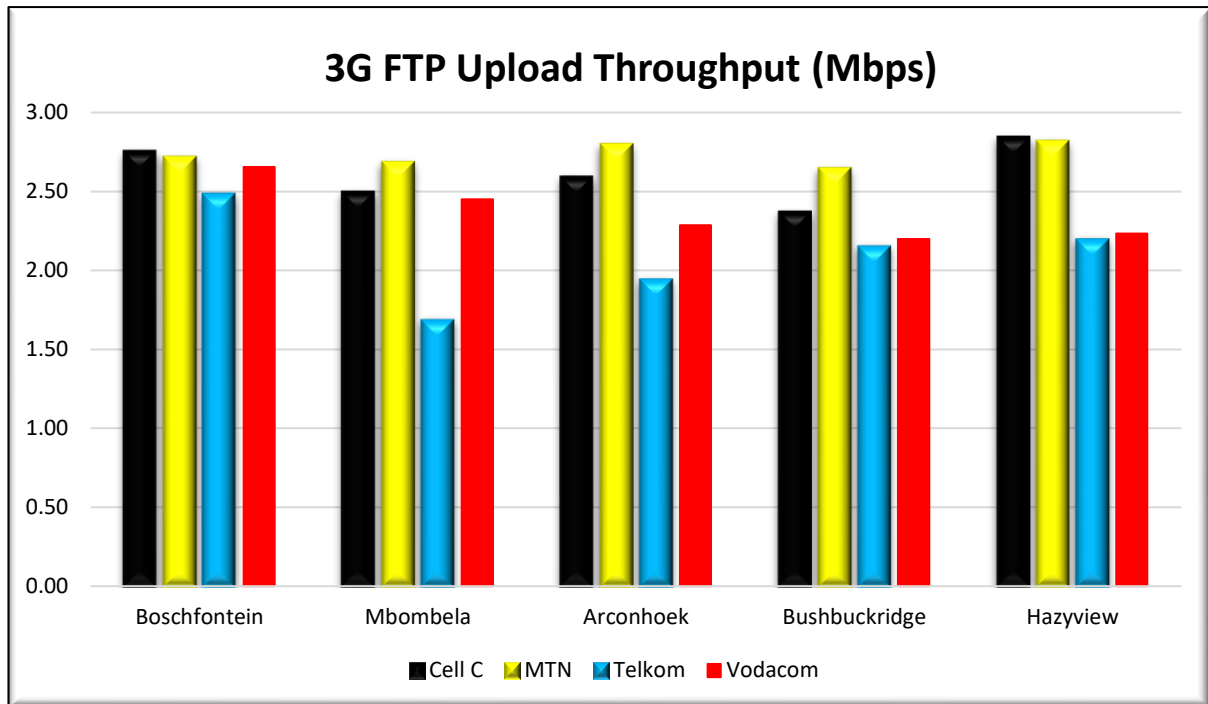*4.1.1.4   3G Preferred File Transfer results per area*


Figure 5. 3G Preferred HTTP Download Throughput per route

Figure 5 shows that MTN leads in HTTP download throughput in all areas for 3G preferred tests.

3G FTP Upload Throughput (Mbps)

Figure 6. 3G Preferred FTP Upload Throughput per route

Figure 6 shows that MTN leads in FTP upload throughput in Mbombela, Acornhoek, Bushbuckridge.   Cell C leads in FTP upload throughput in Boschfontein and Hazyview.

4.1.1.5   3G Preferred Latency/Ping results per area

3G Latency - Google [ms]
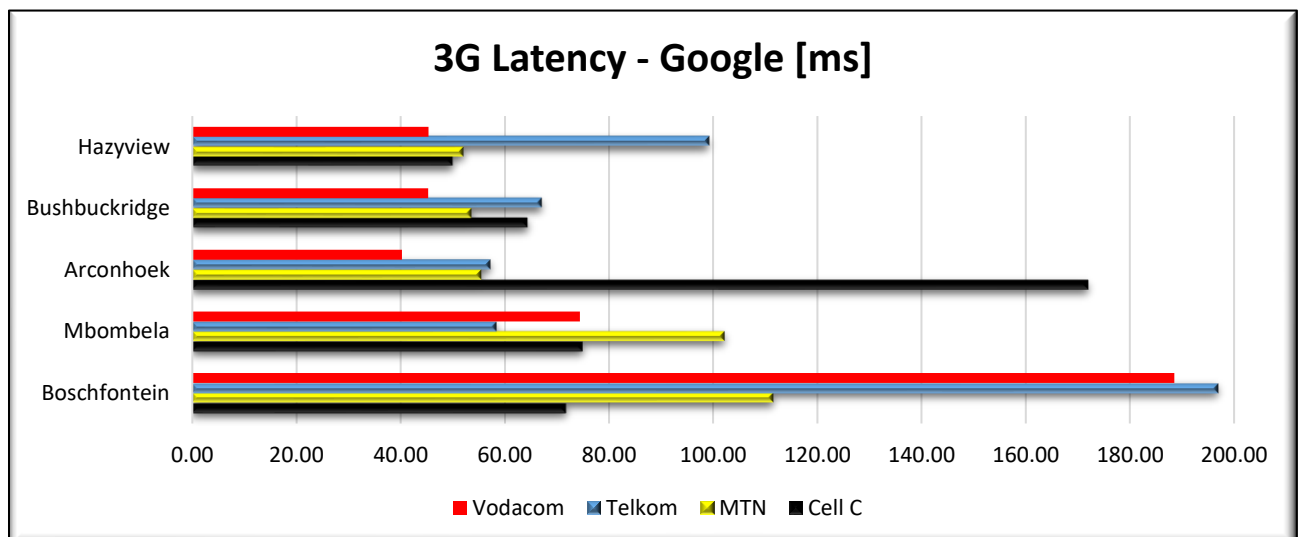
Figure 7. 3G Preferred Latency - Google

Figure 7 shows the results for latency test to Google. Vodacom achieved the best latency results to Google in Hazyview, Bushbuckridge and Acornhoek; while Cell C achieved best latency in Boschfontein and Telkom in Mbombela.
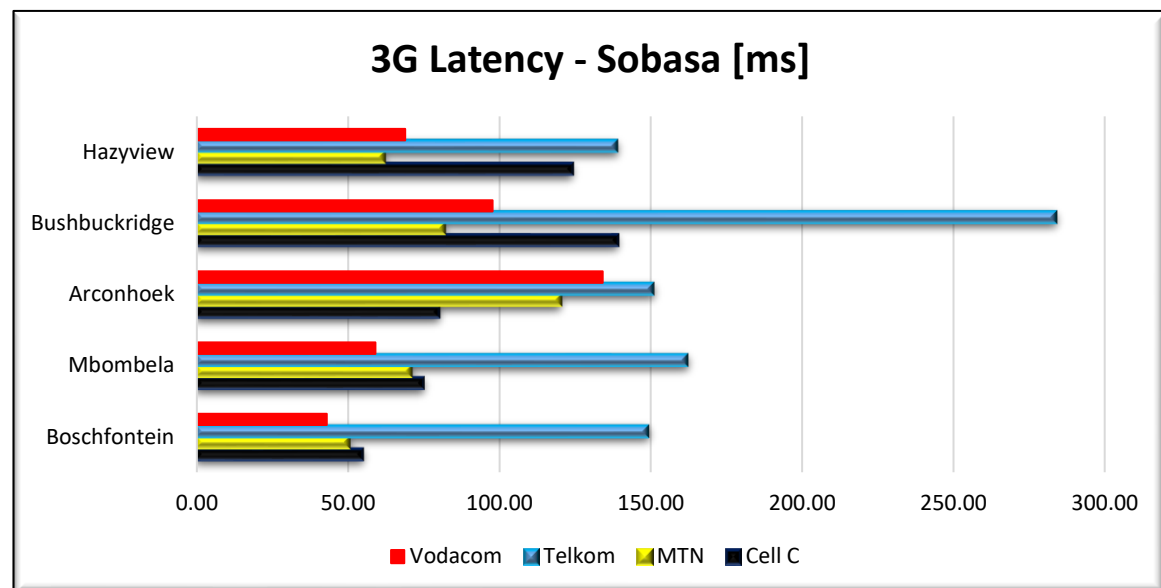

Figure 8. 3G Preferred Latency per Area – sobasa.org.za

Figure 8 shows that Vodacom achieved the best latency results to www.sobasa.org.za in Mbombela and Boschfontein. MTN achieved the best latency results to www.sobasa.org.za in Bushbuckridge and Hazyview. Cell C achieved the best latency results to www.sobasa.org.za in Acornhoek.
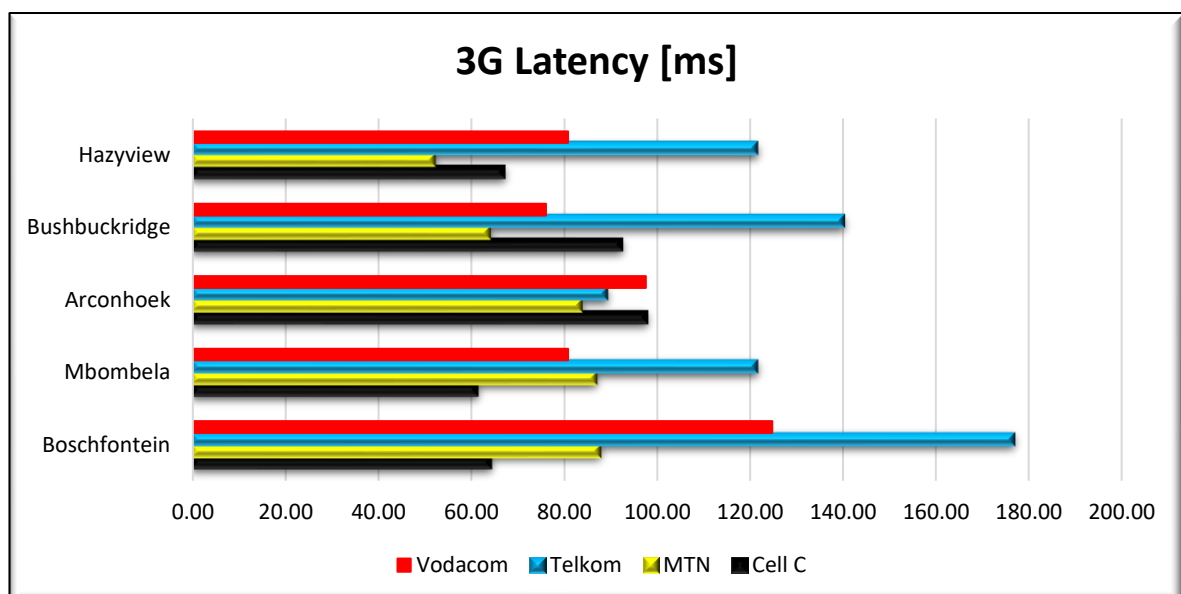

Figure 9. 3G Preferred Overall Average Latency per Area

Figure 9 shows the overall (www.sobasa.org.za and www.google.com combined) average Latency results. MTN achieved the best average latency results in Hazyview, Bushbuckridge and Acornhoek. Cell C achieved the best average in Mbombela and Boschfontein.

4.2   4G Mobile Drive Test Results

4.2.1 4G Preferred Summary Results

Table 7 shows the overall results obtained per KPI for 4G Preferred testing in Boschfontein, Mbombela, Acornhoek, Bushbuckridge and Hazyview.

Table 7: 4G Preferred overall results

		Cell C	MTN	Telkom	Vodacom
Latency (ms)	**Google**	43.78	34.17	59.10	72.03
	Sobasa	34.25	35.08	51.72	79.21
HTTP	**HTTP Mean Throughput DL [Mbps]**	8.94	32.29	9.91	15.62
FTP (Mbps)	**FTP Mean Throughput DL [Mbps]**	7.69	19.28	10.04	19.17
	FTP Mean Throughput UL [Mbps]	6.04	14.25	8.16	9.49

In Table 7, the values in the green blocks indicate which operator is leading in that KPI. The results show that MTN is leading in 4 KPIs, while Cell C lead in one KPI.
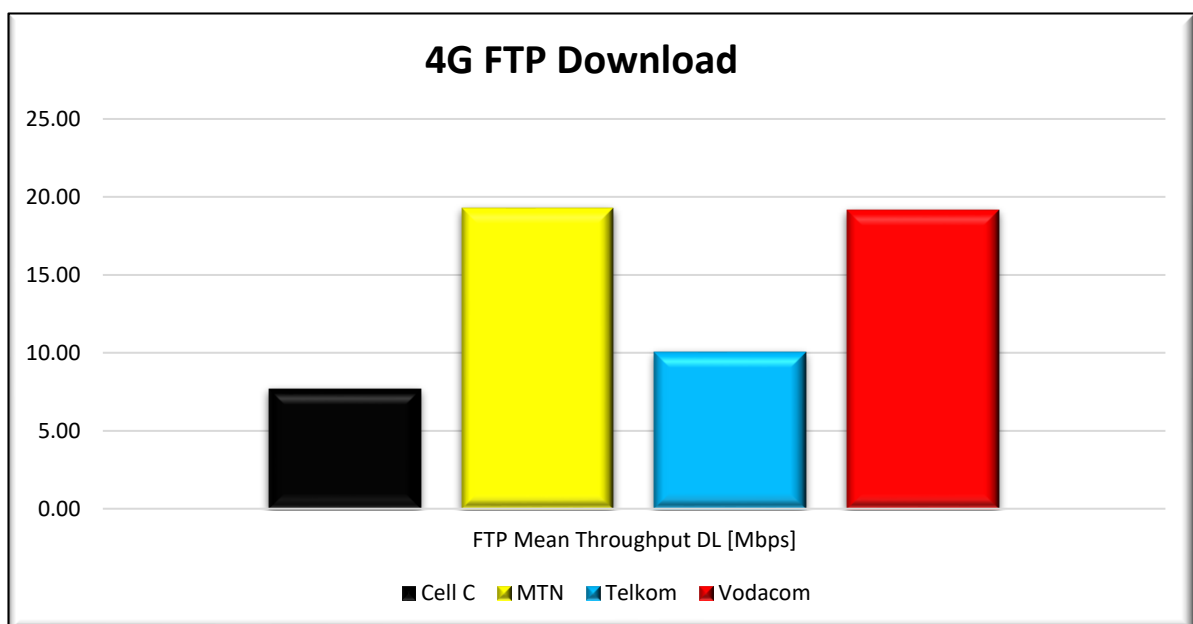
Below find the charts providing a graphical view of the results obtained/highlighted in Table 7.
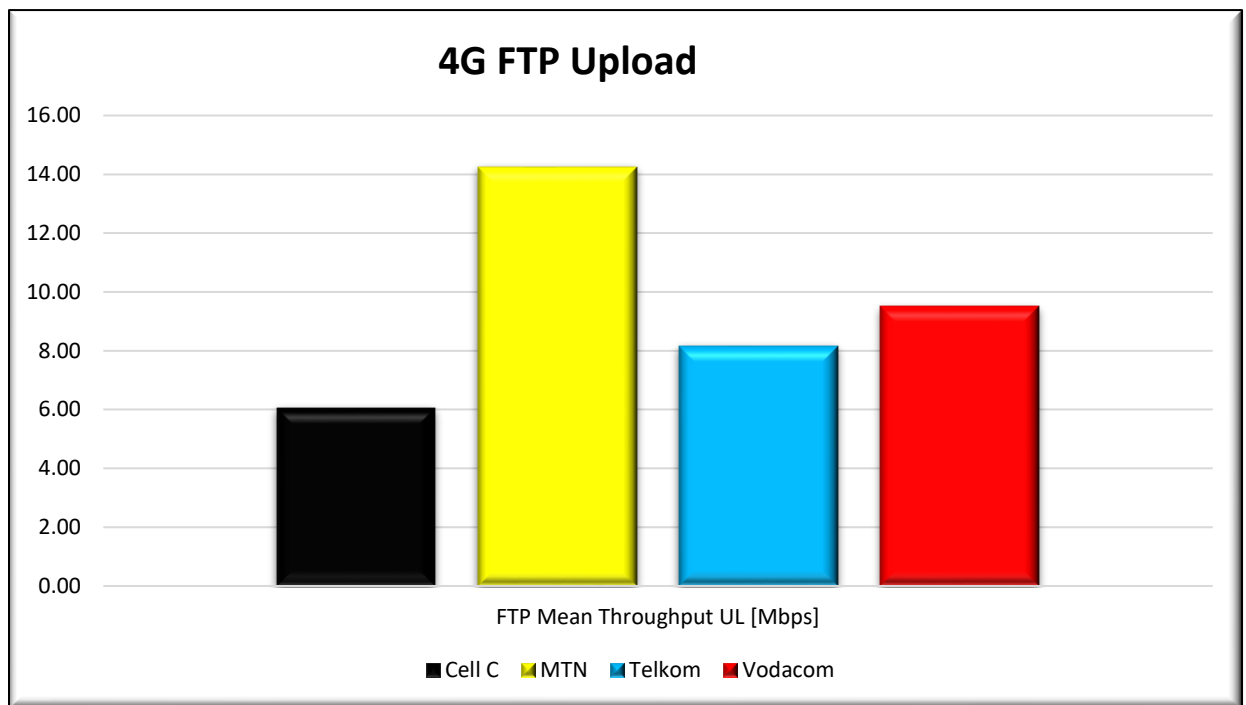
4.2.1.1   4G Overall File Transfer results
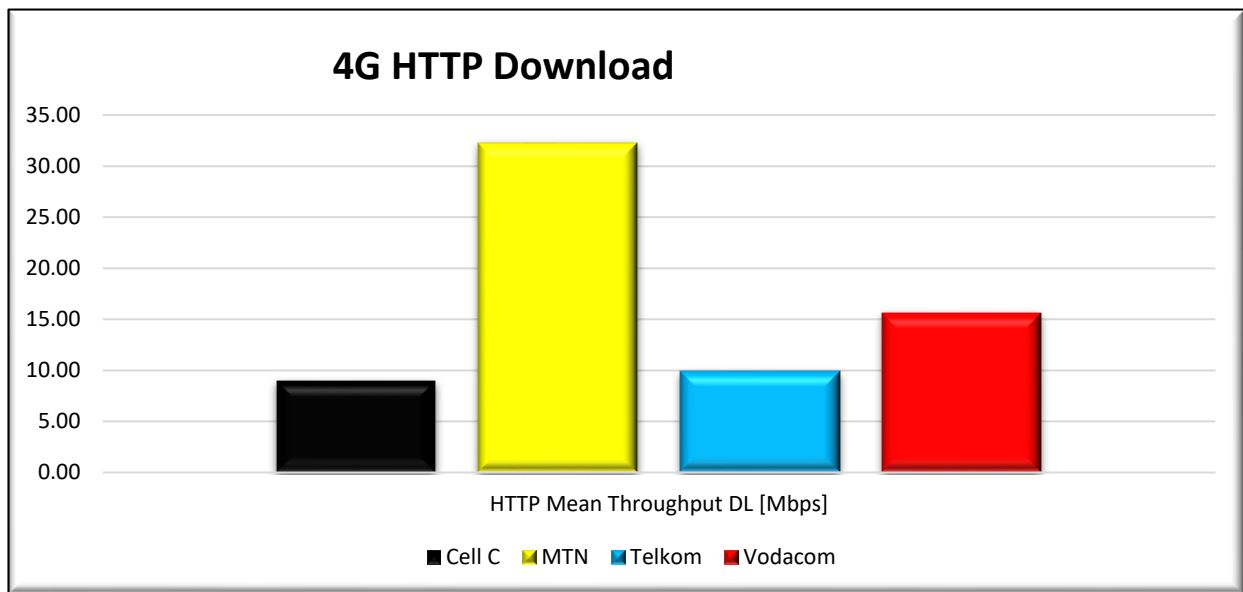
Figure 10. 4G Preferred Overall HTTP Download

Figure 10 shows that MTN leads in HTTP download throughput, followed by Vodacom, Telkom and Cell C in a descending order.

*Figure 11. 4G Preferred Overall FTP Download Throughput*

Figure 11 shows that MTN leads in FTP download throughput, followed by Vodacom, Telkom and Cell C in a descending order.

Figure 12. 4G Preferred Overall FTP upload Throughput

Figure 12 shows that MTN leads in FTP upload throughput, followed by Vodacom, Telkom and Cell C in a descending order.

4.2.1.2   4G Latency results
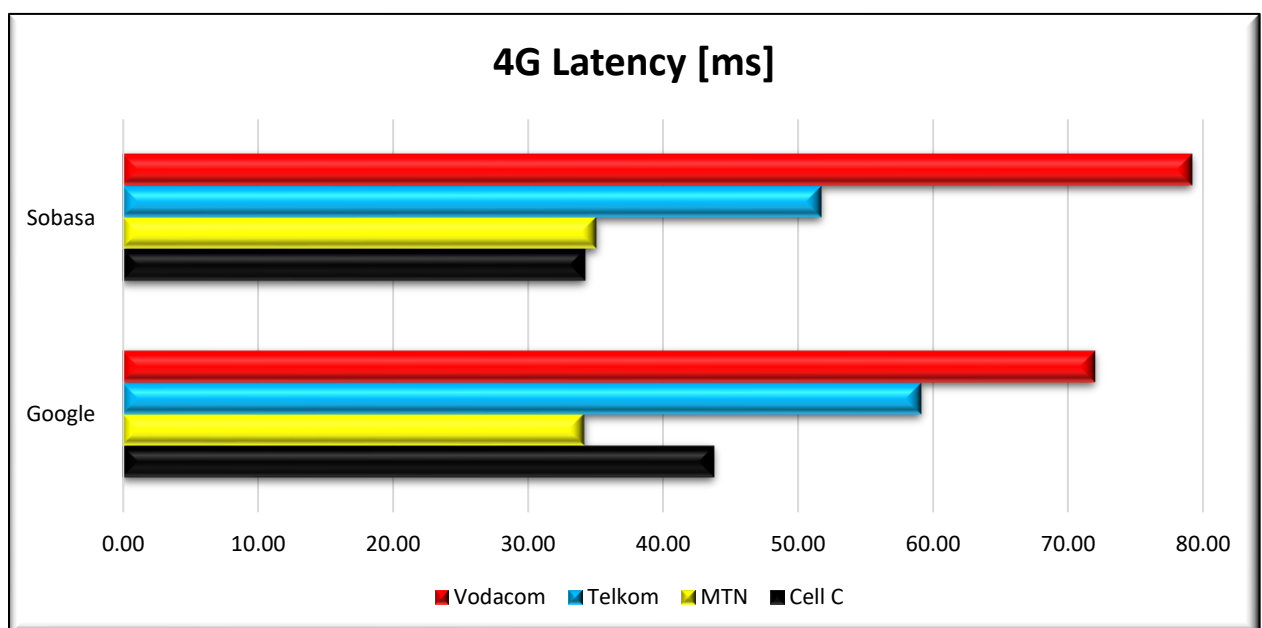
Figure 13. 4G Overall Latency per server

Figure 13 shows that Cell C achieved best latency results for the ftp server (www.sobasa.org.za), followed by MTN, Telkom and Vodacom in their respective order. MTN achieved best latency results for the google server (www.google.co.za), followed by Cell C, Telkom and Vodacom in their respective order.

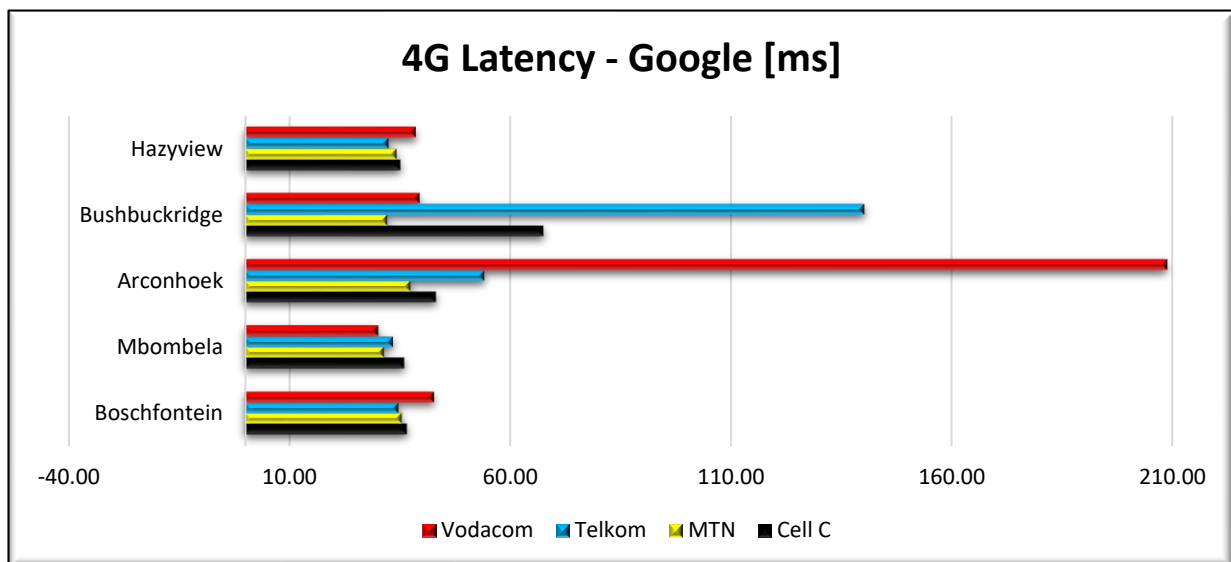*4.2.1.3   4G Preferred Latency/Ping results per area*

Figure 14. 4G Preferred Latency - Google

Figure 14 shows the results for latency test to Google. MTN achieved the best latency results to Google in Bushbuckridge and Acornhoek. Telkom achieved best latency results in Boschfontein and Hazyview, while Vodacom achieved the best latency in Mbombela.
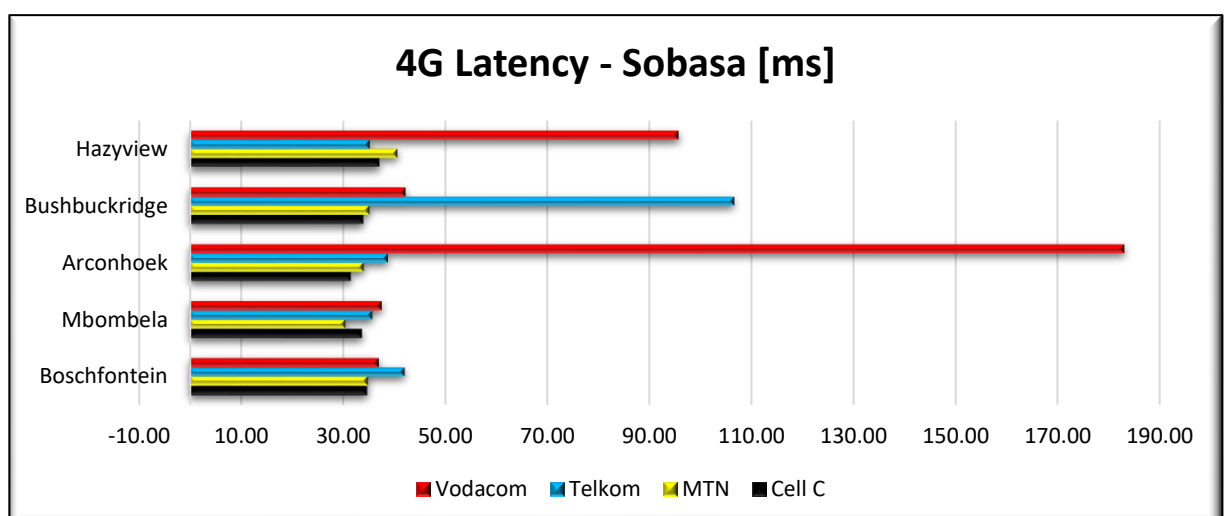

Figure 15. 4G Preferred Latency per Area – sobasa.org.za

Figure 15 shows that Cell C achieved the best latency results for ping to sobasa ftp server for areas; Bushbuckridge, Acornhoek and Boschfontein. Telkom achieved the best latency results in Hazyview. MTN achieved the best latency results in Mbombela.
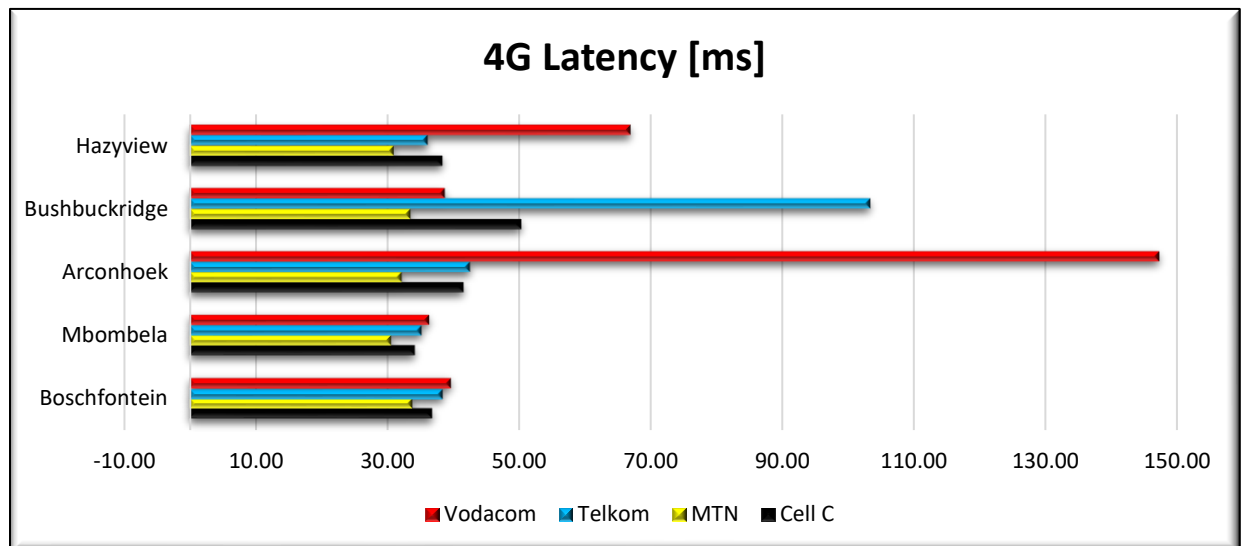

Figure 16. 4G Preferred Overall Average Latency per Area

Figure 16 shows the overall (www.sobasa.org.za and www.google.com combined) average Latency results. MTN achieved the best average latency results in all tested areas.

4.2.1.4   4G Preferred Results per area

Table 8: 4G Preferred overall results

Route Name	Operator	HTTP Download (Mbps)	FTP Download (Mbps)	FTP Upload (Mbps)	Latency (ms)
Boschfontein	Cell C	8.10	7.27	4.51	36.80
	MTN-SA	34.60	20.85	13.46	33.76
	Telkom	8.56	8.38	8.12	38.46
	VodaCom-SA	15.05	17.42	9.60	39.70
Mbombela	Cell C	14.36	10.68	12.06	34.18
	MTN-SA	46.72	22.07	18.80	30.52
	Telkom	11.87	11.74	6.02	35.28
	VodaCom-SA	26.24	33.19	18.46	36.40
Acornhoek	Cell C	6.84	6.78	3.86	41.59
	MTN-SA	22.93	17.00	11.82	32.12
	Telkom	10.87	11.40	8.08	42.60
	VodaCom-SA	10.22	10.45	2.73	147.31
Bushbuckridge	Cell C	8.05	7.00	5.13	50.32

	MTN-SA	26.60	18.93	12.22	33.46
	Telkom	10.31	10.55	9.09	103.39
	VodaCom-SA	11.14	11.37	6.70	38.75
Hazyview	Cell C	7.35	6.71	4.65	38.36
	MTN-SA	30.59	17.52	14.95	30.90
	Telkom	7.94	8.14	9.49	36.16
	VodaCom-SA	15.45	23.43	9.98	66.94
Overall results for the above 5 areas	Cell C	8.94	7.69	6.04	40.25
	MTN-SA	32.29	19.28	14.25	32.15
	Telkom	9.91	10.04	8.16	51.18
	VodaCom-SA	15.62	19.17	9.49	65.82

Table 8 shows mobile data measurements results per route per operator and the overall areas tested. The latency results include an average of both the ping tests to **Google** and www.sobasa.org.za.

MTN leads in HTTP download throughput in all tested areas (Boschfontein,Mbombela, Acornhoek and Hazyview, Bushbuckridge). MTN also leads in FTP upload for 4G preferred in all 4G preferred tested areas, as well as the FTP upload throughput overall results. MTN leads in FTP download throughput in three areas (Boschfontein, Bushbuckridge and Acornhoek) as well as on the FTP download throughput for the overall results. Vodacom leads in FTP download throughput in two areas (Mbombela and Hazyview). MTN achieved the lowest overall Latency and in all 4G preferred areas.
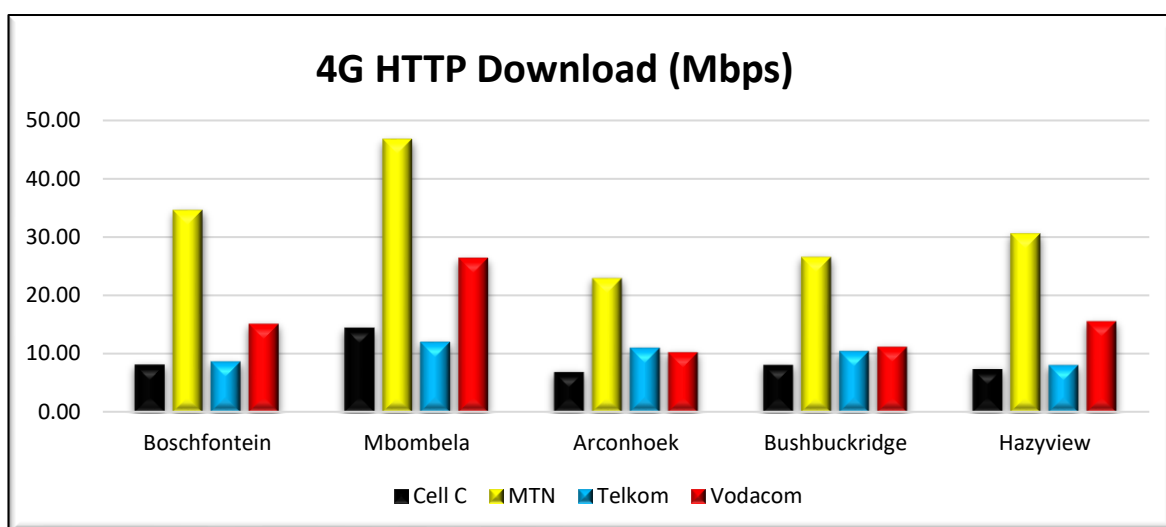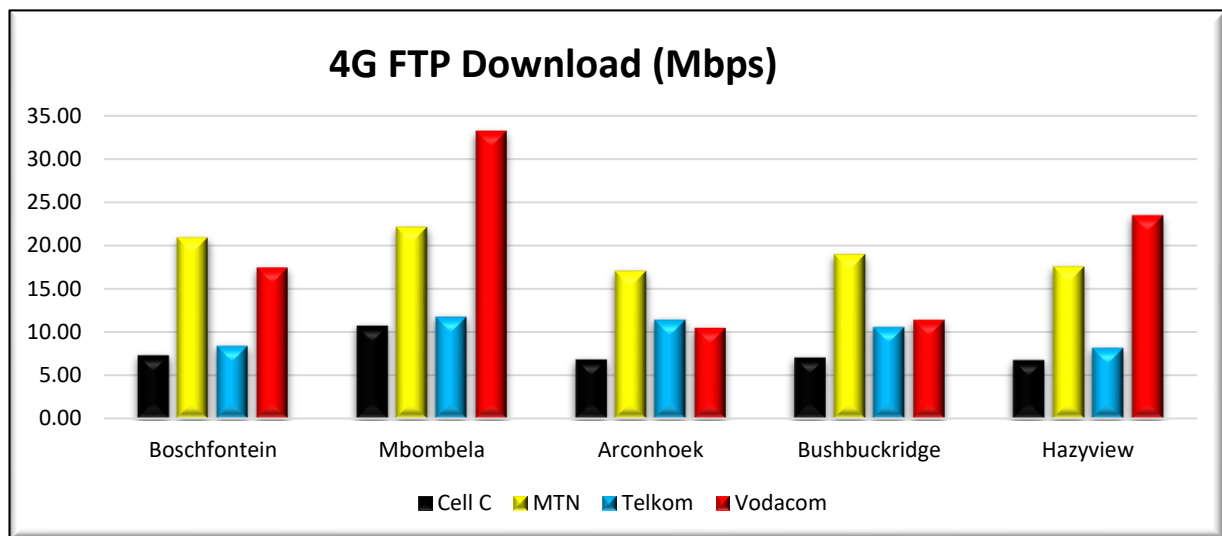
4.2.1.5   4G Preferred File Transfer results per area

Figure 17. 4G Preferred HTTP Download Throughput per route

Figure 17 shows that MTN leads in HTTP download throughput in all 4G preferred tested areas.

Figure 18. 4G Preferred FTP Download Throughput per route

Figure 18 shows that MTN leads in FTP download throughput in Boschfontein, Acornhoek and Bushbuckridge. Vodacom leads in Mbombela and Hazyview.
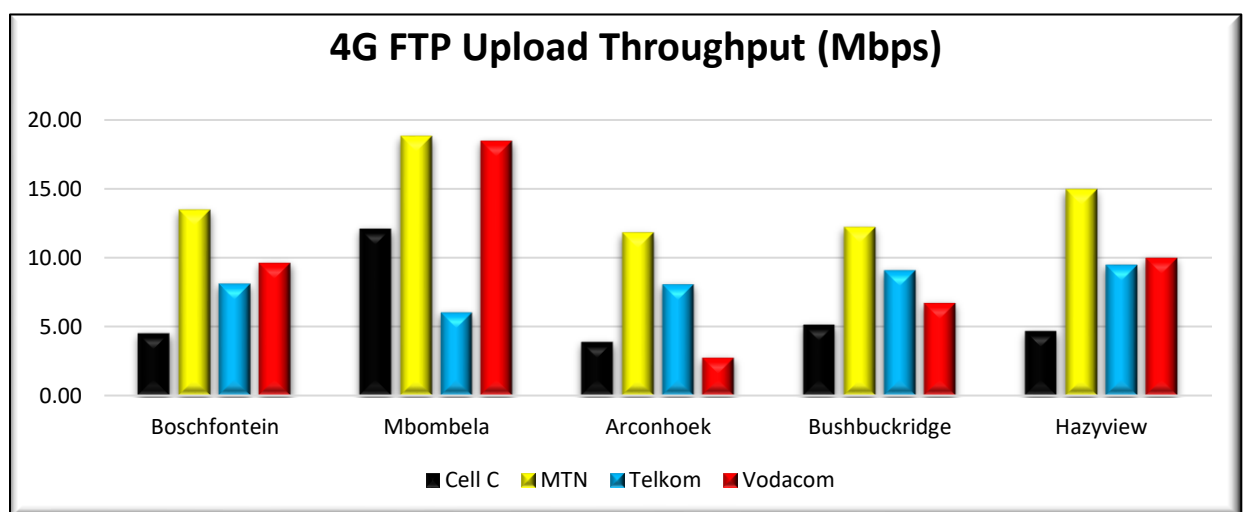

Figure 19. 4G Preferred FTP Upload Throughput per route

Figure 19 shows that MTN leads in FTP upload throughput in all 4G preferred tested areas.
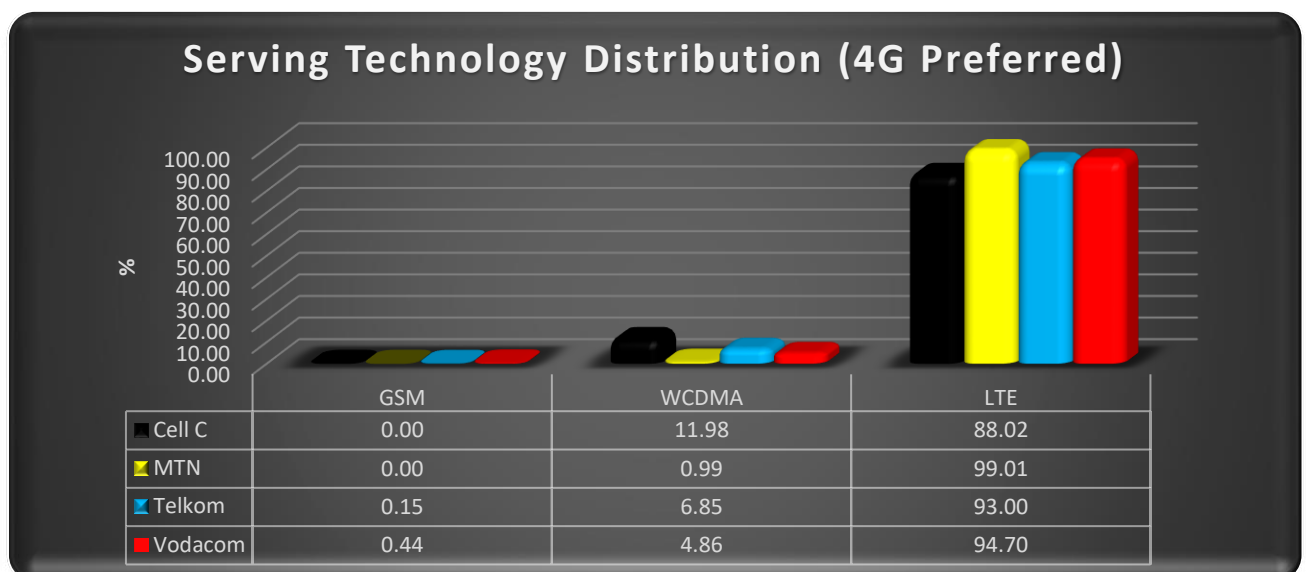
4.3   Analysis of the service technology

The serving technology distribution was 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 20 and 21 below shows the statistical distribution of the serving technology during the drive test.

	GSM	WCDMA
Cell C	0.00	100.00
MTN	0.12	99.88
Telkom	0.12	99.88
Vodacom	1.50	98.50
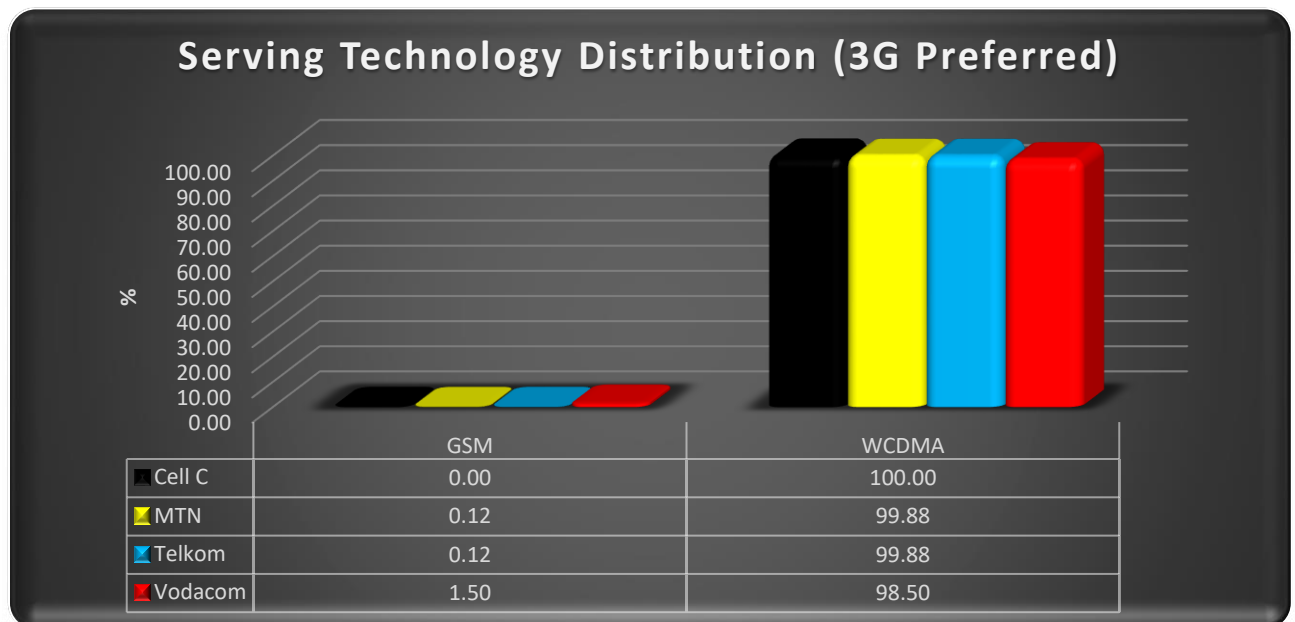
Figure 20. 3G Preferred Technology Distribution

The serving technology distribution for all operators was mainly on WCDMA/3G for 3G preferred measurements as shown in Figure 20.

	GSM	WCDMA	LTE
Cell C	0.00	11.98	88.02
MTN	0.00	0.99	99.01
Telkom	0.15	6.85	93.00
Vodacom	0.44	4.86	94.70

Figure 21. 4G Preferred Technology Distribution

The 4G preferred serving technology distribution for all operators were mainly on LTE as shown in Figure 21 with MTN having the highest LTE serving technology distribution.

5 Conclusion

This section provides the summary and key findings of all measurements. The obtained results illustrate a snapshot of the mobile network performance within the measured time and location. The results also indicate that the end-user's quality of service and the operators' network performance varies significantly per area tested as well as different KPIs tested.

5.1   3G Preferred measurements

In terms of overall results for 3G preferred, MTN leads in HTTP download and FTP upload throughput. MTN achieved the lowest overall Latency.

After benchmarking the operators for 3G preferred, the results show that on per areas basis; MTN leads in HTTP download throughput in all 3G preffered tested areas and FTP upload throughput in Mbombela, Acornhoek and Bushbuckridge. Cell C leads in FTP upload in Boschfontein and Hazyview. Vodacom achieved the best latency results to Google in Hazyview, Bushbuckridge and Acornhoek, while Cell C achieved best latency in Boschfontein and Telkom in Mbombela.

5.2   4G Preferred measurements

In terms of overall results, MTN leads in 4G HTTP download throughput, FTP download, FTP upload throughput and Latency.

After benchmarking the operators for 4G preferred, the results show that on per areas basis; MTN leads in HTTP download throughput in all 4G preferred tested areas (Boschfontein, Mbombela, Acornhoek, Bushbuckridge and Hazyview. MTN leads in FTP upload thropughput for 4G preferred in all 4G preferred tested areas. MTN leads in FTP download throughput in three areas (Boschfontein, Bushbuckridge and Acornhoek), while Vodacom leads in FTP download throughput in two areas (Mbombela and Hazyview). MTN achieved the lowest Latency in all 4G preferred areas.

6   Appendix B: Serving Technology Maps

6.1   4G Preferred Serving Technology Details
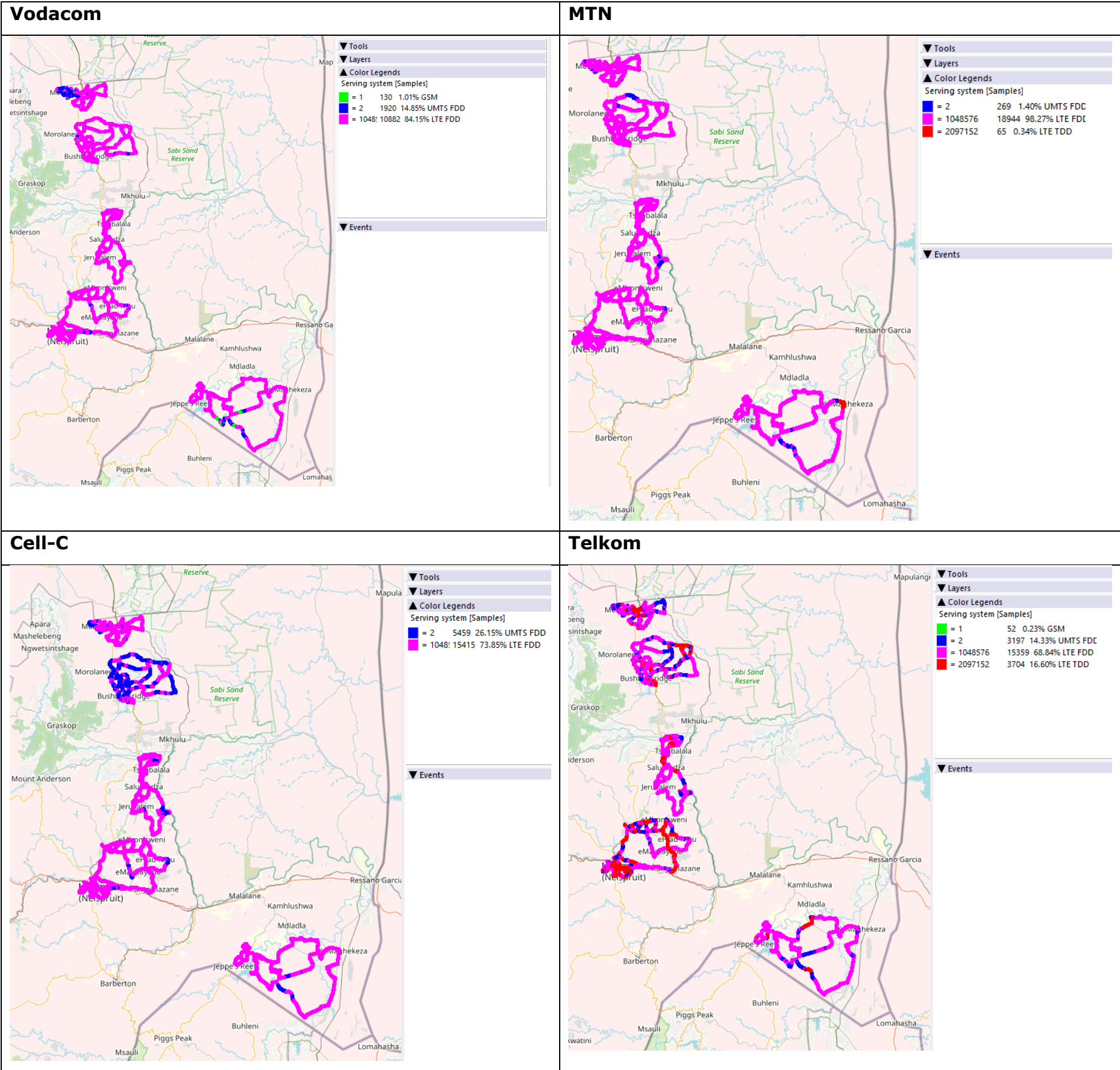

Figure 7: Mpumalanga Province Serving Technology Plot
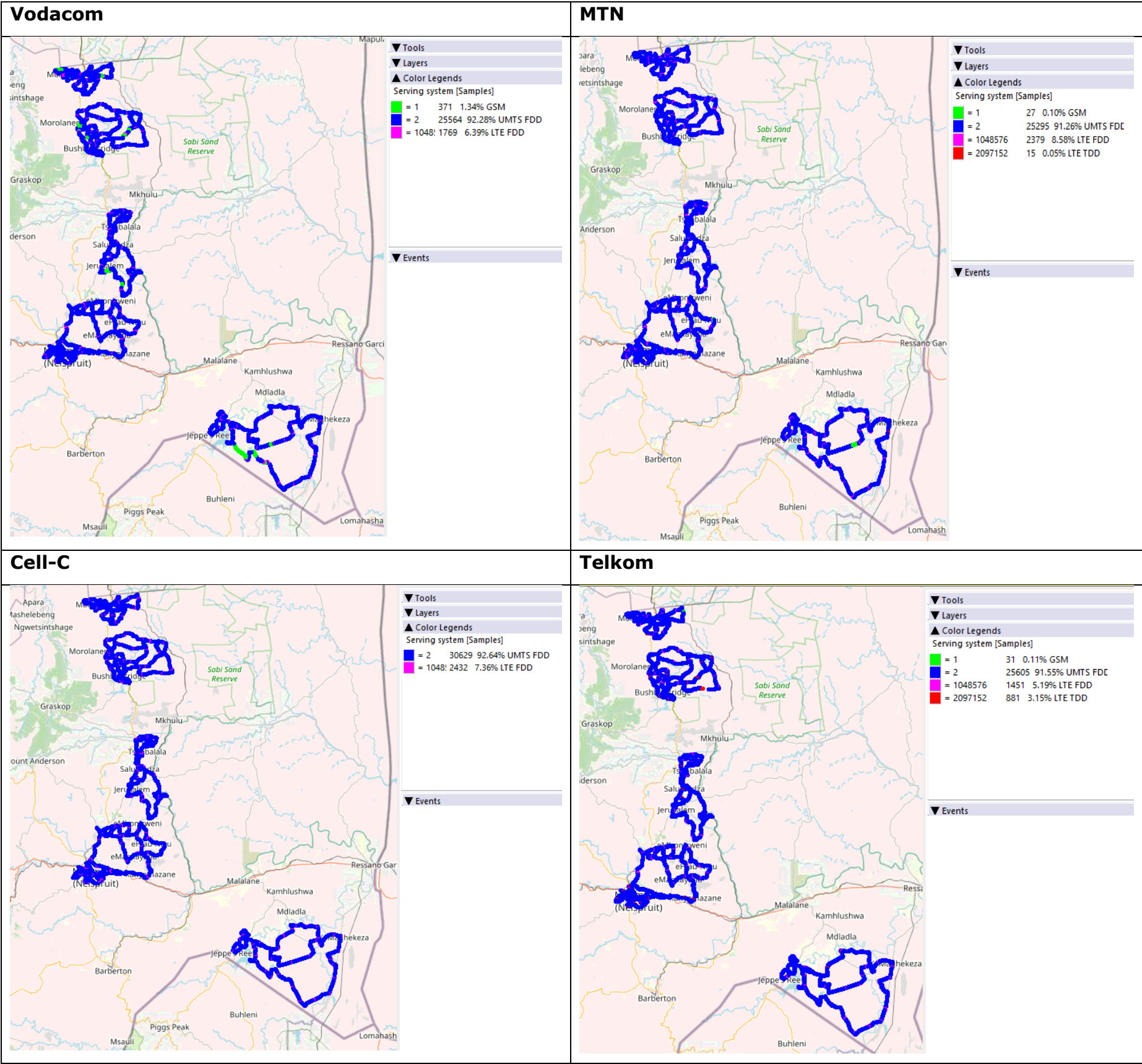
6.2   3G Preferred Serving Technology Details

Figure 7: Mpumalanga Province Serving Technology Plot

7 Appendix C: Mobile operators' feedback on the report

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

7.1 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 and shared the following remedial and action plans:

- Projects such as RAN modernization , Additional sectors upgrade , Bandwidth expansion are in the list of actions which are being executed to permanently remedy this poor performance situation in these areas.
    - o 26 sites in the tested areas will be sectorised during the Financial year 2022.
    - o 94 New sites will be rolled out in phases in the tested areas during Financial Year 2021 to 2023.
    - o Cluster Optimisation project will be conducted to improve performance in the tested areas.

Furthermore, Vodacom indicated that it strives to provide minimum Download Throughput not less than 5 Mbps and Upload Throughput not less than 3 Mbps to support broadband services in the country.

7.2 MTN

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. Vodacom shared the following remedial and action plans:

- **Boschfontein** – Network optimisation will be implemented on 3 sites to ensure improvement on FTP upload throughput and latency.
- **Mbombela** - antenna and power optimisation will be implemented on the 3G network to ensure higher 3G throughputs in the area and Power optimisation will be implemented on the LTE sites to ensure higher throughputs.

- ***Hazyview*** -   new planned 3G/4G site in the area to improve the quality of data services provided and on 4G power optimisation will be implemented on three sites.

Furthermore, MTN has indicated that it will remain committed to continual investment on the network infrastructure to ensure that MTN achieves the highest KPI scores and leads in network performance to ensure that consumers experience the highest quality of service for both data and voice services in the network.

7.3   Telkom

Telkom has noted the Authority report and further indicated that it views these test results as significant and use them as additional input to further improve the quality of its mobile network.

Network quality improvement mitigation plans include:

- Boschfontein and Hazyview - Telkom has limited coverage and will engage with its roaming partner to improve/resolve network performance issues and to improve customer experience in the area.
- Optimization that will be done to improve customer experience and new site built where optimization is not possible; alternatively, Telkom customers will roam of Telkom's roaming partner's network.
- Nine (9) sites that will be upgraded from 100 MB backhaul to a higher backhaul capacity, which will also improve throughput.
- Telkom has 29 sites at different stages of rollout in the tested areas. However, due to site acquisition challenges, 21 planned sites are still pending acquisition. Telkom expects more than (2) of these to be in-service before the end of the 2020/2021 financial year.

Furthermore, Telkom emphasised that it continues to use 1800 MHz as a coverage layer, in absence of permanently assigned 700/800 MHz spectrum. Telkom has been deploying coverage sites in the 700/800 MHz bands since July 2020 using the temporary spectrum. Permanent assignment of spectrum in these sub-1 GHz bands to Telkom will assist to deliver increased performance and better customers experience.

7.4 Cell C

Cell C has noted the findings of the Authority, specifically the latency challenges and indicated that it will continue to provide improved services to its subscribers by working with its national roaming services provider to address these challenges in the affected areas.