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2021/2022 Quarter 2:

Mobile Data Quality of Service

Report – Northern Cape Province

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List of Abbreviations

GSM	Global System for Mobile Communications
ICASA	Independent Communications Authority of South Africa
IVR	Interactive Voice Response
KPI	Key Performance Indicator
LTE	Long Term Evolution
MOC	Mobile Originating Call
MOS	Mean opinion score
WCDMA	Wideband Code Division Multiple Access
VOLTE	Voice Over Long-Term Evolution

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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 assess the performance of data services offered by the operators in the Northern Cape Province. The measurements were carried out between the 3rd and the 28th of August 2021, covering a total distance of over 2906 kilometres.

This report is structured as follows:

Section 1 of the report provides an introduction, the purpose of the benchmark and the areas selected for testing.

Section 2 provides quality control measures implemented throughout the testing process and selected test cases. The test cases were selected to align with the accepted international best practices and are also 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 standard. These standards provide definitions of QoS parameters and their calculation.

Section 3 provides the customer experience oriented Key Performance Indicators (KPIs) results aggregated for the areas tested. The detailed breakdown for each area's performance is provided as supporting information in the Appendix.

The **Appendix** also provides the following supporting information:

- Performance per area tested.
- RF measurement maps per area tested.
- Statistical count of samples.

In terms of overall results for 3G preferred mobile mode, Vodacom leads in HTTP download throughput, FTP download throughput. Telkom is the fastest in browser page load time for HTTPS protocol. MTN has the best YouTube Overall Success Ratio. Vodacom achieved the lowest results for average Latency.

In terms of overall results for 4G preferred mobile mode, MTN leads in majority of KPIs, average HTTP download throughput, average HTTP upload throughput, average FTP download throughput, average FTP upload throughput, best YouTube Overall Success Ratio, lowest overall Latency, and fastest browser page load time.

2. Introduction

ICASA's mandate 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 Africa's society as required in terms of the constitution.[1].The Authority ensures the quality of service through its Quality of Service (QoS) monitoring activities. The Authority appointed Metro Global Telecom Services (Pty) Ltd. (MetroTelworks) to conduct drive testing in selected areas of the Northern Cape Province. The test was focused on monitoring the mobile broadband (cellular data telephony) service being offered by MTN, Vodacom, Cell C and Telkom within the Northern Cape Province.

The purpose of the test campaign was to provide an objective measure of the quality of service for mobile data services as currently provided by the Mobile Network Operators ("MNOs") in the Northern Cape. The QoS monitoring was conducted in areas within Francis Baard and Pixley ka Seme District Municipalities. The areas of interest were Barkly West, Galeshewe, Hopetown, Jan Kempdorp and Kimberley. The areas consist of major towns, townships, farm areas, rural areas, major road arteries, economic activity nodes and areas of previous complaints.

Figure 1 depicts the routes which were driven in the Northern Cape Province.

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

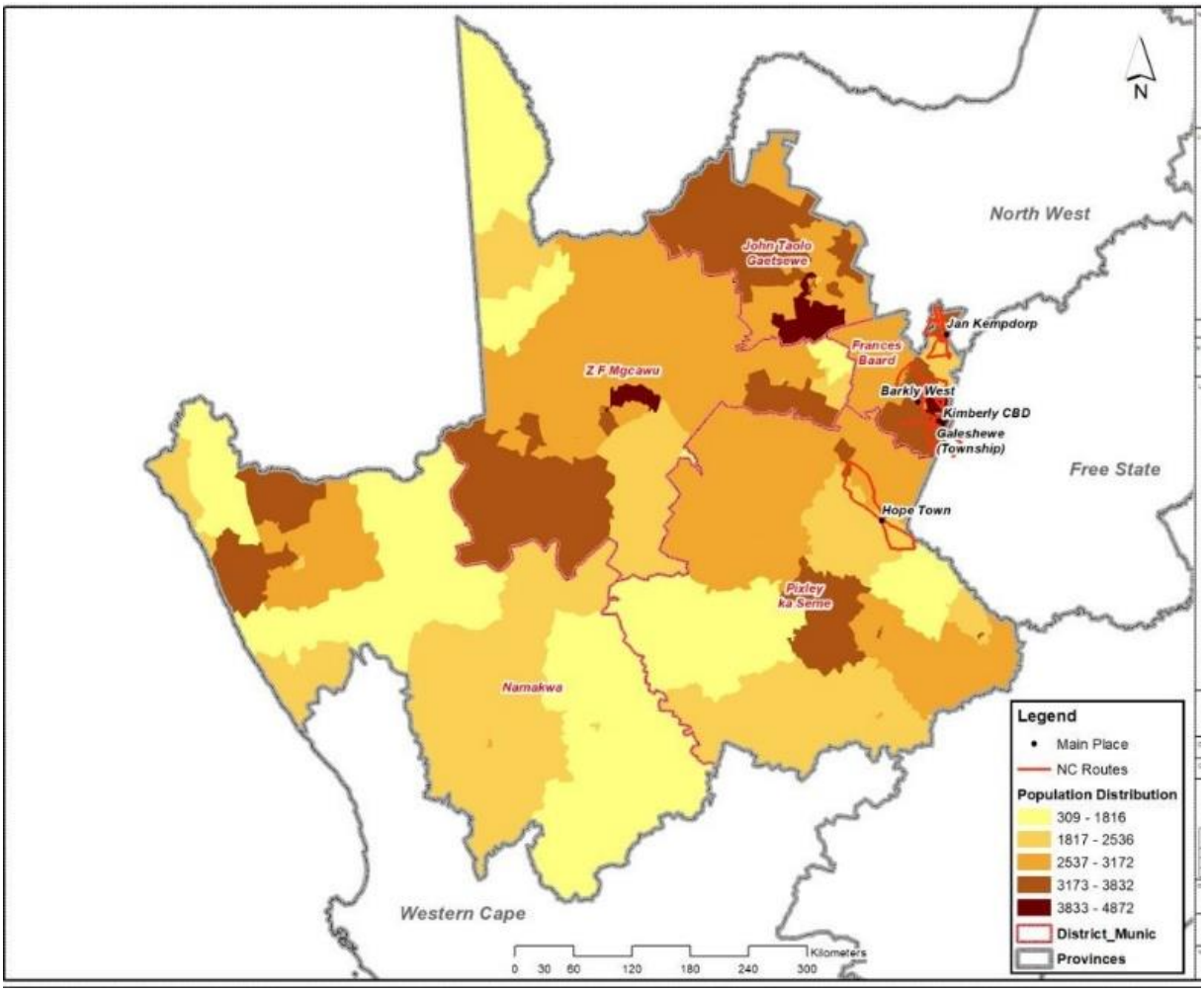


Figure 1. Northern Cape Province Route Map with Population Distribution

3. Methodology

Drive tests 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 tests were 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 the users' behaviour.

Data testing set-up consisted of two categories which were Mobile and Stationary testing, each category required one end user device. This set-up results in two user equipment (UE) per operator. As the testing was done to mimic users with different device capabilities; namely 3G capable devices as well as 4G capable devices. This resulted in a total of eight UE in one drive test vehicle. Details of test case methodology can be found on Table 1.

3G Preferred Scenario - results are based on simulating a user whose device is capable of using only the Universal Mobile Telecommunications Service (UMTS) and Global System for Mobile communication (GSM) bands and will register on UMTS when available and GSM in the absence of any UMTS coverage.

4G preferred - results are based on a user whose smartphone 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 UMTS.

3.1. Test Cases

Table 1 shows the sequence of tests within the methodology used for both mobile and stationary tests. The mobile device was always connected to the data network (PDP always on/always attached) between the different tests, a 10 second pause was inserted 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 and Timeout	Technology	
		4G Pref	3G Pref
PDP always on			
1	ICMP PAYLOAD PING 800 BYTES		
	FILE TRANSFER DOWNLOAD 135s (4G Pref) and 93s (3G Pref)	FTP DL (5MB) wait 10s	FTP DL (3MB) wait 10s
2	ICMP PAYLOAD PING 800 BYTES		
	FILE TRANSFER UPLOAD 135s (4G Pref) and 93s (3G Pref)	FTP UL (3MB) wait 10s	FTP UL (1MB) wait 10s
3	ICMP PAYLOAD PING 800 BYTES		
	FILE TRANSFER DOWNLOAD 135s (4G Pref) and 93s (3G Pref)	HTTP Get (5MB) wait 10s	HTTP Get (3MB) wait 10s
4	ICMP PAYLOAD PING 800 BYTES		
	FILE TRANSFER UPLOAD 135s (4G Pref) and 93s (3G Pref)	HTTP Put (3MB) wait 10s	HTTP Put (1MB) wait 10s
5	ICMP PAYLOAD PING 800 BYTES		
	ICMP PING 32 BYTES	Ping (32 bytes) * 5 wait 10s	Ping (32 bytes) * 5 wait 10s
6	ICMP PAYLOAD PING 800 BYTES		
	YOUTUBE STREAMING 95 seconds	Video: YouTube 60sec wait 10s	Video: YouTube 60sec wait 10s
7	ICMP PAYLOAD PING 800 BYTES		
	KEPLER WEB BROWSING 45s (4G and 3G Pref)	HTTPS Browsing: Kepler wait 10s	HTTPS Browsing: Kepler wait 10s
8	ICMP PAYLOAD PING 800 BYTES		
	LIVE WEB BROWSING 45s (4G and 3G Pref)	NEWS24, GOOGLE and MSN wait 10s	NEWS24, GOOGLE and MSN wait 10s
9	ICMP PAYLOAD PING 800 BYTES		
	KEPLER MOBILE WEB BROWSING 45s (4G and 3G Pref)	HTTPS Browsing: Kepler Mobile wait 10s	HTTPS Browsing: Kepler Mobile wait 10s
10	ICMP PAYLOAD PING 800 BYTES		
	ICMP PING 32 BYTES	Ping (32 bytes) * 5 - www.google.com wait 10s	Ping (32 bytes) * 5 - www.google.com wait 10s
11	ICMP PAYLOAD PING 800 BYTES		
	FILE TRANSFER – CAPACITY DOWNLOAD 10s fixed duration	HTTP Get (500MB) - Multiple files wait 10s	HTTP Get (500MB) - Multiple Files wait 10s
12	ICMP PAYLOAD PING 800 BYTES		
	FILE TRANSFER – CAPACITY DOWNLOAD 10s fixed duration	HTTP Put (500MB) - Multiple Files wait 10s	HTTP Put (500MB) -Multiple Files wait 10s

3.2. Equipment test setup and configuration

3.2.1. System used

The Test Equipment used was Rohde & Schwarz SwissQual Benchmarker II platform with smartphones installed inside the car using the Rohde & Schwarz Phone Mount Walls.

Figure 2. Drive Test System Configuration

3.2.2. Device Used

The Samsung S10 (5G) Smartphone was selected as the measurement device for Data Services. The device supports the following technologies GSM, CDMA, HSPA, LTE, LTE-A and 5G.

Figure 3. Data Test Device - Samsung S10 5G

3.3. Route selection

The QoS benchmark was conducted in the Northern Cape Province and covered the areas listed in Table 2 and stationary points listed in Table 3 below.

Table 2. Areas tested for Mobile data

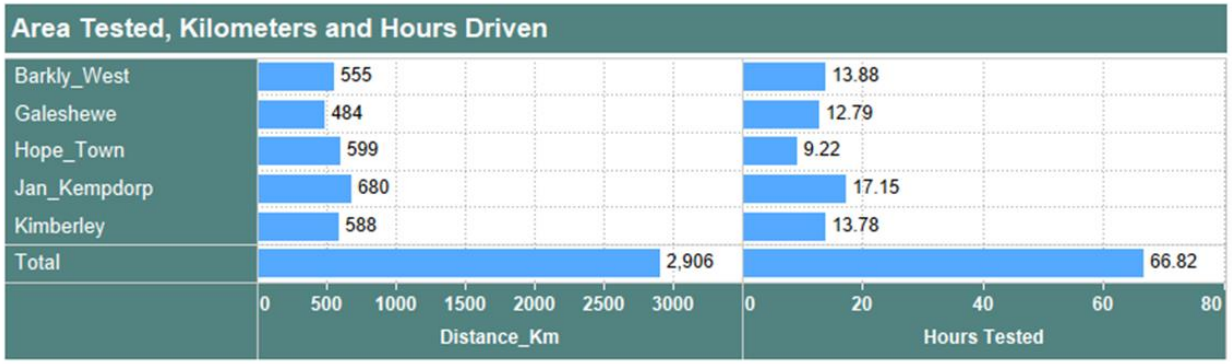
Routes and Dates			
District	**Area**	**Dates**	**Phase**
Frances Baard	Kimberley	04/08/2021 and 05/08/2021	Phase1
		19/08/2021 and 20/08/2021	Phase 2
	Galeshewe	6/8/2021 and- 11/8/2021	Phase1
		23/08/2021 and 24/08/2021	Phase 2
	Barkly West	12/8/2021	Phase1
		25/08/2021	Phase 2
	Jan Kempdorp	17/08/2021 and 18/08/2021	Phase1
		27/08/2021 and 28/08/2021	Phase 2
Pixley Ka Seme	Hopetown	13/08/2021	Phase1
		26/08/2021	Phase 2

Table 3: Static Points tested

Routes and Dates			
District	**Static Point**	**Dates**	**Phase**
Frances Baard	Kimberley Hospital Kimberley_Diamond_Pavillon_Shopping_Center Kimberley_Sol_Plaatje_University	3/8/2021	Phase1
	Galeshewe_DrWinston_Torres_Clinic Galeshewe_Police_Station Galeshewe_Urban_TVET_College	5/8/2021	Phase1
	Barkly_West_CBD_Post_Office Barkly_West_Delportshoop_High_School	12/8/2021	Phase1
	Jan_Kempdorp_Hartswater Jan_Kempdorp	18/8/2021	Phase 1
Pixley Ka Seme	Hope_Town_Community_Correction_Office Hope_Town_Orania	16/8/2021	Phase1

Table 4 shows the total distance covered in each area for two phases and active measurement duration.

Table 4. Distance and Measurement Duration per area



3.4. Test Overview

3.4.1. Measurement Environment

For this campaign, two main environments based on the SABS Standard for data[2] measurement environment were tested. The tests covered both stationary and mobile user simulations. The stationary tests are aligned to category S10 of the specification whilst the drive tests align to categories D2, D4 and D5 of the same specification. The 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.

Static Points of Interest (SPOI) Scenario – Category S10: The purpose of this scenario is to emulate an outdoor nomadic wireless user in a non-mobile situation at public points of concentration. These location types include shopping centres, municipal and malls, business districts and exhibition areas

3.4.2. Quality Control

When conducting benchmark testing, it is important to ensure that the test environment functions correctly throughout the campaign. The following measures were therefore put in place to ensure reliable and objective results:

- Daily integrity checks were performed on the vehicle installation and test equipment operation,

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

prior to the commencement of each day's test campaign.

- During the mobility test, there were two people in the test vehicle: a driver and technician responsible for monitoring the equipment.
- The same equipment was used throughout the campaign.
- Daily checks were performed on the collected test data for validation and checked for any abnormalities.

3.4.3. Test Cases

Packet switched/Data service benchmark testing is more complex than voice benchmark testing as there is number of 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 5 lists the test types used in the benchmarking campaign. These are widely used by operators and regulators around the world to measure the basic factors which affect users' experience of data; speed, latency (or response) and video content reproduction quality.

Table 5. Test Cases

Test Case	Key Measurements	Test Description
32-byte ICMP Ping	Round trip time or latency, in milliseconds	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. The server hosted within the Microsoft Azure environment making this the "Independent Server" 2. www.google.com.
HTTP	Download and Upload throughput	The 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 and uploaded between the independent server and the device to measure the throughput performance.
Capacity	1. HTTP (500MB) - Multiple files 2. Capacity Download and	1. Reference files are downloaded simultaneously from the test server to the users' device to measure capacity download throughput, using the HTTP 'get' command. 2. Reference files are uploaded simultaneously from the users'

Test Case	Key Measurements	Test Description
	Capacity Upload throughput speeds are measured	device to the test server to measure capacity upload throughput, using the HTTP 'put' command.
FTP	File transfer throughput, in kbps Download and Upload throughput speeds are measured	A reference file is downloaded 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. Throughput is the rate at which data is transferred from the server to the user or vice versa and is measured in kbps. The throughput speed varies in any data transfer session.
Browser	Web browsing session time (page loading) – measured for both HTTP and HTTPS protocols	This test case is associated with web page download or browsing. Customer experience in this environment is difficult to measure due to the dynamic nature of web pages, which carry dynamic content. In accordance with common international best practice, two test types were carried out to measure the page loading times and were as follows: 1. Testing of the ETSI Kepler reference page hosted on the independent, with static fixed size content. This allows repeatable test and measurement. The test server is configured in an HTML web page format, to test throughput as well as the time takes for the page to display on the user's device. This page provides both a mobile version as well as a standard desktop version and both pages were tested. 2. International and Local websites were also used to test HTTP and HTTPS performance from live websites with dynamic content with the following being selected. o MSN.com – **HTTPS Protocol** o News24.com – **HTTPS Protocol** o Google.co.za – **HTTPS Protocol** *NB: For the dynamic websites the content can vary throughout the day and hence the values are to be used as an indication of possible performance*

Test Case	Key Measurements	Test Description
YouTube	1. Video Average Resolution 2. ETSI YouTube Video Play Start 3. Integrity - Video Stream Visual Quality (Average over the stream) 4. Overall Access Success Ratio 5. YouTube Number of Freezing's	YouTube is the most popular video-sharing service on the mobile internet platform and is therefore commonly used as the reference test by MNOs for video experience. Testing involves repeated downloading and playback of a known video clip. The clip selected was 60 seconds long. *(https://www.youtube.com/watch?v=SjIlYK5BBlI)* The YouTube test was aimed at measuring the following elements that make up the customer experience: 1. How long does a subscriber wait before a video starts playing on their device? 2. At what resolution was the Video clip delivered to the user? 3. What would be the average perceived Video quality for the test? 4. The overall access success ratio per operator is the percentage of successful attempts to overall attempts. 5. YouTube number of Freezing shows the total number of freezing we experienced whilst streaming our Video clip.

4. Overall Results

This section provides a summary of the mobile operator's performance results based on the drive test routes in the following tested areas: Barkly West, Galeshewe, Jan Kempdorp, Hopetown, and Kimberley.

4.1. Mobile Drive Test Results

4.1.1. 3G Preferred Summary Results

Table 6 shows summary results obtained per KPI for 3G Preferred measurements.

Table 6. 3G Preferred Mobile Drive Test Summary Results

		Cell C	MTN	Telkom	Vodacom
File Transfer	HTTP DL Throughput - Average [Mbps]	4.94	5.73	6.01	6.46
	HTTP UL Throughput - Average [Mbps]	2.05	2.02	2.07	1.74
	Capacity DL Throughput - Average [Mbps]	5.57	6.7	7.92	6.63
	Capacity UL Throughput - Average [Mbps]	2.48	2.48	2.38	2.08
	FTP DL Throughput - Average [Mbps]	2.59	3.69	3.68	3.91
	FTP UL Throughput - Average [Mbps]	1.41	1.38	1.41	1.36
HTTPS Browser	Overall HTTPS Browsing -Web page Load Time[s]	4.44	4.11	4.27	4.28
	Kepler Page [s]	7.44	6.82	7.09	7.25
	Mobile Kepler Page [s]	2.02	1.64	1.89	1.86
	MSN [s]	3.46	3.05	3.25	3.01
	Google [s]	3.71	4.04	3.48	3.96
	News24 [s]	5.64	5.14	5.71	5.36
Data	Overall Average Ping Latency [ms]	99	111	135	71
	Average Ping - Google Website [ms]	78	102	182	70
	Average Ping - Independent Server [ms]	122	121	86	73
YouTube	YouTube Successful Ratio [%]	88.1	96.44	72.69	91.68
	YouTube Number of Freezing's	72	40	120	56
	YouTube Average Resolution [pixels]	801.27	899.69	895.35	896.16
	YouTube Access Time [s]	13.68	8.53	9.64	8.86
	YouTube Quality MOS	3.90	4.08	4.09	4.06

In Table 6, the value in the green blocks indicates the operator that is leading in that specific KPI. MTN led in 9 of the KPIs, followed by Vodacom which led in 6 KPIs, Telkom led in 5 KPIs and Cell C in 2. Telkom had no coverage in major parts of Hopetown, the operator also lacked coverage in parts of Barkly West, Galeshewe and outskirts of Kimberley.

4.1.1.1. 3G Preferred File Transfer Results

4.1.1.1.1. 3G Preferred HTTP Download

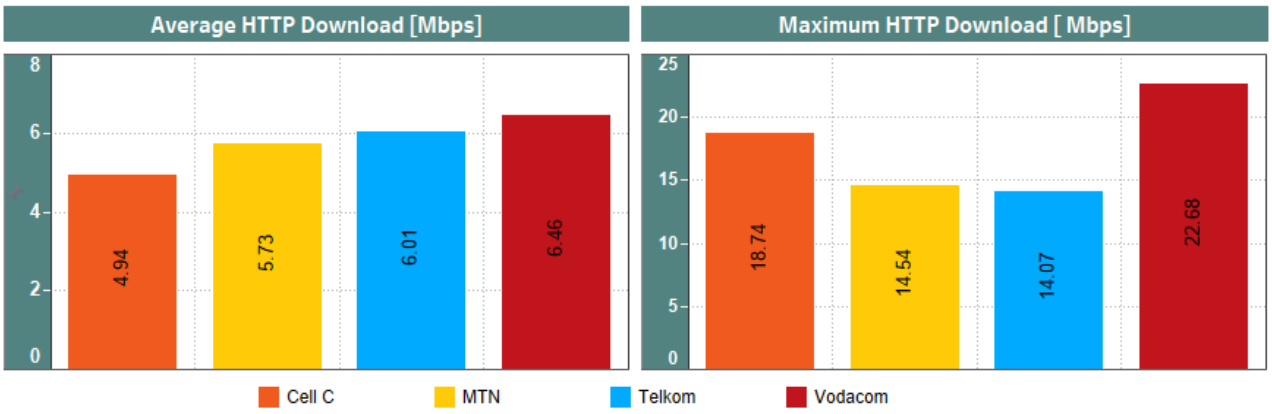


Figure 4. 3G Preferred average HTTP Download Throughput Overall results (Mbps)

Figure 4 provides a graphical view of the overall download file transfer results obtained in Table 6 and incorporates the average and maximum result values achieved by each operator. The results show that Vodacom achieved the highest results for average HTTP download throughput followed by Telkom, MTN and Cell C in descending order. Figure 4 also shows that Vodacom achieved the highest maximum HTTP throughput, followed by Cell C, MTN and Telkom.

Figure 5 shows the results per area. Vodacom achieved the highest results for average HTTP download throughput in Barkly West and Jan Kempdorp, MTN achieved the highest average throughput in Galeshewe and Kimberley. Telkom achieved the highest average download throughput in Hopetown.

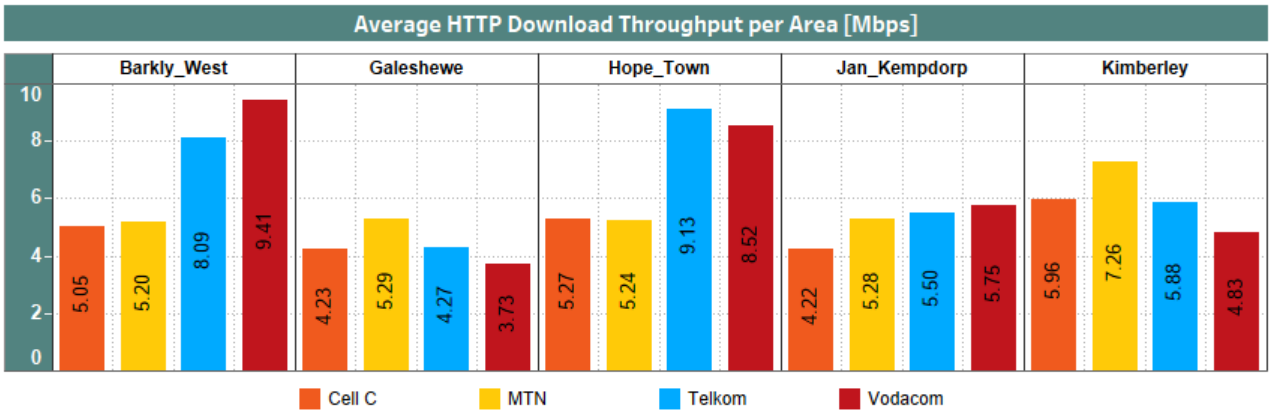


Figure 5. 3G Preferred average HTTP Download Throughput results per Area (Mbps)

4.1.1.1.2. 3G Preferred HTTP Capacity Download

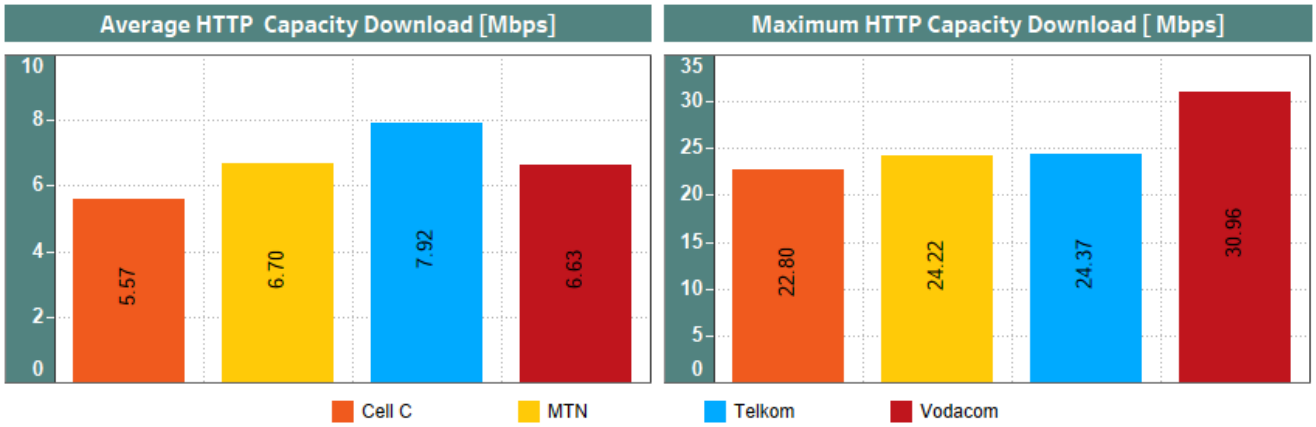


Figure 6. 3G Preferred HTTP Capacity Download Throughput Overall results (Mbps)

Figure 6 provides a graphical view of the overall download throughput results for HTTP Download Capacity Test and incorporates the maximum and average values achieved by each operator per KPI. The results show that Telkom achieved the highest results for average HTTP Capacity Download throughput followed by MTN, Vodacom and Cell C in descending order. Figure 6 also shows that Vodacom achieved the highest maximum HTTP Capacity Download throughput followed by Telkom, Cell C and MTN.

Figure 7 show**s** the results per area. Telkom achieved the highest results for average HTTP Capacity Download throughput in Barkly West, Jan Kempdorp and Hopetown. MTN achieved the highest average HTTP Capacity Download throughput in Galeshewe and Kimberley.

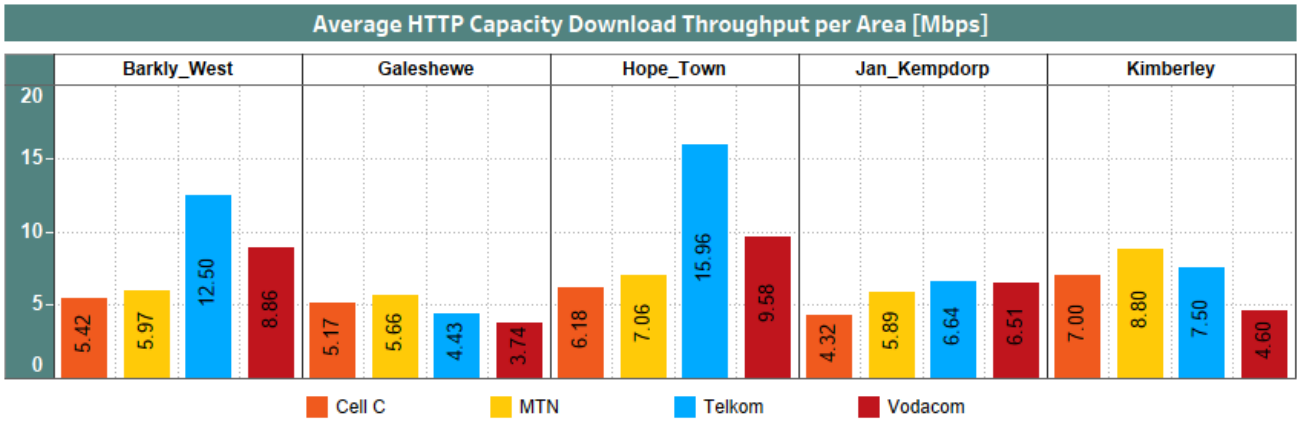


Figure 7. 3G Preferred average HTTP Capacity Download Throughput results per Area (Mbps)

4.1.1.1.3. 3G Preferred FTP Download

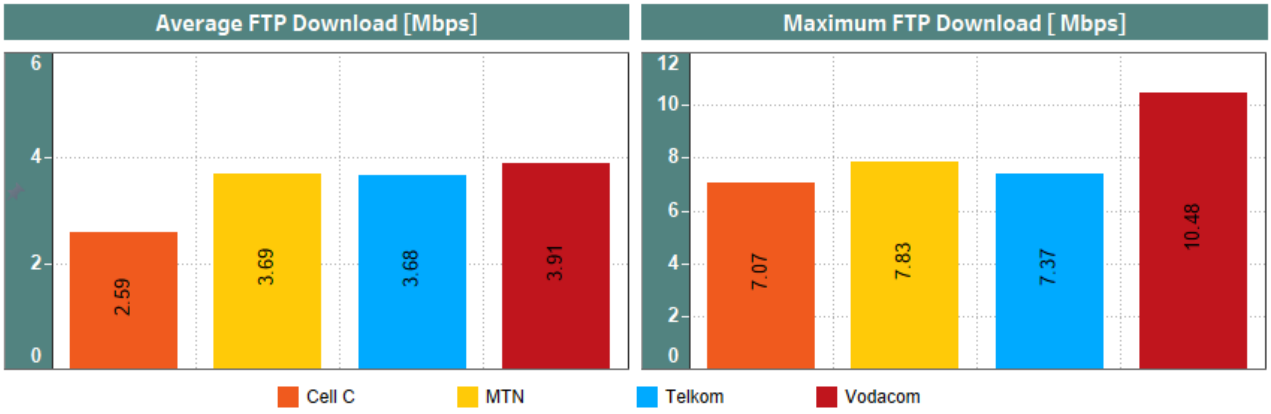


Figure 8. 3G Preferred FTP Download Throughput Overall results (Mbps)

Figure 8 provides a graphical view of the overall download file transfer results for FTP Download Test and incorporates the maximum and average values achieved by each operator per KPI. The results show that Vodacom achieved the highest results for average FTP Download throughput followed by MTN, Telkom and Cell C in a descending order. Vodacom also had the highest maximum FTP download throughput, followed by MTN, Telkom and Cell C.

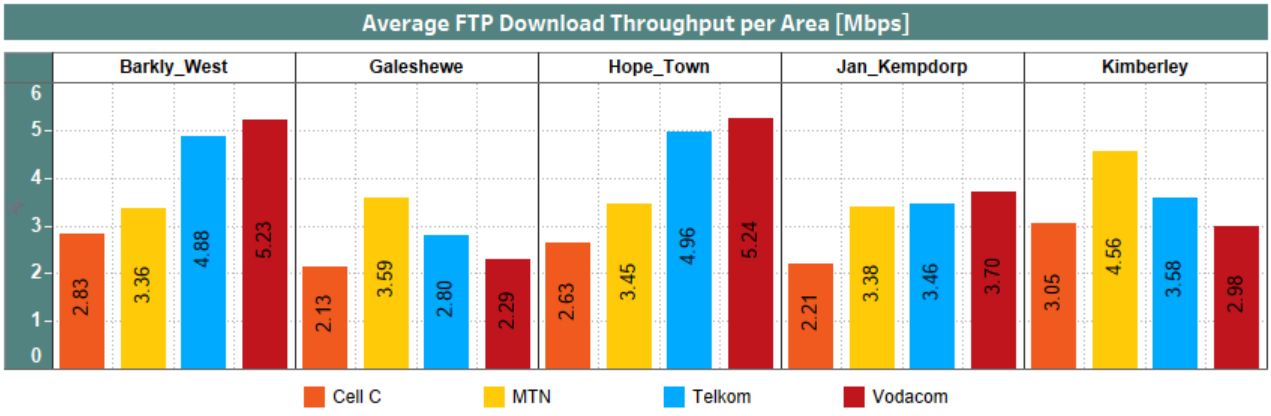


Figure 9. 3G Preferred average FTP Download Throughput results per Area (Mbps)

Figure 9 shows the results per area. Vodacom achieved the highest results for average FTP Download throughput in Barkly West, Hopetown, and Jan Kempdorp. MTN achieved the highest average FTP Download throughput in Galeshewe and Kimberley.

4.1.1.1.4. 3G Preferred HTTP Upload

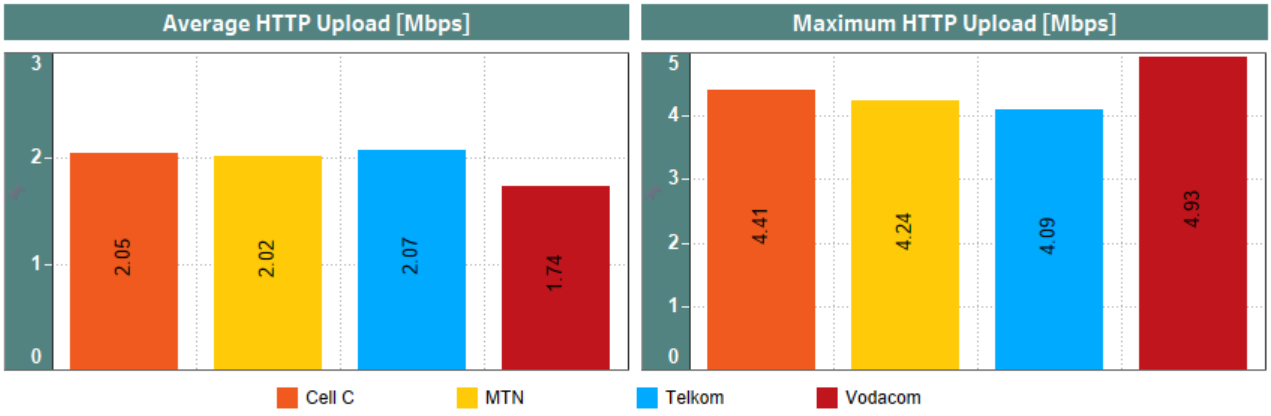


Figure 10.3G Preferred HTTP Upload Throughput Overall results (Mbps)

Figure 10 provides a graphical view of the upload file transfer results obtained in Table 6 for HTTP upload Test and incorporates the maximum and average values achieved by each operator. The results show that Telkom achieved the highest results for average HTTP upload throughput followed by Cell C, MTN and Vodacom. Vodacom led in the maximum HTTP upload throughput followed by Cell C, MTN and Telkom.

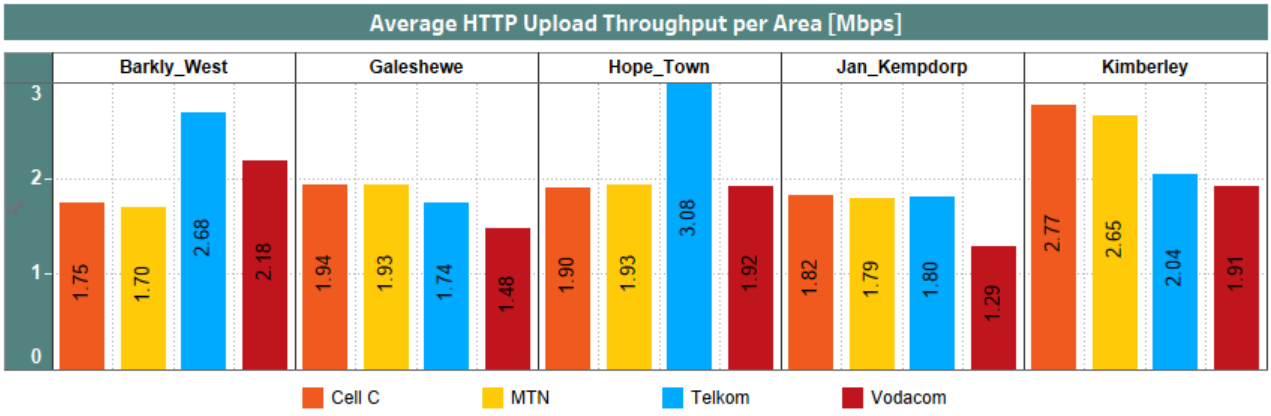


Figure 11. 3G Preferred HTTP Upload Throughput results per Area (Mbps)

Figure 11 shows results per area for average HTTP Upload throughput. Telkom achieved the highest results for average HTTP Upload throughput in Barkly West and Hopetown. Cell C led in Galeshewe Jan Kempdorp and Kimberley.

4.1.1.1.5. 3G Preferred HTTP Capacity Upload

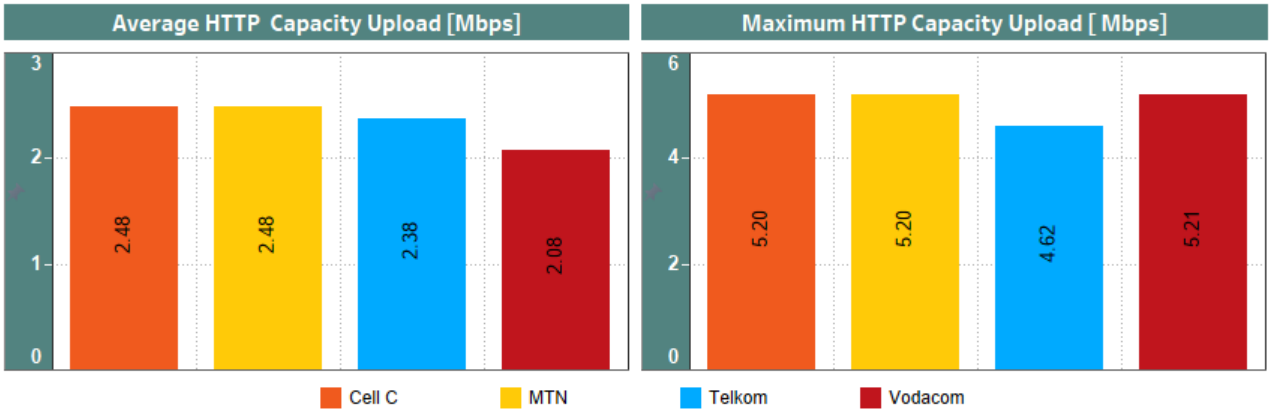


Figure 12. 3G Preferred HTTP Capacity Upload throughput Overall results (Mbps)

Figure 12 provides a graphical view of the upload file transfer results obtained in Table 6 for HTTP Capacity upload test and incorporates the maximum and average values achieved by each operator per KPI. Results in Figure 12 show that Cell C and MTN achieved the highest results for average HTTP Capacity upload throughput followed by Telkom and Vodacom. Cell C and MTN also achieved the highest maximum results for HTTP Capacity upload throughput.

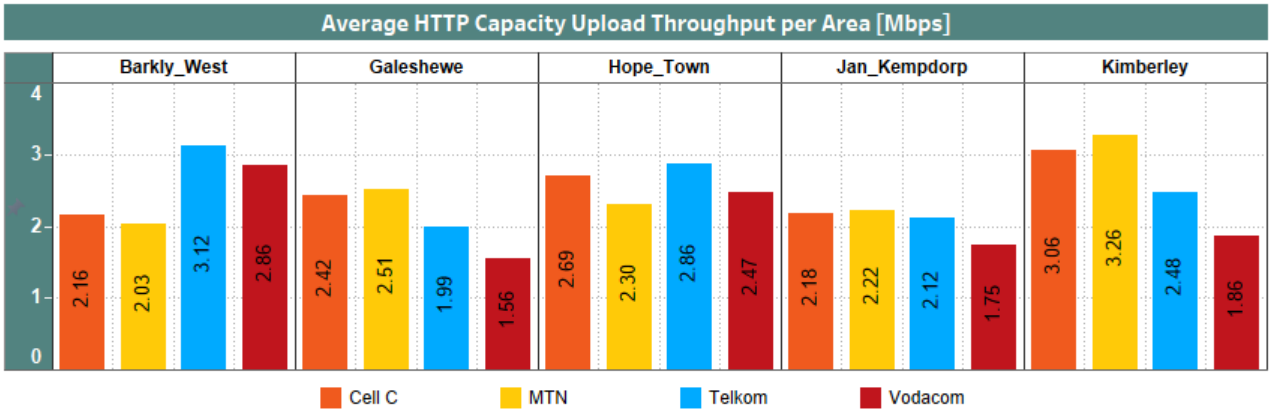


Figure 13. 3G Preferred File Transfer Upload throughput results per Area (Mbps)

Figure 13 show results per area per operator. MTN achieved the highest results for average HTTP Capacity upload throughput in Galeshewe, Jan Kempdorp and Kimberley. Telkom achieved highest results for average HTTP Capacity upload throughput in Barkly West and Hopetown.

4.1.1.1.6. 3G Preferred FTP Upload

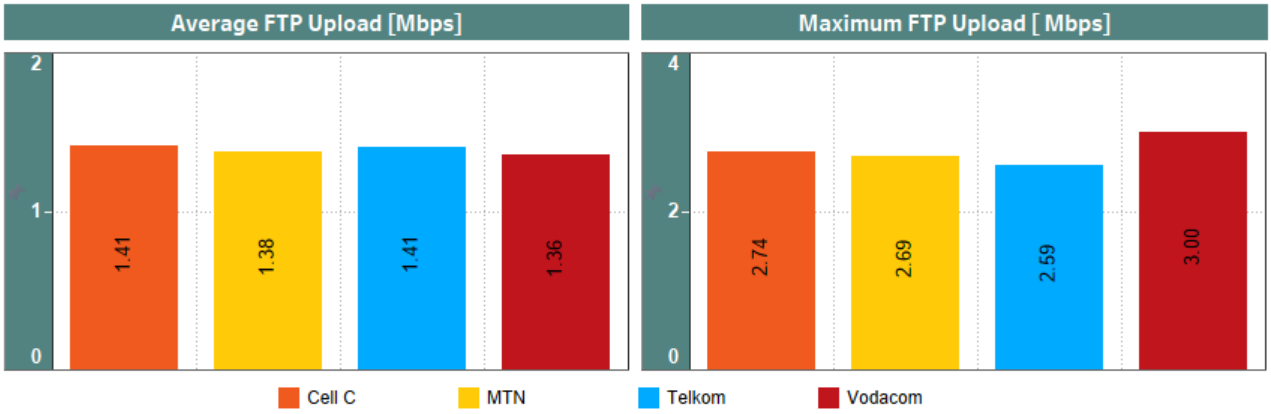


Figure 14. 3G Preferred FTP Upload Throughput Overall results (Mbps)

Figure 14 provides a graphical view of the download file transfer results obtained in Table 6 for FTP Upload test and incorporates the maximum and average values achieved by each operator per KPI. Results in Figure 12 show that all operators had similar results for average FTP Upload throughput. Figure 14 also show that Vodacom led in maximum FTP upload throughput followed by Cell C, MTN and Telkom in a descending order.

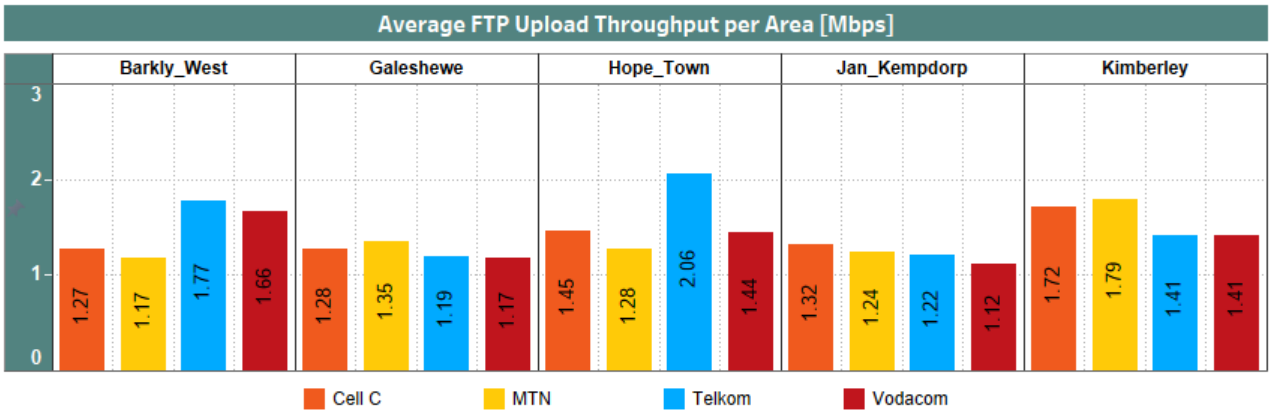


Figure 15. 3G Preferred average FTP Upload Throughput results per Area (Mbps)

Results in Figure 15 show that Telkom achieved the highest average FTP Upload throughput in Barkly West and Hopetown. MTN led in Galeshewe and Kimberley, and Cell C achieved the highest FTP Upload throughput in Jan Kempdorp.

4.1.1.2. 3G Preferred YouTube Results

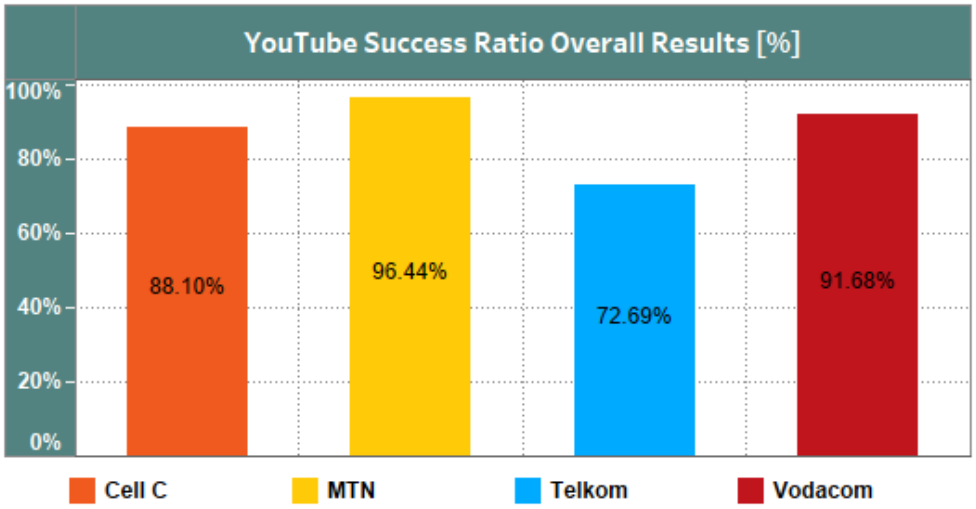


Figure 16. 3G Preferred YouTube Success Ratio Overall results [%]

Figure 16 shows MTN achieved the best 3G Preferred YouTube Overall Success ratio followed by Vodacom, Cell C and then Telkom in a descending order.

Figure 17 shows 3G Preferred YouTube Success Ratio per area. MTN achieved the highest YouTube Success Ratio in Galeshewe, Jan Kempdorp and Kimberley. Vodacom had the highest YouTube Success Ratio in Hopetown and Cell C had the highest YouTube Success Ratio in Barkly West.

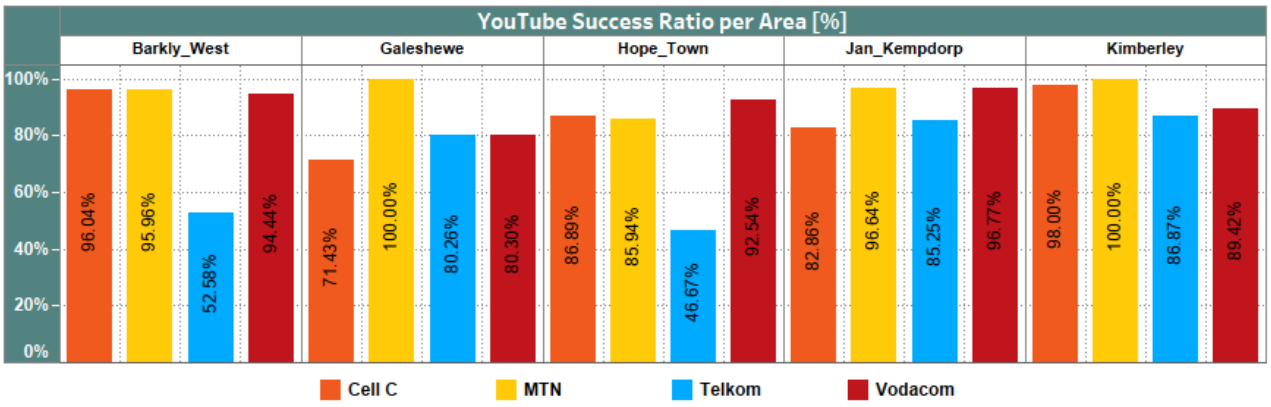


Figure 17. 3G Preferred YouTube Success Ratio results per Area [%]

4.1.1.3. 3G Preferred Web Browsing Page Download Time

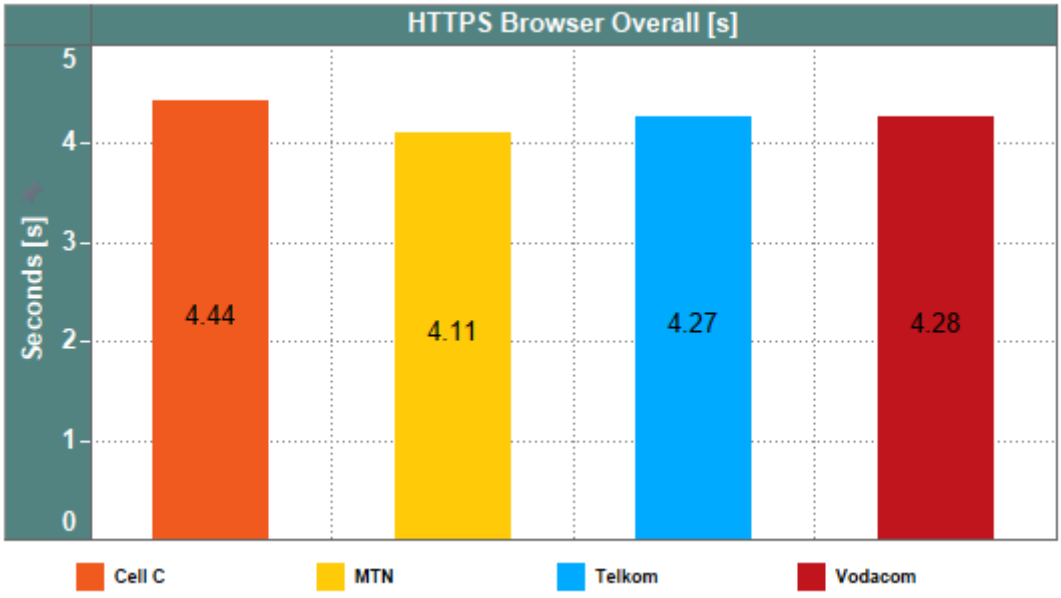


Figure 18. 3G Preferred HTTPS Web Browsing Overall Results [s]

Figure 18 depicts overall web browser page loading time in seconds for HTTPS protocol. MTN achieved the fastest browsing time for HTTPS protocol followed by Telkom, Vodacom, and Cell C.

Figure 19 shows 3G Preferred web browsing page loading time for HTTPS protocol per area. MTN achieved the fastest web browsing page load time in Galeshewe and Kimberley. Vodacom achieved the fastest webpage load time in Jan Kempdorp, and Telkom had the fastest web browsing page load time in Barkly West and Hopetown.

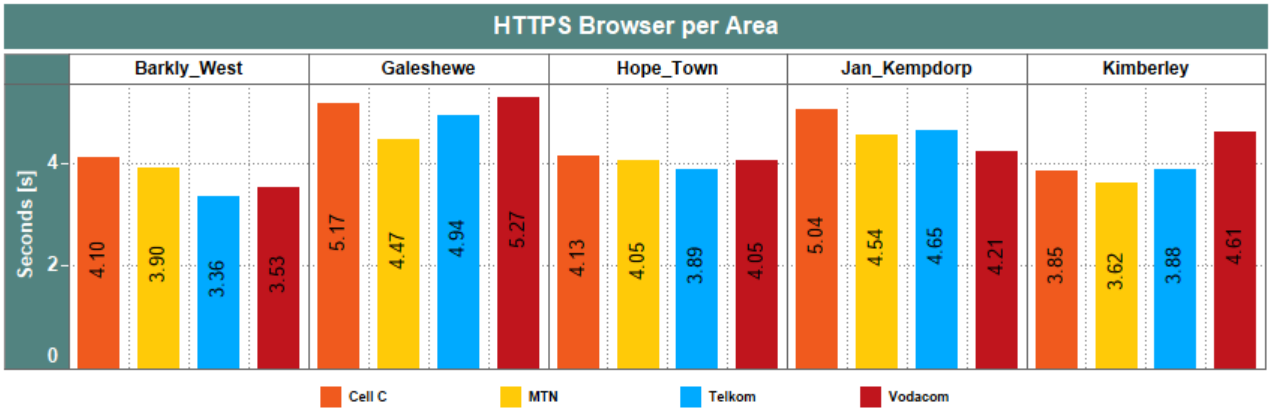


Figure 19. 3G Preferred HTTPS Web Browsing Results per Area [s]

4.1.1.4. 3G Preferred Ping Latency Results

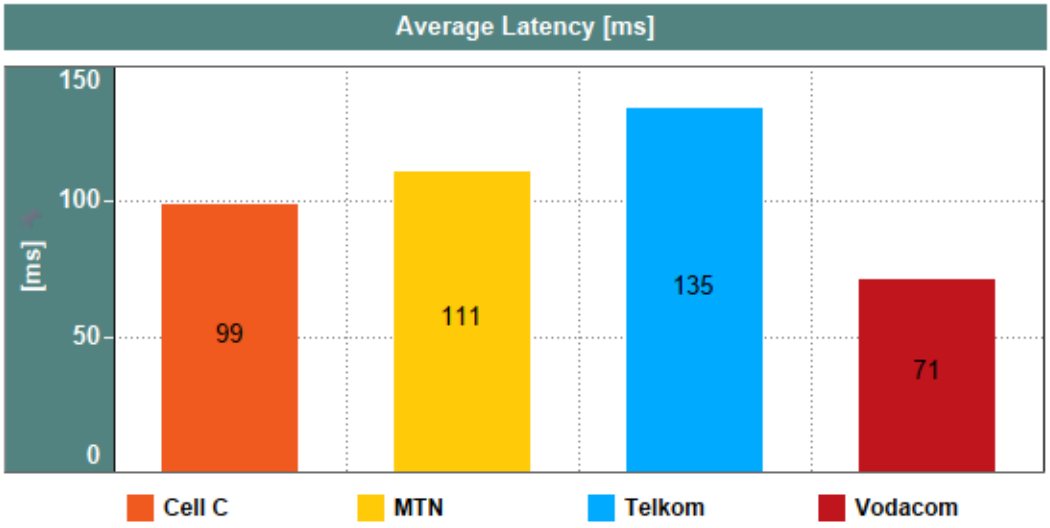


Figure 20. 3G Preferred Average Latency Overall Results (ms)

Figure 20 shows the overall results for ping tests. Vodacom achieved the lowest average latency followed by Cell C, MTN and Telkom.

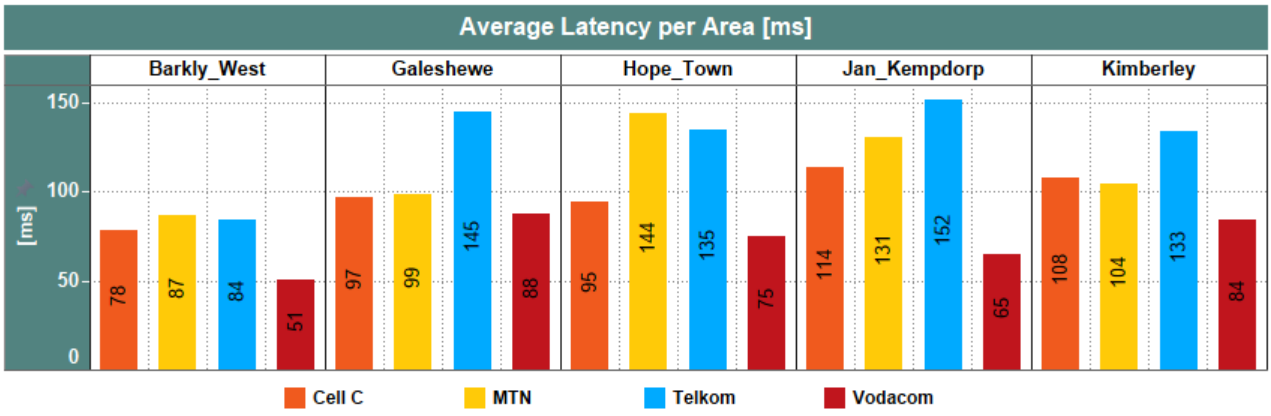


Figure 21. 3G Preferred Average Latency Results per Area (ms)

Figure 21 shows results per area for the ping tests. Vodacom achieved the lowest latency in all the 5 tested areas.

4.1.2. 4G Preferred Summary Results

4G Preferred results are based on a user whose smartphones are LTE capable and the device will select LTE as the preferred serving technology where available, move to UMTS in the absence of LTE and finally GSM in the absence of UMTS.

Table 7 shows summary results obtained per KPI for 4G Preferred testing.

Table 7: 4G Preferred Mobile Drive Test Results

		Cell C	MTN	Telkom	Vodacom
File Transfer	HTTP DL Throughput - Average [Mbps]	11.1	43.13	18.35	22.63
	HTTP DL Throughput - Average [Mbps]	8.2	19.74	6.09	9.81
	Capacity DL Throughput - Average [Mbps]	12.29	57.08	32.16	29.52
	Capacity UL Throughput - Average [Mbps]	8.4	20.94	9.63	10.95
	FTP DL Throughput - Average [Mbps]	5.72	10.68	8.7	10.28
	FTP UL Throughput - Average [Mbps]	4.71	9.01	3.94	6.12
HTTPS Browser	Overall HTTPs Browsing – Web page Load Time [s]	3.82	3.06	3.49	3.41
	Kepler Page [s]	6.77	6.25	6.72	6.68
	Mobile Kepler Page [s]	1.31	0.93	1.39	1.03
	MSN [s]	3.09	2.34	2.71	2.75
	Google [s]	3.21	1.88	2.21	2.20
	News24 [s]	4.75	3.92	4.42	4.42
Data	Overall Average Ping Latency [ms]	47	41	61	43
	Average Ping - Google Website [ms]	40	37	65	44
	Average Ping - Independent Server [ms]	54	44	57	42
YouTube	YouTube Successful Ratio [%]	96.04	98.5	76.89	95.95
	YouTube Number of freezing's	26	8	123	17
	YouTube Average Resolution [pixels]	928.45	1001.24	1007.13	996.82
	YouTube Access Time [s]	8.07	4.39	4.86	6.83
	YouTube Quality MOS	4.10	4.18	4.18	4.17

In table 7, the values in the green blocks indicate which operator is leading in that KPI. MTN led in eighteen (18) of the KPIs and had best performance for tests conducted in 4G Preferred mode. Telkom lacked coverage in major parts of Hopetown. The operator had similar coverage issues in parts of Barkly West, Galeshewe and outskirts of Kimberley.

4.1.2.1. 4G Preferred File Transfer Results

4.1.2.1.1. 4G Preferred HTTP Download

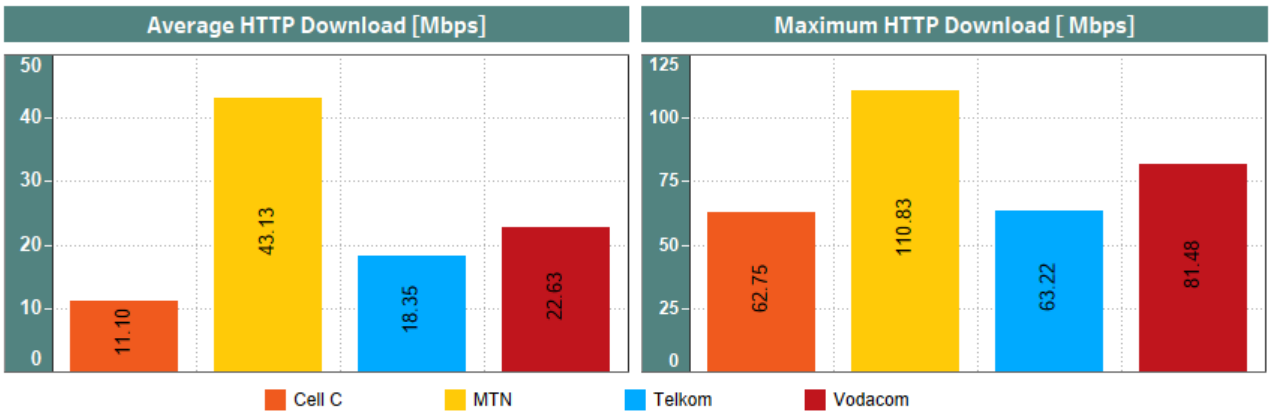


Figure 22. 4G Preferred HTTP Download Throughput Overall Results (Mbps)

Figure 22 provides a graphical view of the results obtained in Table 7 for HTTP Download test and incorporates the maximum and average values achieved by each operator. MTN achieved the highest results for average HTTP Download throughput followed by Vodacom, Telkom and then Cell C in a descending order. MTN also achieved best results for maximum HTTP Capacity download throughput, followed by Vodacom, Telkom, and Cell C in a descending order.

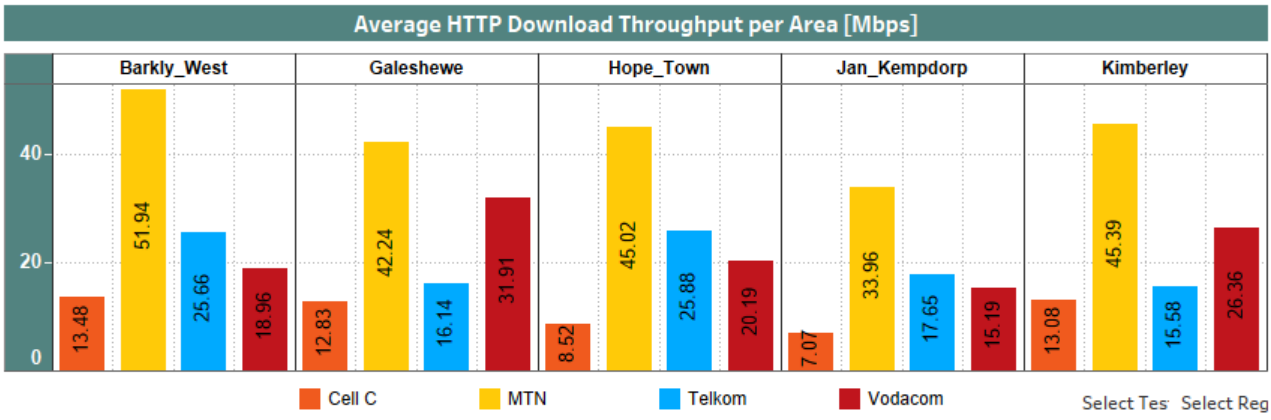


Figure 23. 4G Preferred average HTTP Download Throughput results per Area (Mbps)

Figure 23 shows that MTN achieved the highest results for average HTTP download average throughput in all the 5 tested areas. Cell C had the lowest average HTTP download throughput for 4G Preferred tests.

4.1.2.1.2. 4G Preferred HTTP Capacity Download

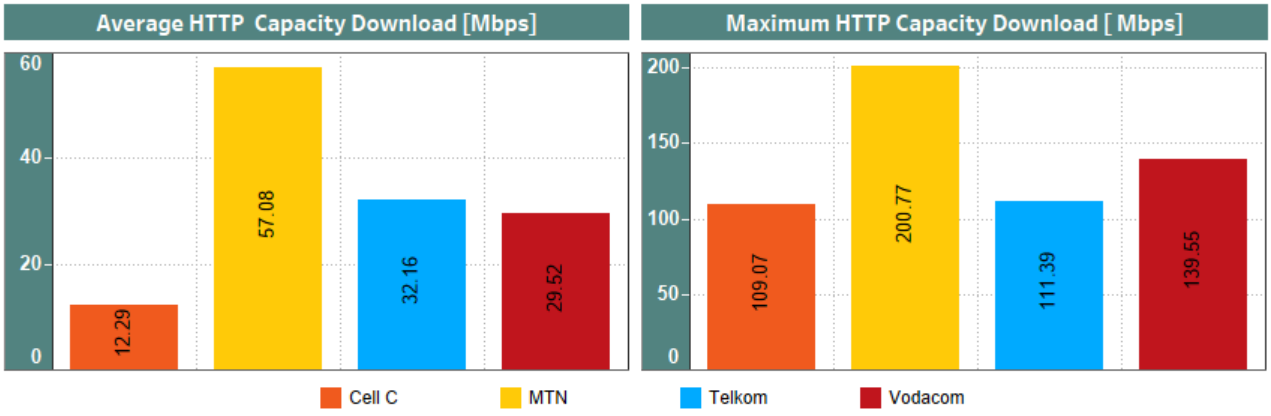


Figure 24. 4G Preferred HTTP Capacity Download Throughput Overall Results (Mbps)

Figure 24 provides a graphical view of the results obtained in Table 7 for HTTP Capacity Download test and incorporates the maximum and average values achieved by each operator. MTN achieved the highest results for average HTTP Capacity Download throughput followed by Telkom, Vodacom, and Cell C in a descending order. In terms of maximum HTTP Capacity download throughput, MTN achieved the highest results followed by Vodacom, Telkom, and Cell C in descending order.

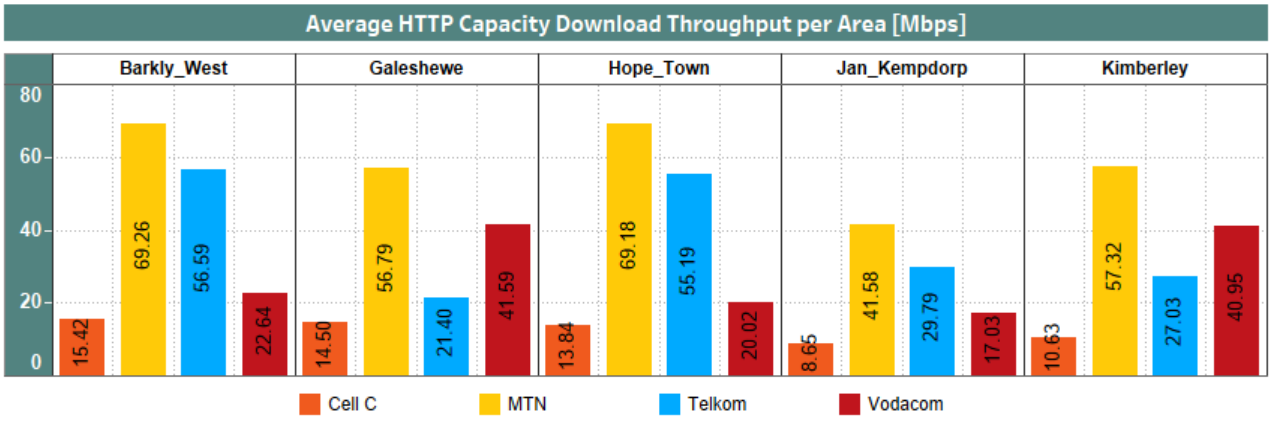


Figure 25. 4G Preferred HTTP Capacity Download Throughput results per Area (Mbps)

Figure 25 shows that MTN achieved the highest results for HTTP Capacity Download throughputs in all the tested areas.

4.1.2.1.3. 4G Preferred FTP Download

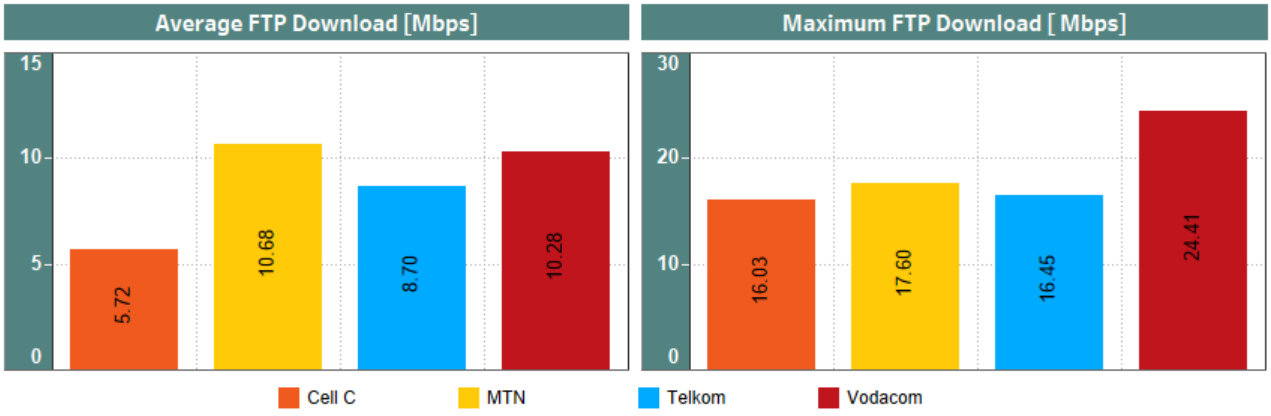


Figure 26.4G Preferred FTP Download Throughput Overall Results (Mbps)

Figure 26 provides a graphical view of the results obtained in Table 7 for FTP Download test and incorporates the maximum and average values achieved by each operator. MTN achieved the highest results for average FTP Download throughput followed by Vodacom, Telkom, and Cell C in a descending order. Vodacom achieved highest results for maximum FTP download throughput, followed by MTN, Telkom and Cell C in a descending order.

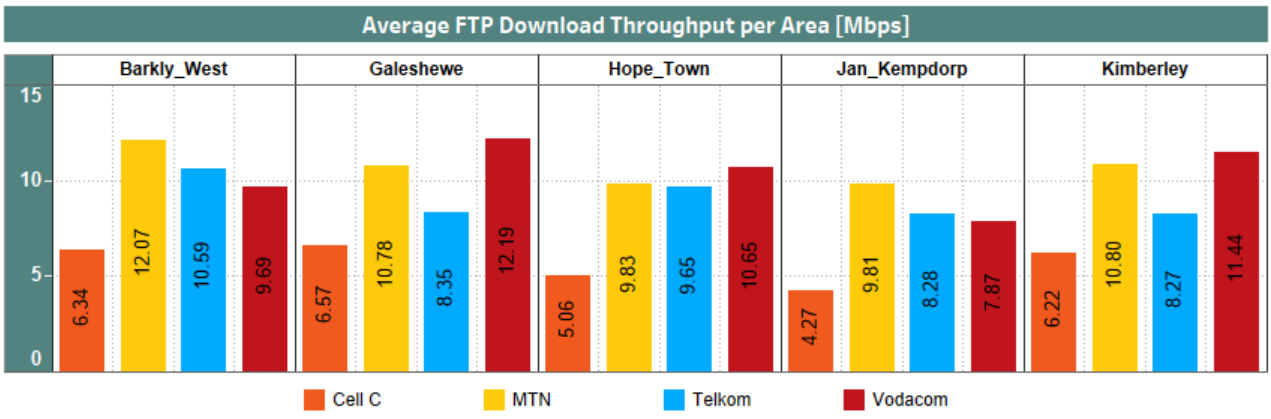


Figure 27. 4G Preferred average FTP Download Throughput Results per Area (Mbps)

Figure 27 shows that MTN achieved the highest results for average FTP download throughput in Barkly West and Jan Kempdorp, Vodacom achieved the highest results in Galeshewe, Hopetown and Kimberley.

4.1.2.1.4. 4G Preferred HTTP Upload

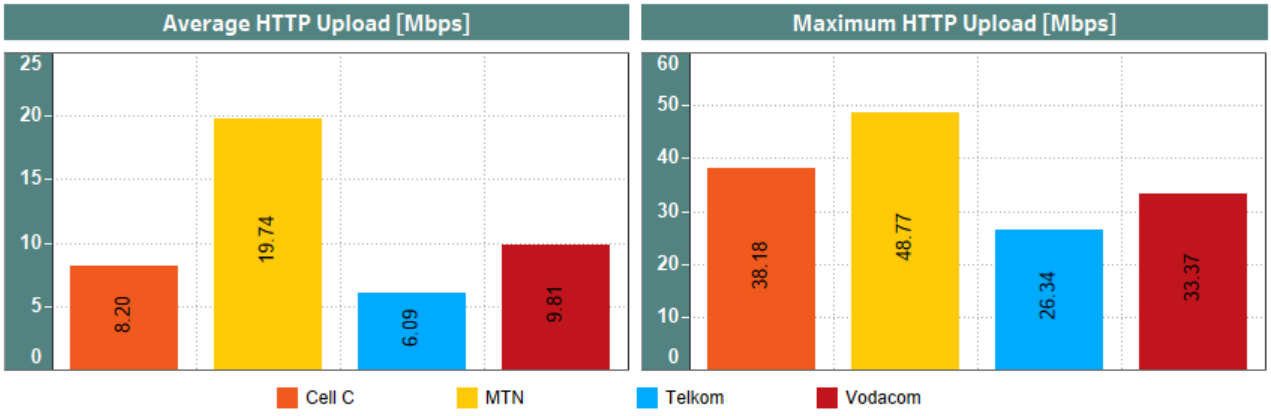


Figure 28. 4G Preferred HTTP Upload Throughput Overall Results (Mbps)

Figure 28 provides a graphical view of the results obtained in Table 7 for HTTP Upload test and incorporates the maximum and average values achieved by each operator. It shows that MTN achieved the highest results for average HTTP Upload throughput followed by Vodacom, Cell C and then Telkom in a descending order. For maximum HTTP Capacity upload throughput, MTN achieved the highest overall results followed by Cell C, Vodacom, and Telkom in a descending order.

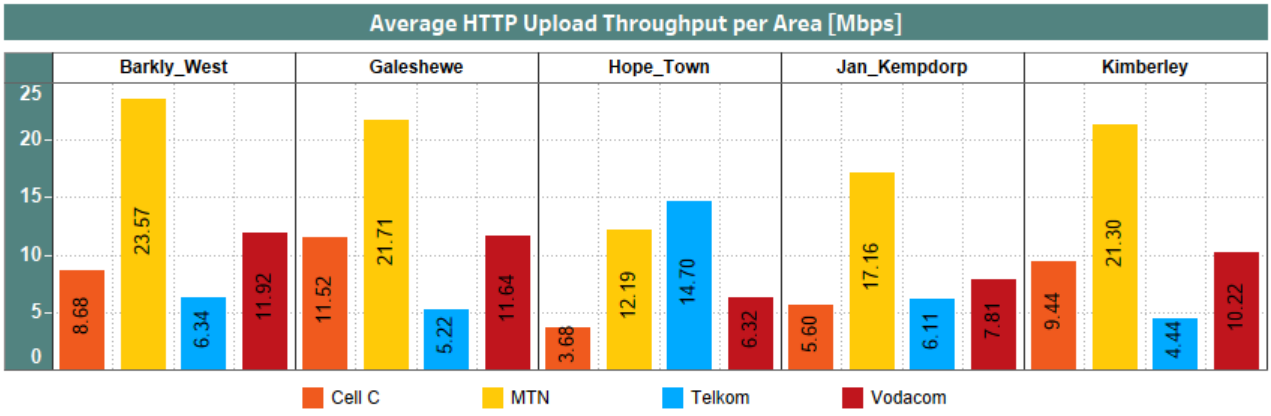


Figure 29. 4G Preferred HTTP Upload Throughput Results per Area (Mbps)

Figure 29 shows test results per area per operator. MTN achieved the highest results for average HTTP Upload throughput in Barkly West, Galeshewe, Jan Kempdorp and Kimberley. Telkom led in Hopetown.

4.1.2.1.5. 4G Preferred HTTP Capacity Upload

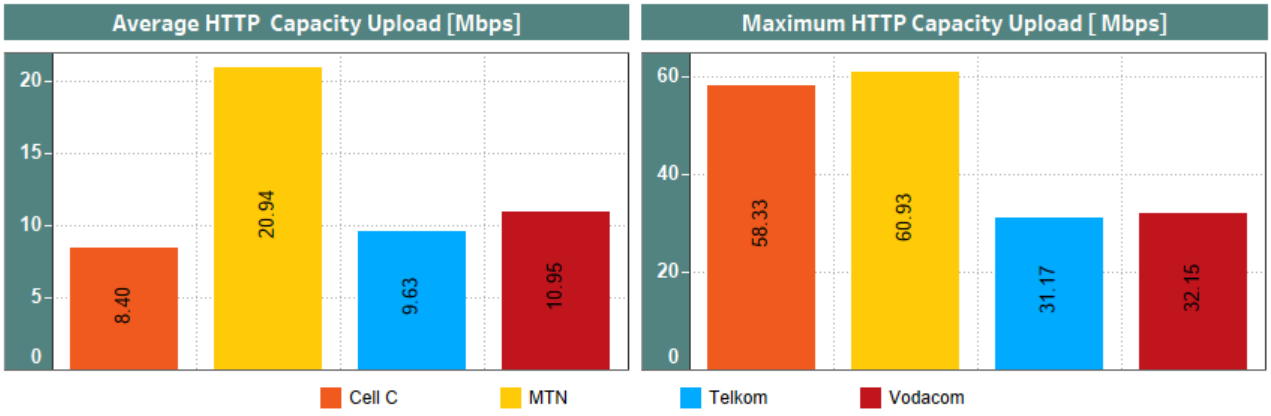


Figure 30. 4G Preferred HTTP Capacity Upload Overall Results (Mbps)

Figure 30 provides a graphical view of the results obtained in Table 7 for HTTP Capacity Upload tests and incorporates the maximum and average values achieved by each operator. It shows that MTN achieved the highest results for average HTTP Capacity Upload throughput followed by Vodacom, Telkom, and Cell C in a descending order.

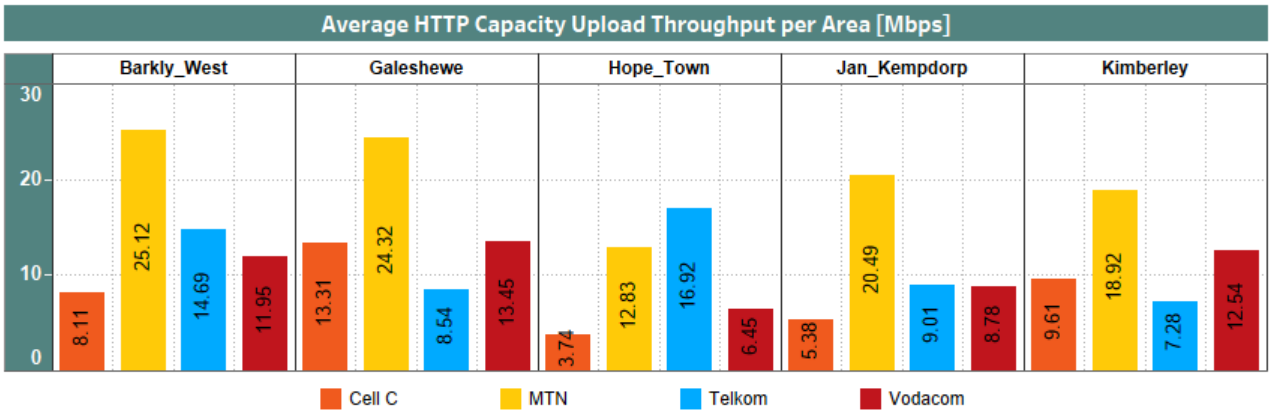


Figure 31. 4G Preferred average HTTP Capacity Upload Results per Area (Mbps)

Figure 31 shows results per area per operator. that MTN achieved the highest results for HTTP Capacity Upload in all the 4 areas Telkom was found to be leading in Hopetown.

4.1.2.1.6. 4G Preferred FTP Upload

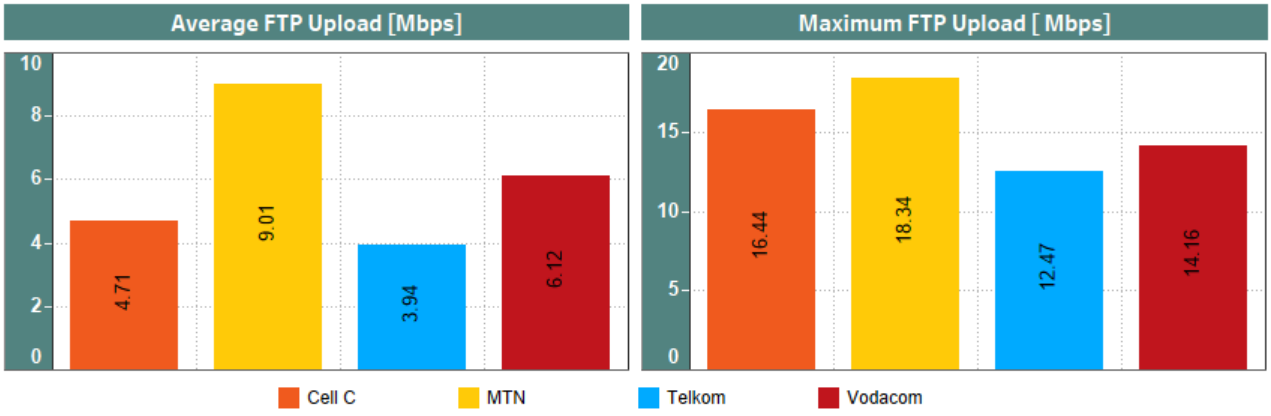


Figure 32. 4G Preferred FTP Download Overall Results (Mbps)

Figure 32 above provides a graphical view of the results obtained in Table 7 for FTP Upload test and incorporates the maximum and average values achieved by each operator. It shows that MTN achieved the highest results for average FTP upload throughput followed by Vodacom, Cell C and Telkom in a descending order.

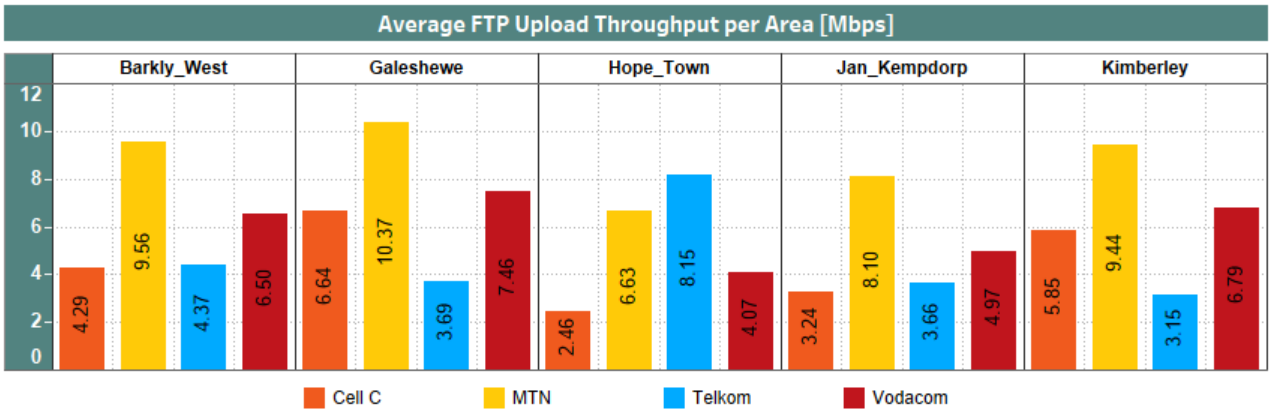


Figure 33. 4G Preferred Average FTP Upload Results per Area

Figure 33 shows that MTN achieved the highest results for average FTP Upload in 4 tested areas except in Hopetown where Telkom was found to be leading in average FTP Upload throughput.

4.1.2.2. 4G Preferred YouTube Results

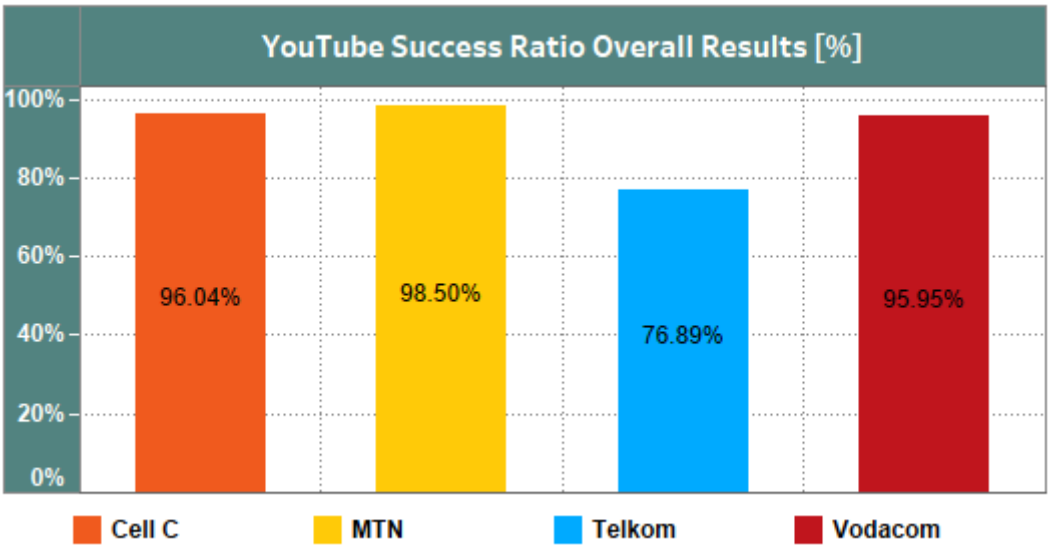


Figure 34. 4G Preferred YouTube Success Ratio Overall results (%)

Figure 34 shows MTN achieved the best 4G Preferred YouTube Overall Success ratio followed by Cell C, Vodacom and then Telkom in a descending order.

Figure 35 shows 4G Preferred YouTube Success Ratio per area. MTN achieved the highest YouTube Success Ratio in 4 out of 5 tested areas: Galeshewe, Jan Kempdorp, Hopetown, and Kimberley. Cell C had the highest YouTube Success Ratio in Barkly West.

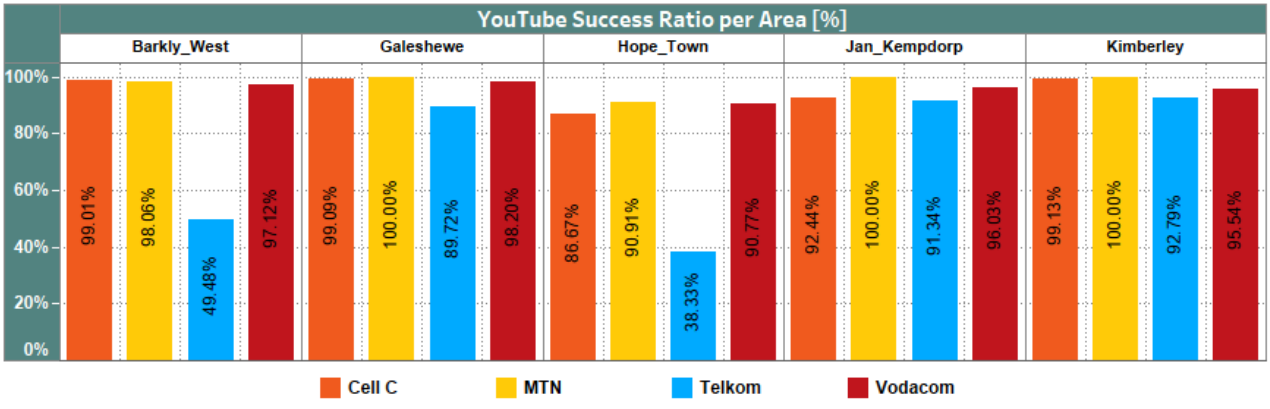


Figure 35. 4G Preferred YouTube Success Ratio results per Area (%)

4.1.2.3. 4G Preferred Web Browsing Page Download Time

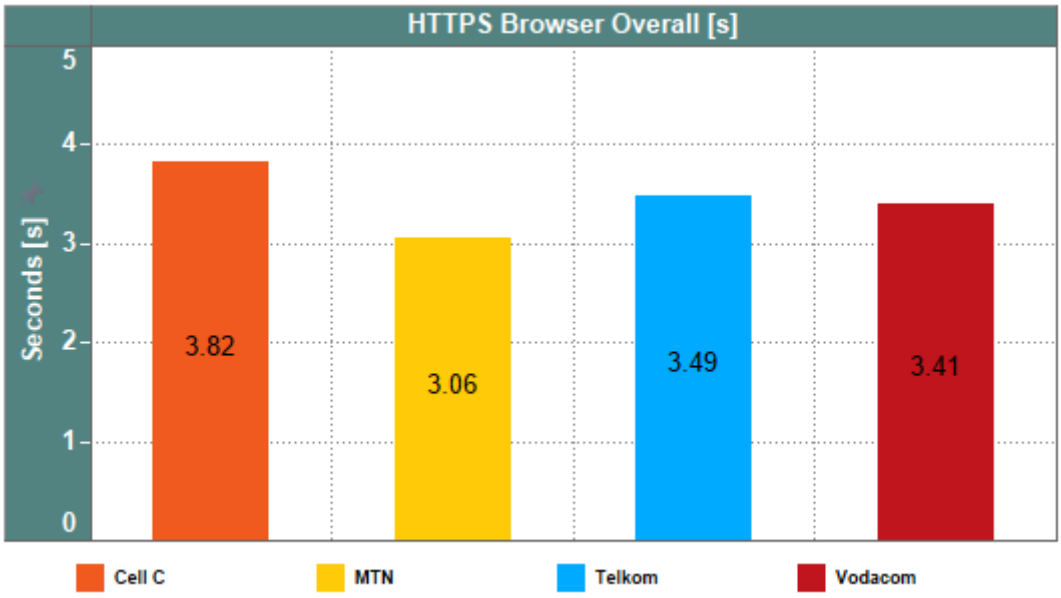


Figure 36. 4G Preferred Web Browsing Page load Time Overall Result (s)

Figure 36 depicts 4G Preferred overall web browser page load time for HTTPS protocol. MTN achieved the fastest browsing time followed by Vodacom, Telkom, and Cell C.

Figure 37 shows 4G Preferred web browsing page load time for HTTPS protocol per area. MTN achieved the fastest browsing time in all the 5 tested areas.

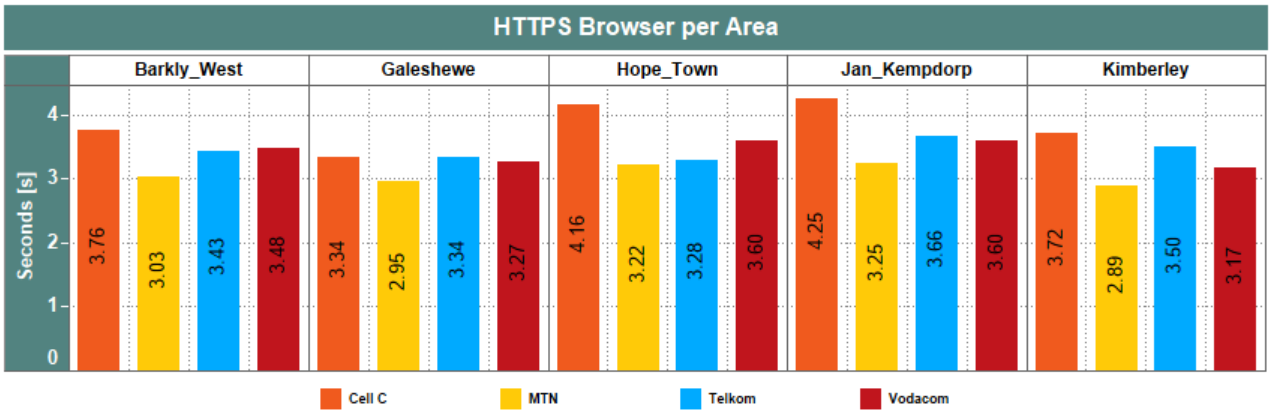


Figure 37. 4G Preferred HTTPS Web Browsing Page load Time Results per Area [s

4.1.2.4. 4G Preferred Ping Latency Results

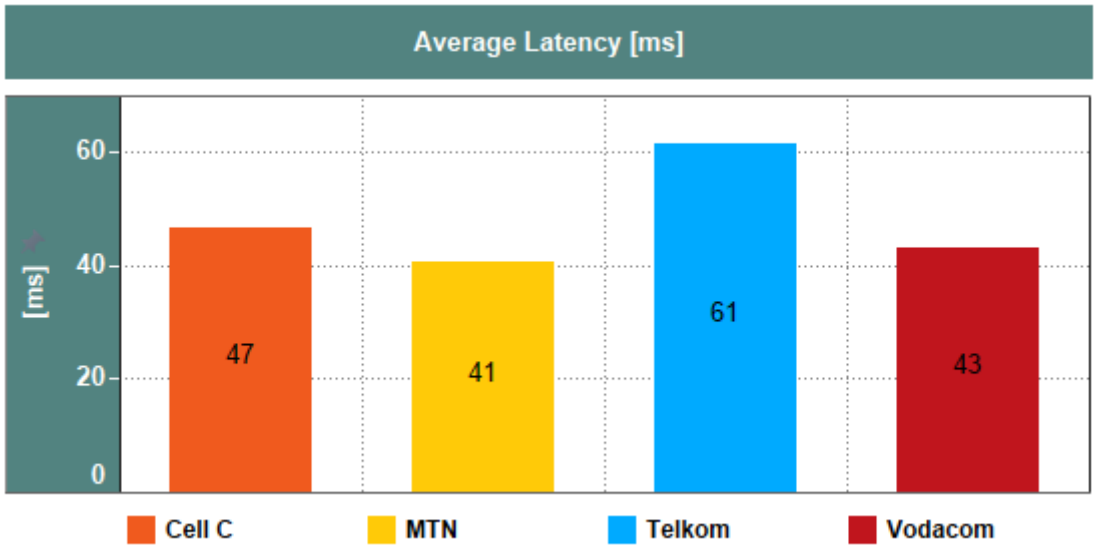


Figure 38. 4G Preferred Average Ping Latency Overall Result (ms)

Figure 38 shows that MTN achieved the best latency in overall results followed by Vodacom, Cell C and Telkom.

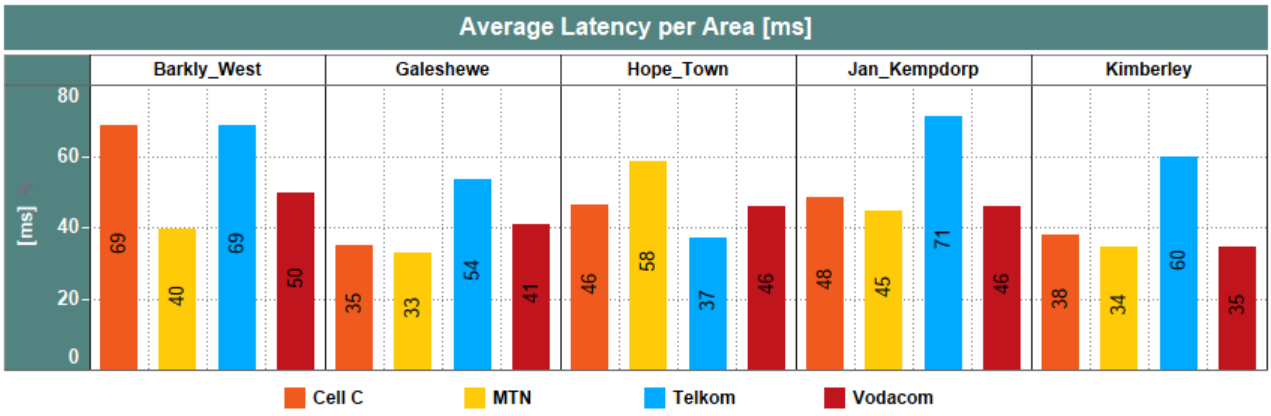


Figure 39. 4G Preferred Average Ping Latency Result per Area (ms)

Figure 39 shows that MTN had the lowest latency for ping tests in Barkly West, Galeshewe, Jan Kempdorp and Kimberley. Telkom achieved the lowest latency in Hopetown.

4.2. Stationary Results

4.2.1. 3G Preferred Summary Results

Table 8 shows summary results obtained per KPI for 3G Preferred testing for Stationary Points.

Table 8: 3G Preferred Mobile Stationary Test Summary Results

		Cell C	MTN	Telkom	Vodacom
File Transfer	HTTP DL Throughput - Average [Mbps]	5.26	6.40	7.30	7.89
	HTTP UL Throughput - Average [Mbps]	2.31	2.33	2.40	2.47
	Capacity DL Throughput - Average [Mbps]	5.76	7.72	11.79	8.92
	Capacity UL Throughput - Average [Mbps]	2.83	2.95	2.96	3.11
	FTP DL Throughput - Average [Mbps]	2.82	4.13	4.70	4.91
	FTP UL Throughput - Average [Mbps]	1.53	1.61	1.62	1.78
HTTPS Browser	Overall HTTPs Browsing – Web page Load Time[s]	4.08	3.67	3.59	3.70
	Kepler Page	6.87	6.68	6.29	6.79
	Mobile Kepler Page	2.10	1.22	1.19	1.29
	MSN	3.12	2.77	2.99	2.81
	Google	3.50	3.30	2.67	3.20
	News24	4.83	4.35	4.81	4.36
Data	Overall Average Ping Latency– Round Trip Time [ms]	84	76	134	56
	Average Ping Latency- Google Website	91	72	184	62
	Average Ping Latency - Independent Server	77	79	82	49
YouTube	YouTube Successful Ratio [%]	90.11	99.03	90.02	94.00
	YouTube Number of freezing's	6	1	10	11
	YouTube Average Resolution [pixels]	852.10	976.35	974.11	947.41
	YouTube Access Time [s]	13.54	6.65	6.95	7.43
	YouTube Quality MOS		4.18	4.17	

In Table 8, the values in the green blocks indicate which operator is leading in that KPI. Vodacom led in most of the throughput and Latency KPIs, MTN led in YouTube KPIs. Telkom led in Web Browsing Page load Time KPIs.

4.2.1.1. 3G Preferred Stationary HTTP Download

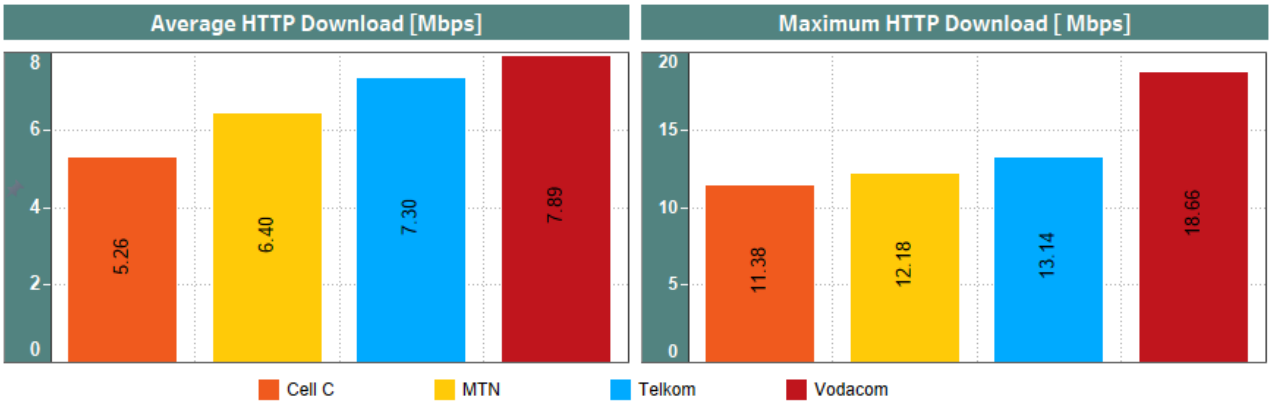


Figure 40. Stationary 3G Preferred HTTP Download Throughput Overall results (Mbps)

Figure 41 shows that for overall results Vodacom achieved the highest stationary HTTP download throughput for both average and maximum HTTP download throughput, followed by Telkom, MTN and Cell C in descending order.

Figure 42 shows 3G Preferred HTTP download throughput per stationary point.

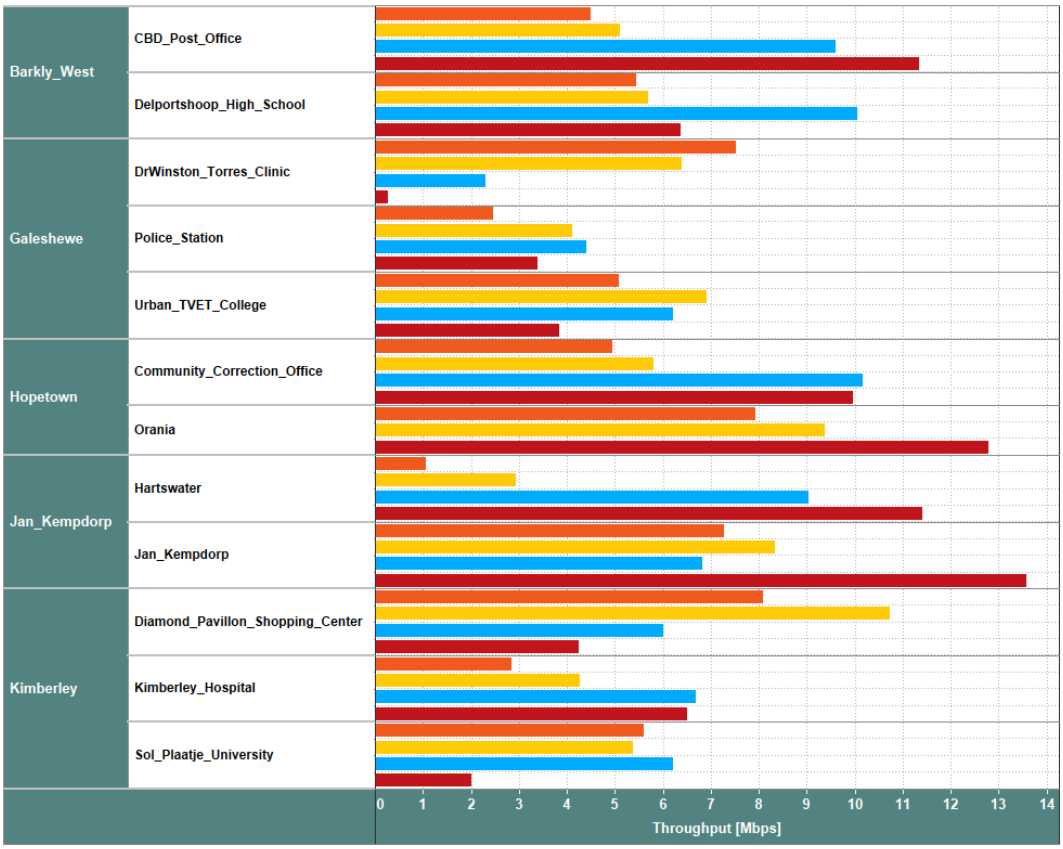


Figure 41. 3G Preferred HTTP Download Throughput results per Stationary Point (Mbps)

4.2.1.2. 3G Preferred Stationary Capacity Download

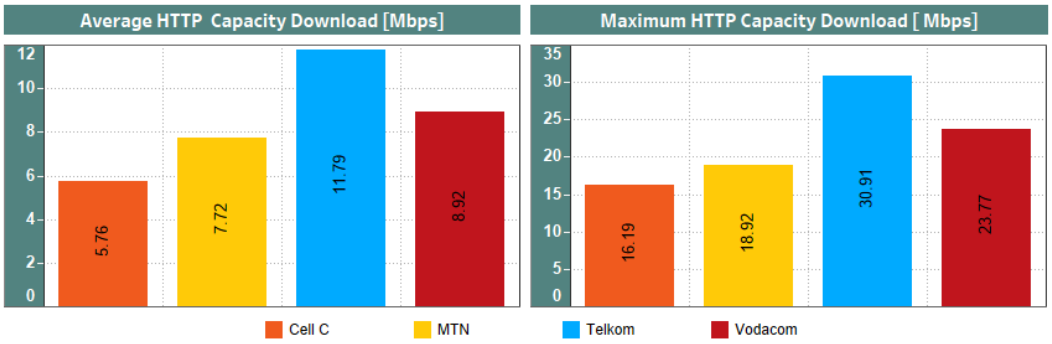


Figure 42. Stationary 3G Preferred HTTP Capacity Download Throughput Overall results (Mbps)

Figure 42 show that Telkom achieved the highest stationary results for both average HTPP download throughput and maximum HTTP capacity download throughput, followed by Vodacom, MTN and Cell C in a descending order.

Figure 43 shows 3G Preferred HTTP capacity download throughput per stationary point.

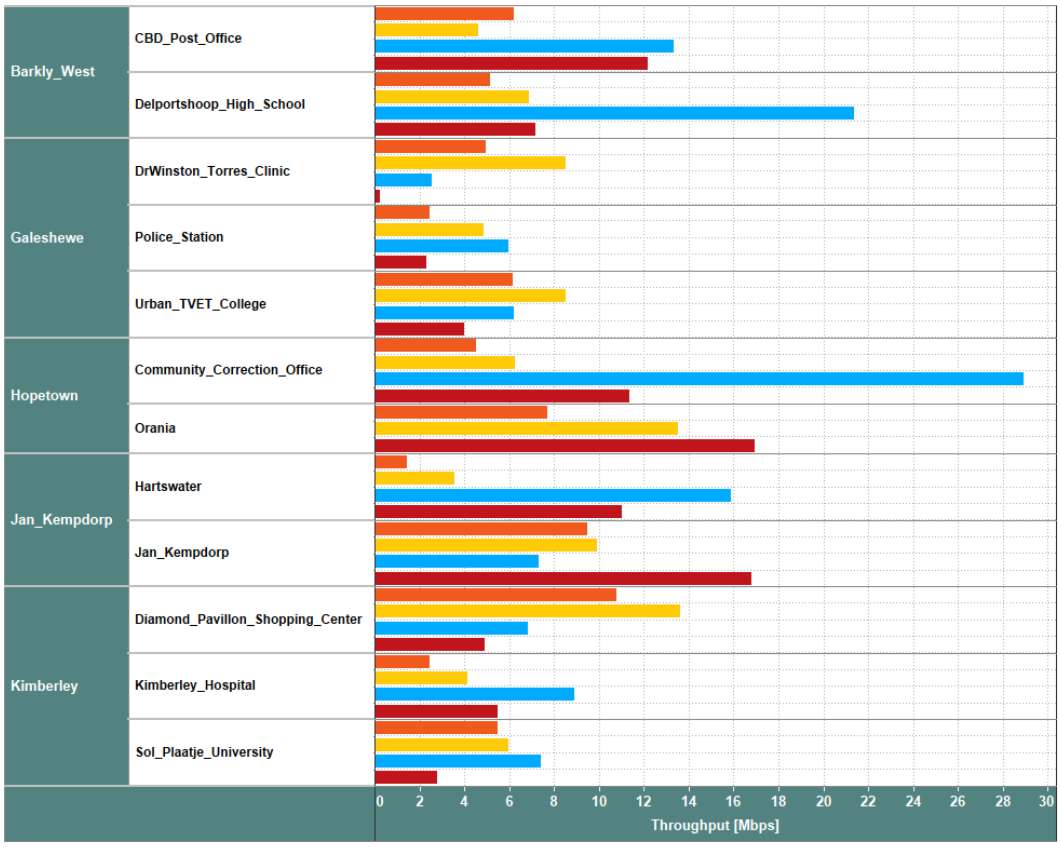


Figure 43. 3G Preferred HTTP Capacity Download Throughput results per Stationary Points (Mbps)

4.2.1.3. 3G Preferred Stationary FTP Download

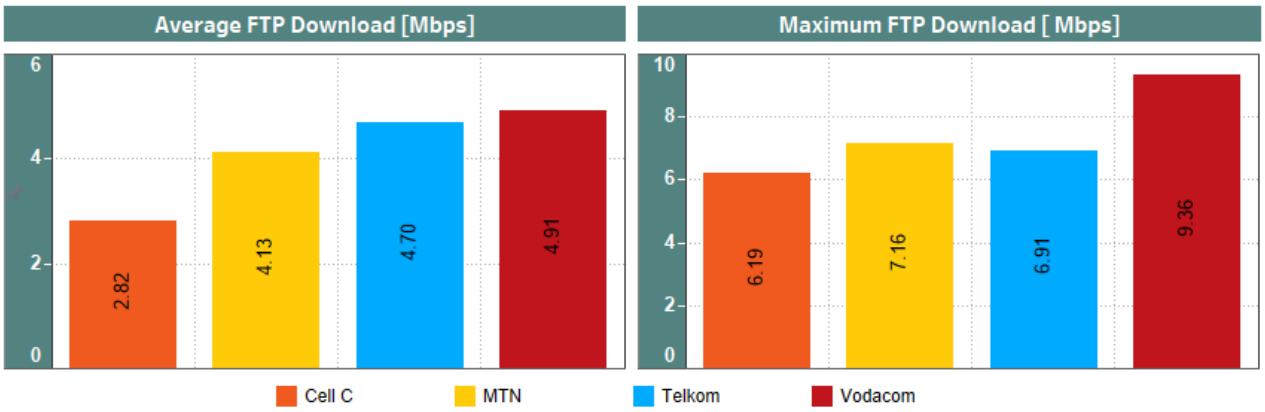


Figure 44. Stationary 3G Preferred FTP Download Throughput Overall results (Mbps)

Figure 44 show that Vodacom achieved the highest stationary average FTP download throughput, followed by Telkom, MTN and Cell C in a descending order. Vodacom also achieved the highest maximum FTP download throughput, followed by MTN, Telkom and Cell C.

Figure 45 shows 3G Preferred FTP download throughput per stationary point.

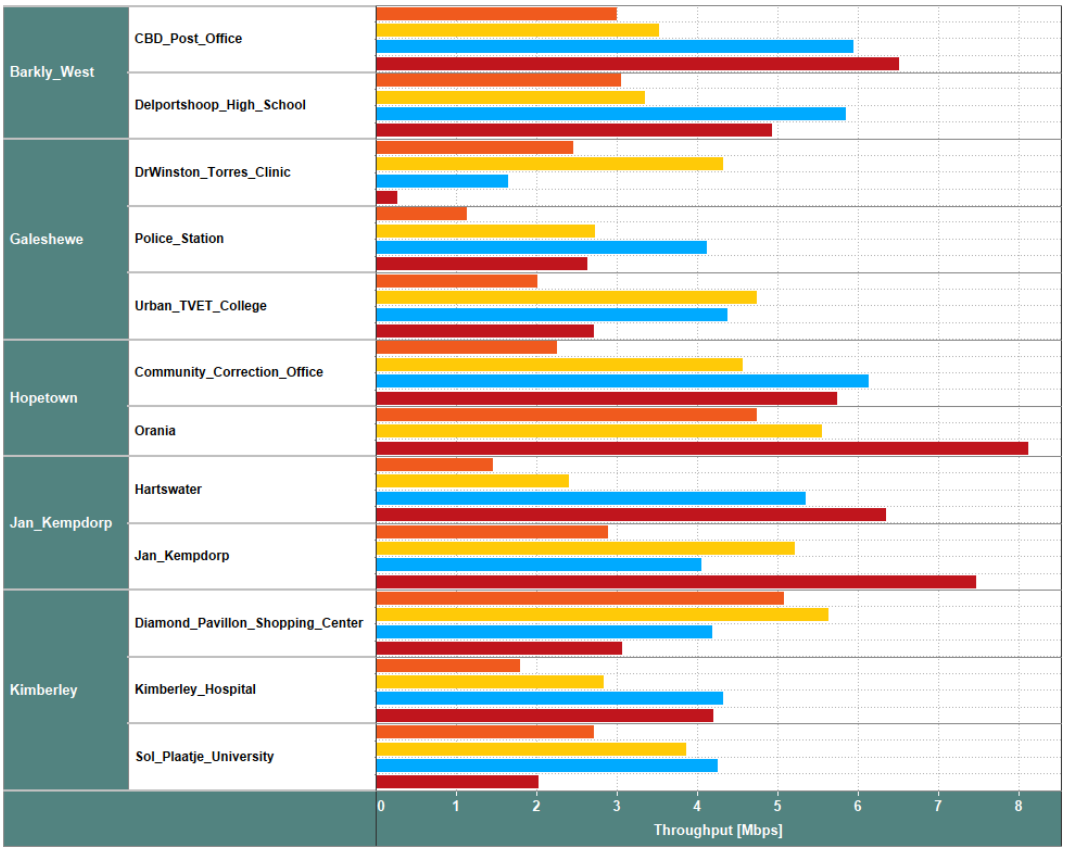


Figure 45. 3G Preferred average FTP Download Throughput results per Stationary Points (Mbps)

4.2.1.4. 3G Preferred Stationary HTTP Upload

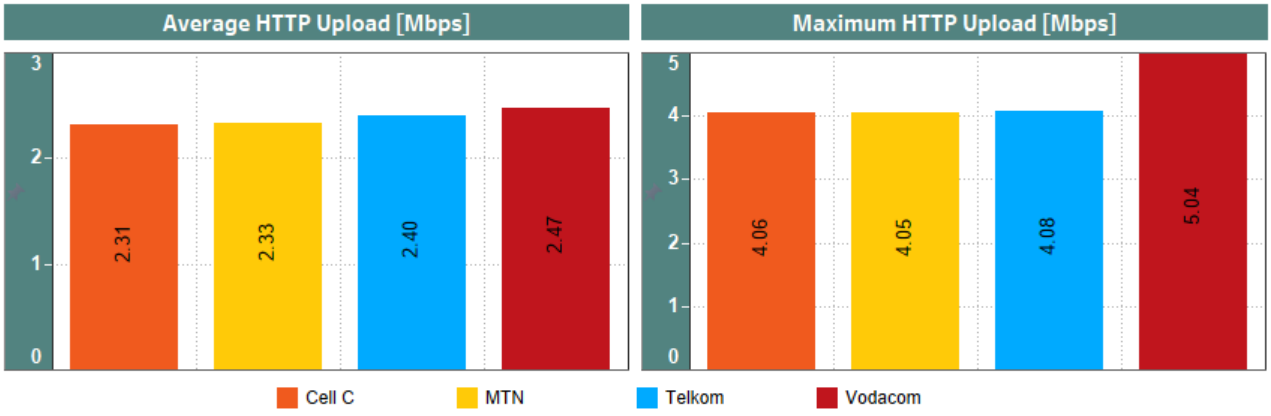


Figure 46. Stationary 3G Preferred HTTP Upload Overall Throughput results (Mbps)

Figure 46 show that Vodacom has the highest stationary average HTTP upload throughput, followed by Telkom, MTN and Cell C in descending order. However, there was no significant different among the operators.

Figure 47 shows 3G Preferred average HTTP upload throughput per stationary point.

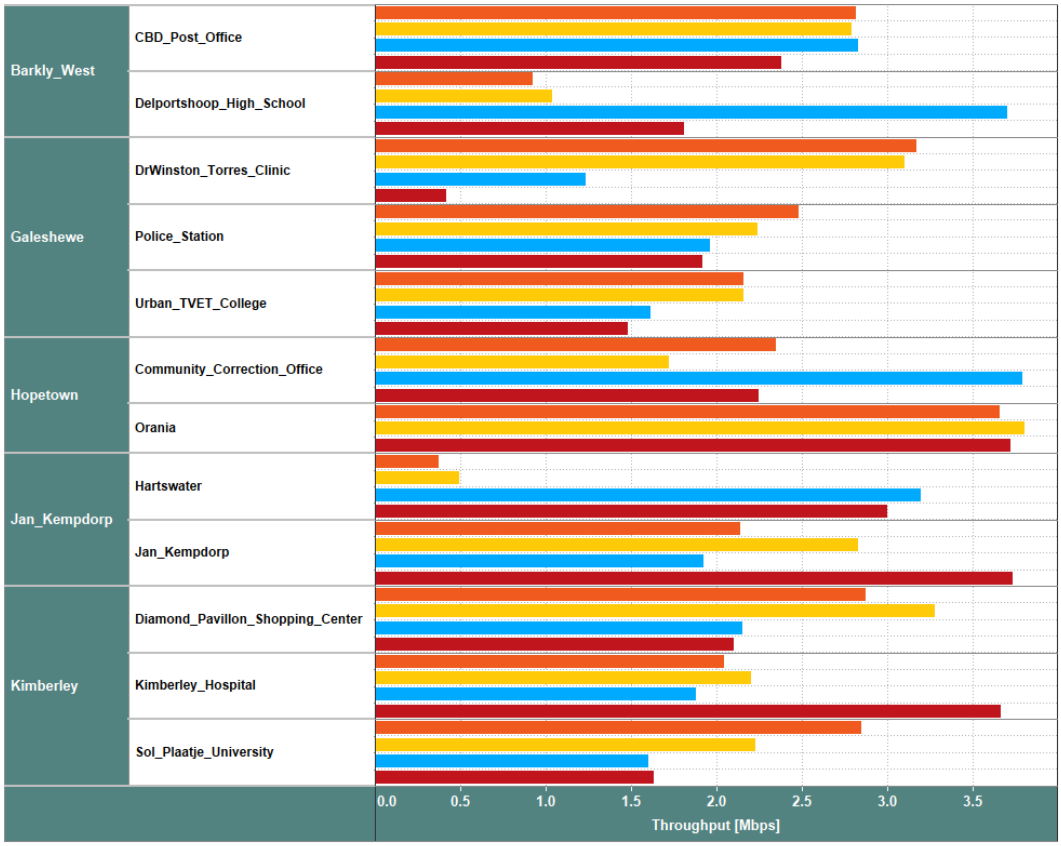


Figure 47. 3G Preferred average HTTP Upload Throughput results per Stationary Points (Mbps)

4.2.1.5. 3G Preferred Stationary Capacity Upload

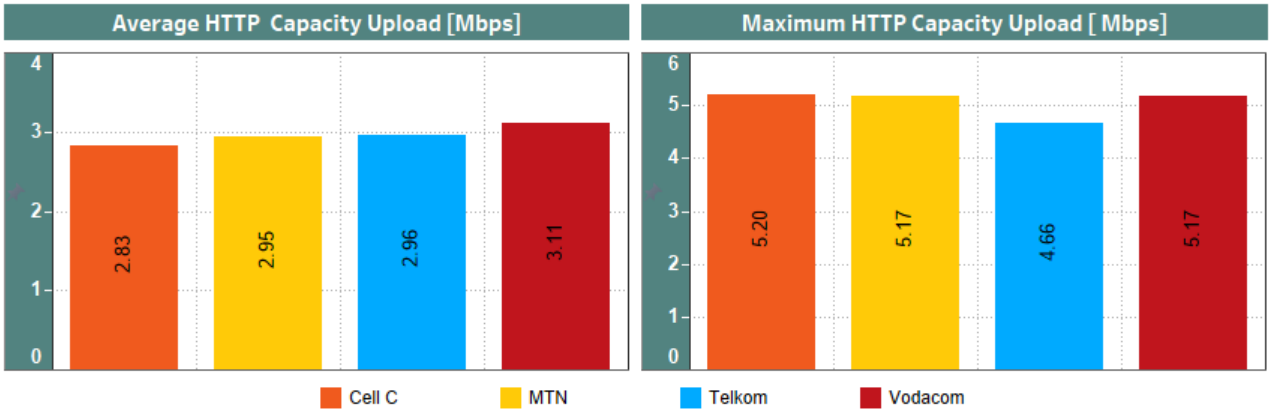


Figure 48. Stationary 3G Preferred HTTP Capacity Upload Throughput Overall results (Mbps)

Figure 48 shows overall results where Vodacom achieved the highest stationary average HTTP capacity upload throughput, followed by Telkom, MTN and Cell C in descending order. However, there was no significant different among the results of the operators.

Figure 49 shows 3G Preferred average HTTP capacity download throughput per stationary point.

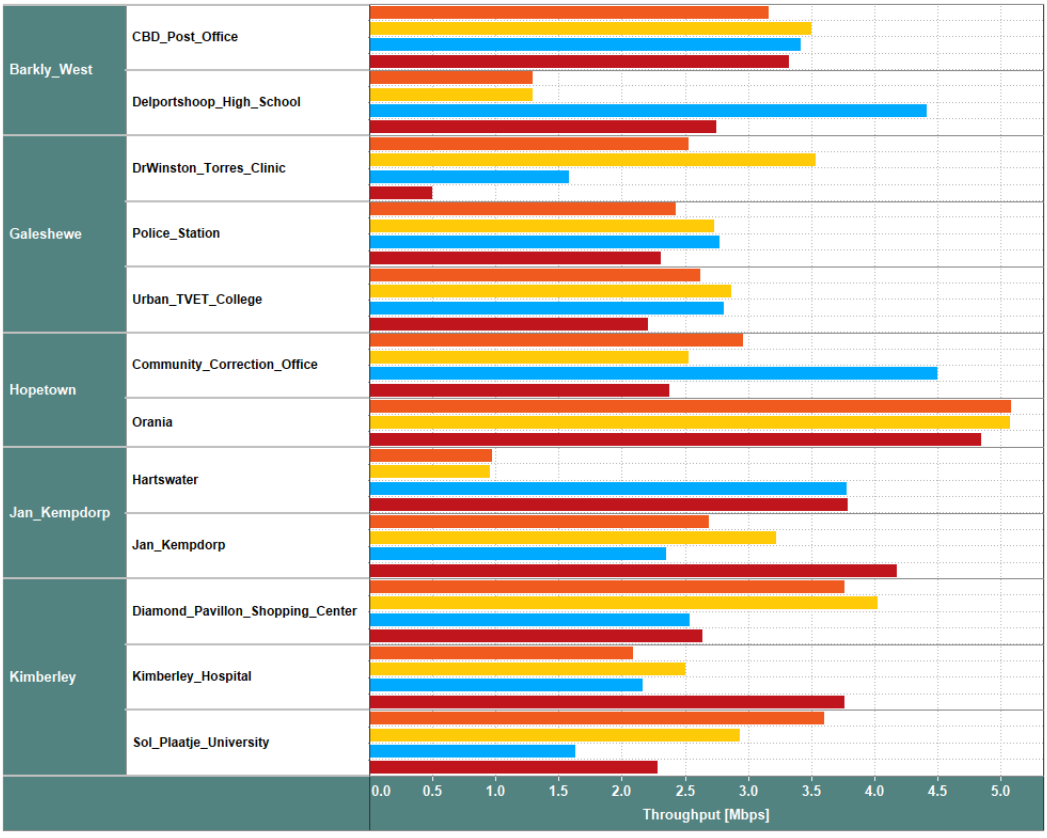


Figure 49. 3G Preferred average HTTP Capacity Upload Throughput results per Stationary Points (Mbps)

4.2.1.6. 3G Preferred Stationary FTP Upload

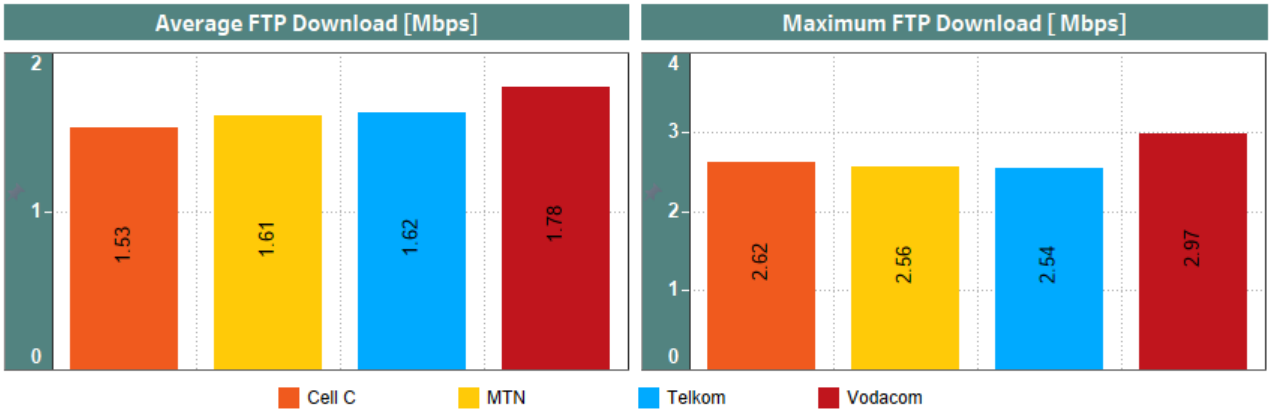


Figure 50. Stationary 3G Preferred FTP Upload Throughput Overall results (Mbps)

Figure 50 shows that Vodacom achieved the highest stationary average FTP upload throughput, followed by Telkom, MTN and Cell C in a descending order.

Figure 51 shows 3G Preferred average FTP upload throughput per stationary point.

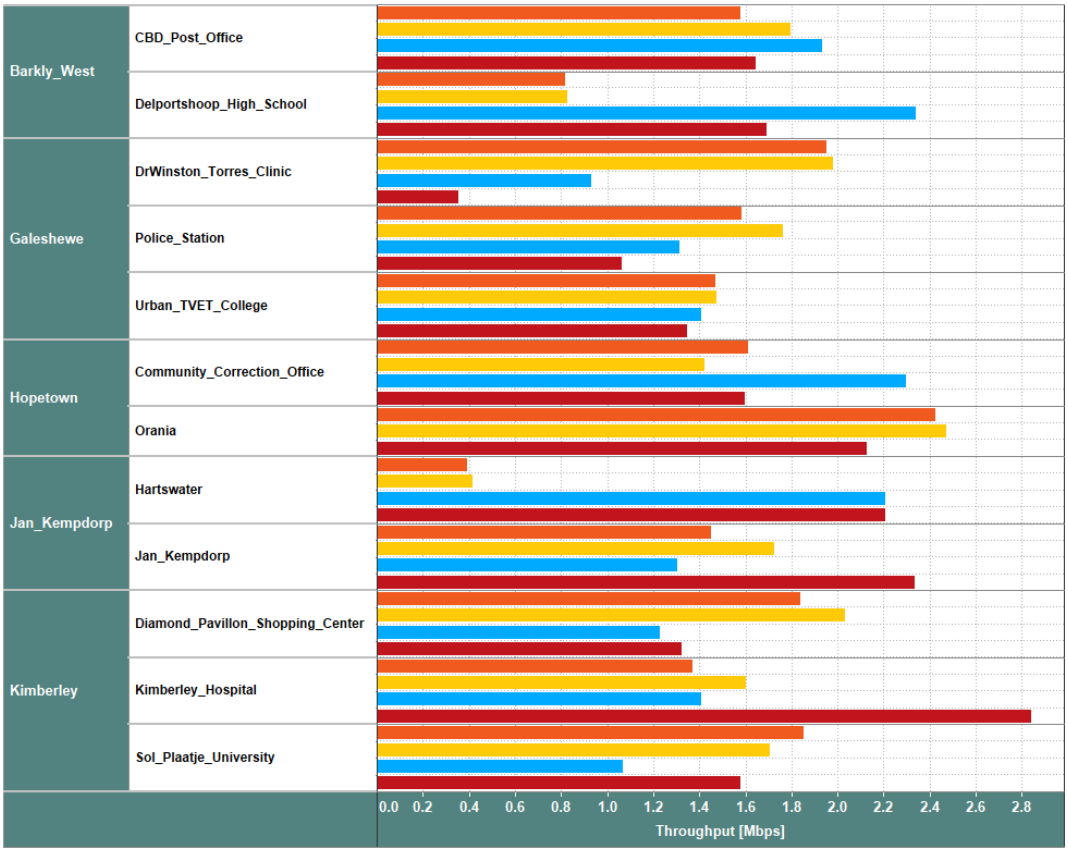


Figure 51. 3G Preferred average FTP Upload Throughput results per Stationary Point (Mbps)

4.2.1.7. 3G Preferred Stationary YouTube Results

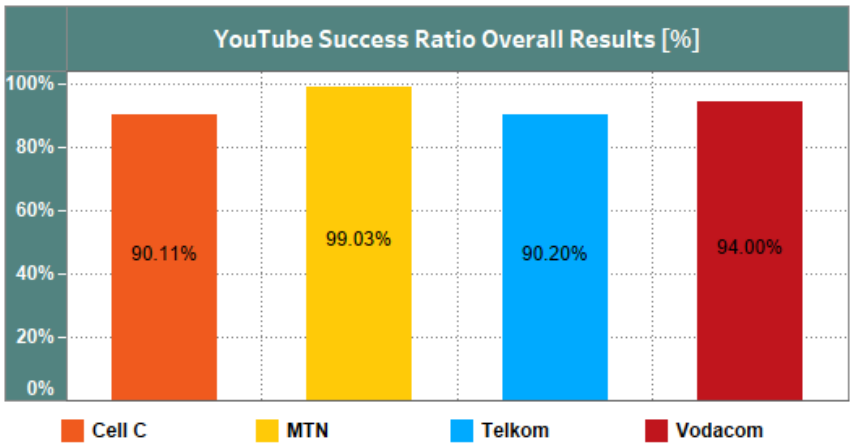


Figure 52. 3G Preferred YouTube Success Ratio Overall results [%]

Figure 16 shows MTN achieved the best 3G Preferred YouTube Overall Success ratio followed by Vodacom, Cell C and then Telkom in descending order.

Figure 17 shows 3G Preferred YouTube Success ratio per stationary point.

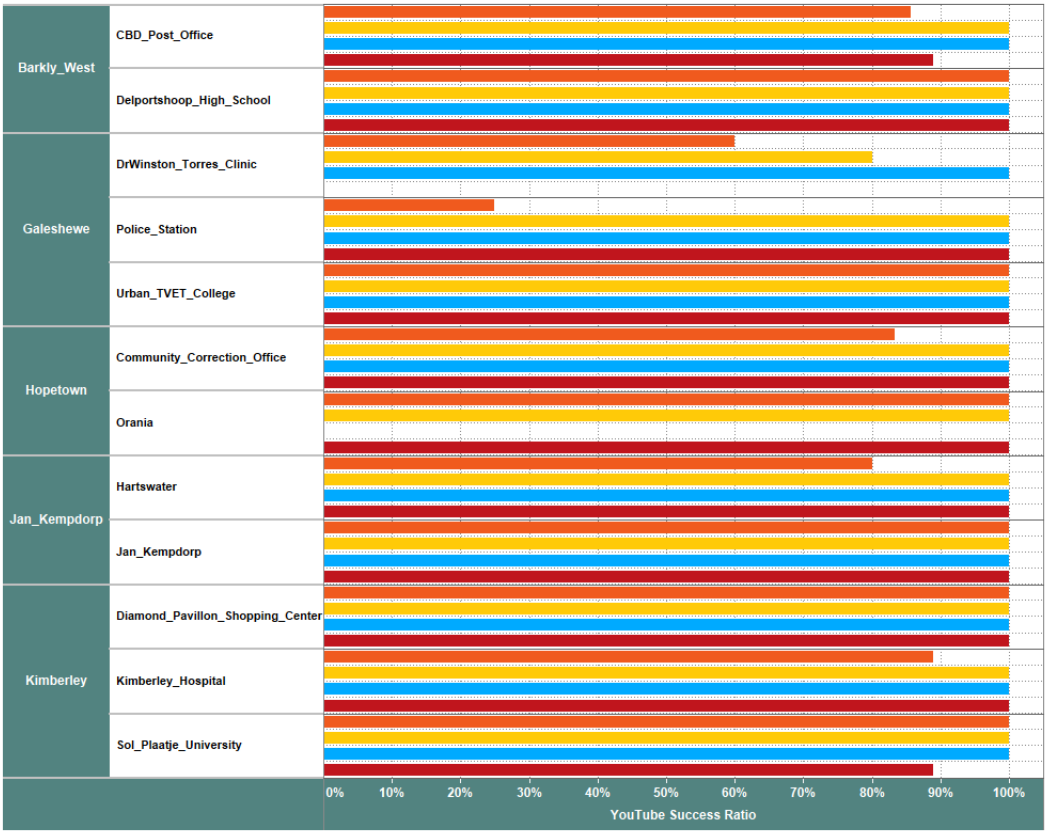


Figure 53. 3G Preferred YouTube Success Ratio results per Stationary Point [%]

4.2.1.8. 3G Preferred Stationary Web Browsing Page Download Time

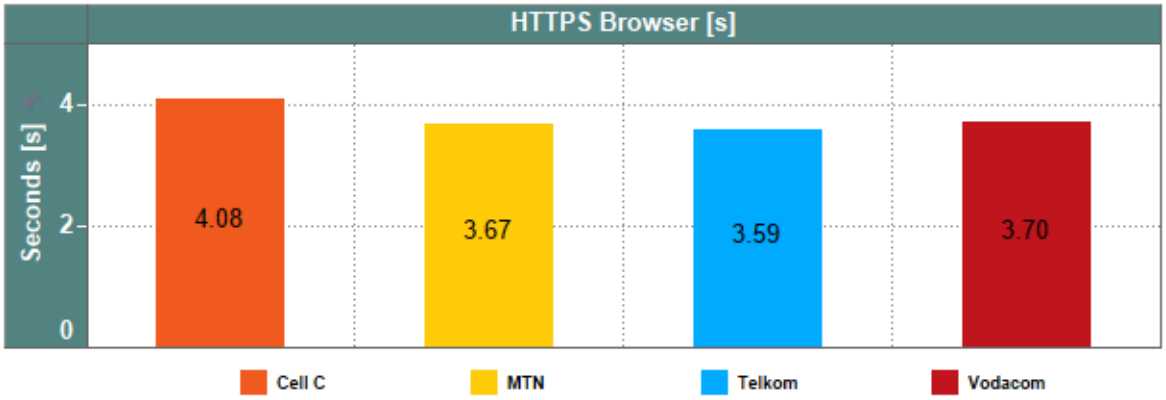


Figure 54. 3G Preferred HTTPS Web Browsing Overall Results(s)

Figure 54 depicts Overall results where Telkom achieved fastest web browsing page load time followed by MTN, Vodacom and then Cell C.

Figure 55 shows 3G Preferred HTTPS web browsing page load time (s) per stationary point.

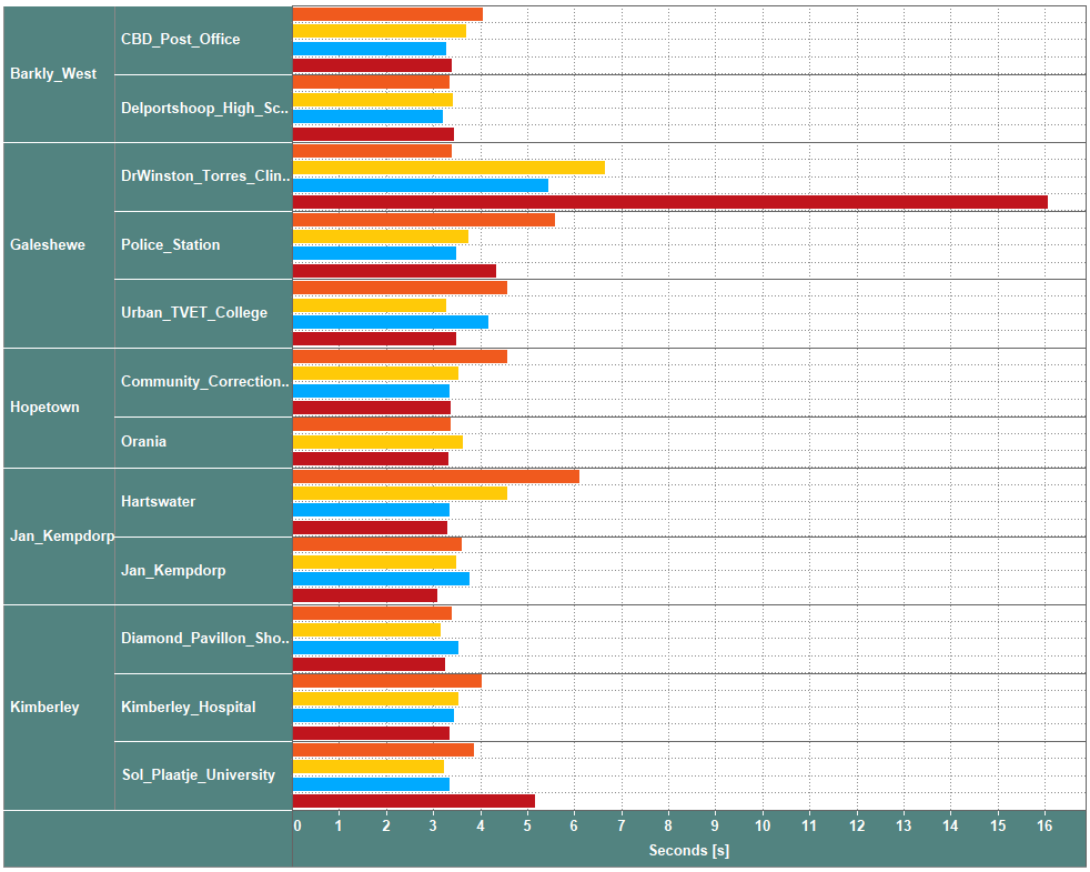


Figure 55. 3G Preferred HTTPS Web Browsing Results per Stationary Point [s]

4.2.1.9. 3G Preferred Stationary Ping Results

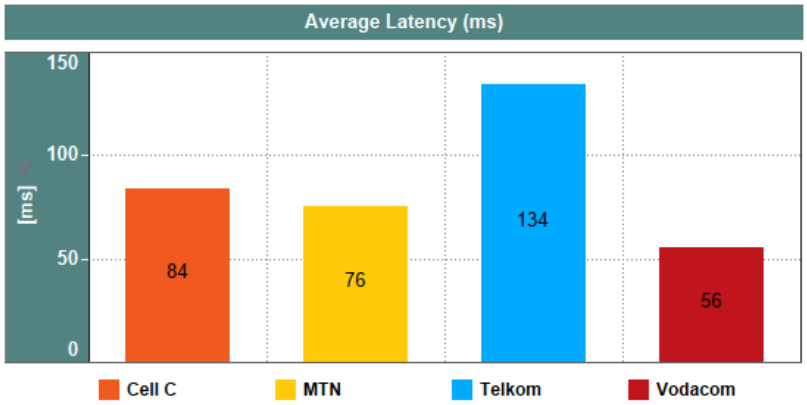


Figure 56. Stationary 3G Preferred Average Ping Overall Results (ms)

Figure 56 depicts Overall results where Vodacom achieved the lowest latency followed by MTN, Cell C and Telkom.

Figure 57 shows 3G Preferred Average Ping Latency results per stationary point.

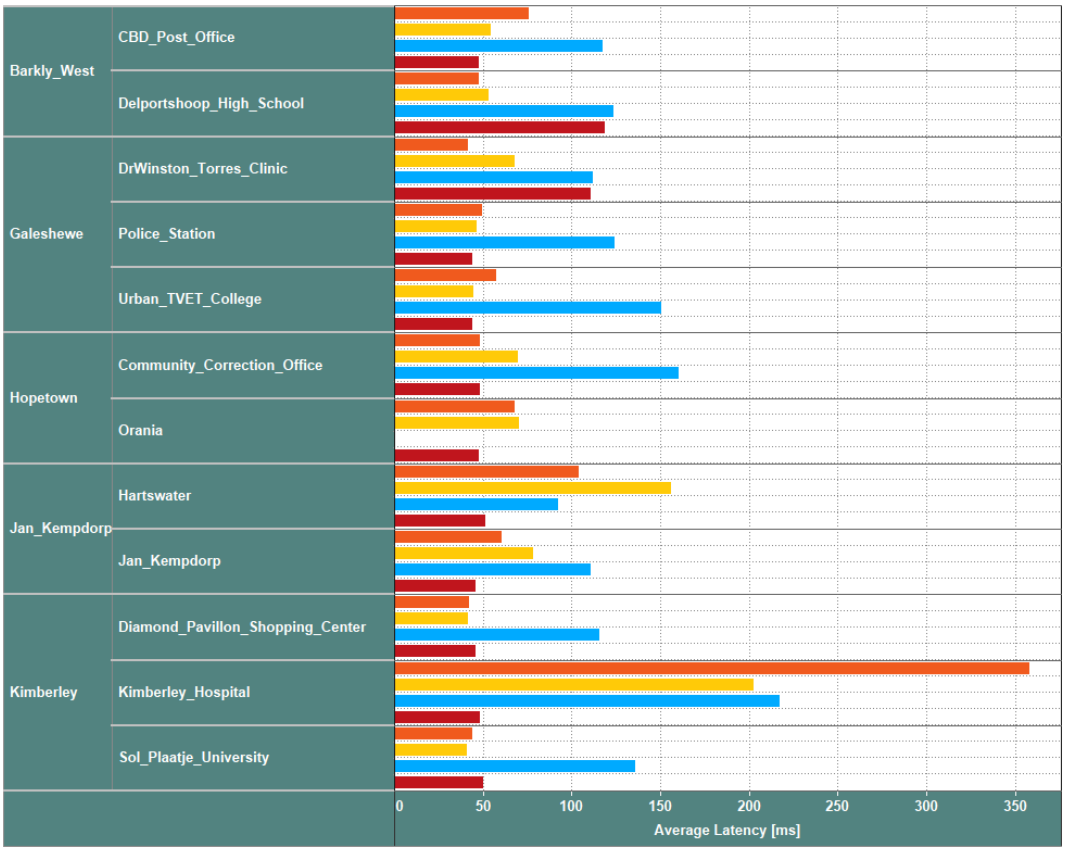


Figure 57. Stationary 3G Preferred Average Ping Results per Stationary Point (ms)

4.2.2. 4G Preferred Summary Results

Table 9 shows summary results obtained per KPI for 4G Preferred testing.

Table 9: 4G Preferred Stationary Drive Test Results

		Cell C	MTN	Telkom	Vodacom
File Transfer	HTTP DL Throughput - Average [Mbps]	11.22	36.34	19.91	22.97
	HTTP UL Throughput - Average [Mbps]	10.38	22.01	8.23	12.7
	Capacity DL Throughput - Average [Mbps]	12.61	46.87	36.95	23.36
	Capacity UL Throughput - Average [Mbps]	9.99	23.03	14.3	13.16
	FTP DL Throughput - Average [Mbps]	6.17	10.31	9.81	9.87
	FTP UL Throughput - Average [Mbps]	5.92	10.12	5.24	7.86
HTTPS Browser	Overall HTTPs Browsing - Web Page Load Time[s]	3.42	2.88	3.10	3.16
	Kepler Page	6.49	6.09	6.30	6.61
	Mobile Kepler Page	0.85	0.67	0.75	0.77
	MSN	2.77	2.28	2.51	2.37
	Google	2.79	1.74	1.84	2.23
	News24	4.22	3.63	4.02	3.82
Data	Overall Average Ping Latency [ms]	41	33	51	37
	Average Ping Latency - Google Website	36	29	52	37
	Average Ping Latency- Independent Server	47	37	50	37
YouTube	YouTube Successful Ratio [%]	99.1	99.12	85.84	98.13
	YouTube Number of freezing's	1	1	16	1
	YouTube Average Resolution [pixels]	945.65	1009.22	1025.11	982.92
	YouTube Access Time [s]	7.72	4.33	4.6	7.76
	YouTube Quality MOS	4.13	4.19	4.20	4.16

In Table 9, the values in the green blocks indicate which operator is leading in that KPI. MTN led in most of the KPIs.

4.2.2.1. 4G Preferred Stationary HTTP Download

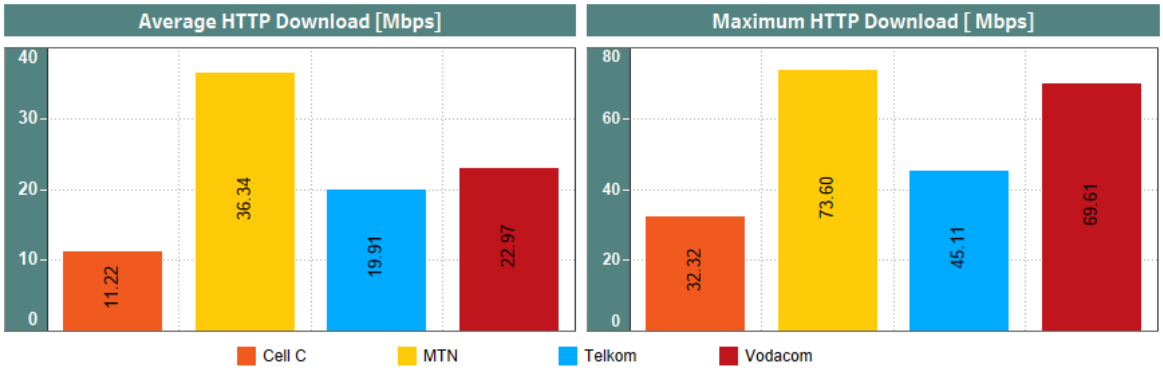


Figure 58. Stationary 4G Preferred HTTP Download Throughput Overall Results (Mbps)

Figure 58 shows that MTN achieved the highest stationary 4G Preferred average HTTP download throughput and maximum HTTP download throughput, followed by Vodacom, Telkom, and Cell C in a descending order.

Figure 59 shows 4G Preferred average HTTP download throughput per stationary point.

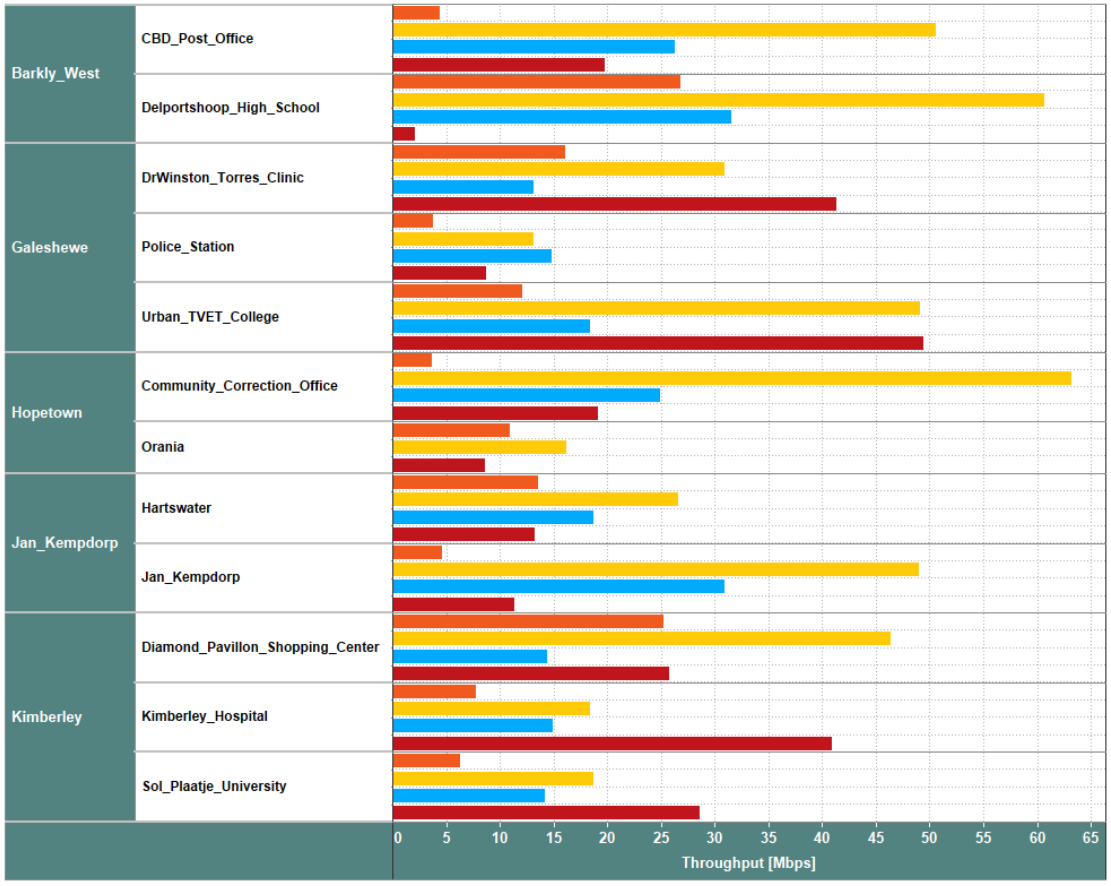


Figure 59. Stationary 4G Preferred average HTTP Download Results per Static Point (Mbps)

4.2.2.2. 4G Preferred Stationary Capacity Download

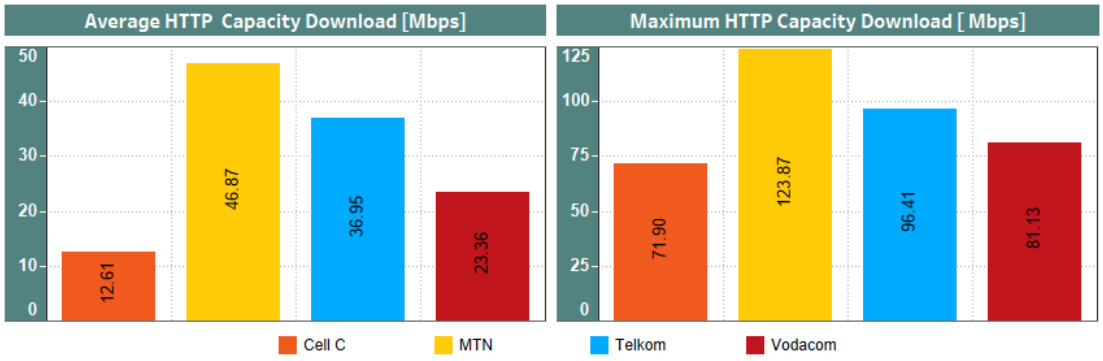


Figure 60. Stationary 4G Preferred HTTP Capacity Download Throughput Overall Results (Mbps)

Figure 60 shows that for overall results MTN achieved the highest stationary HTTP capacity download throughput for both average and maximum HTTP download throughput, followed by Telkom, Vodacom, and Cell C in descending order.

Figure 61 shows 4G Preferred average HTTP download throughput per stationary point.

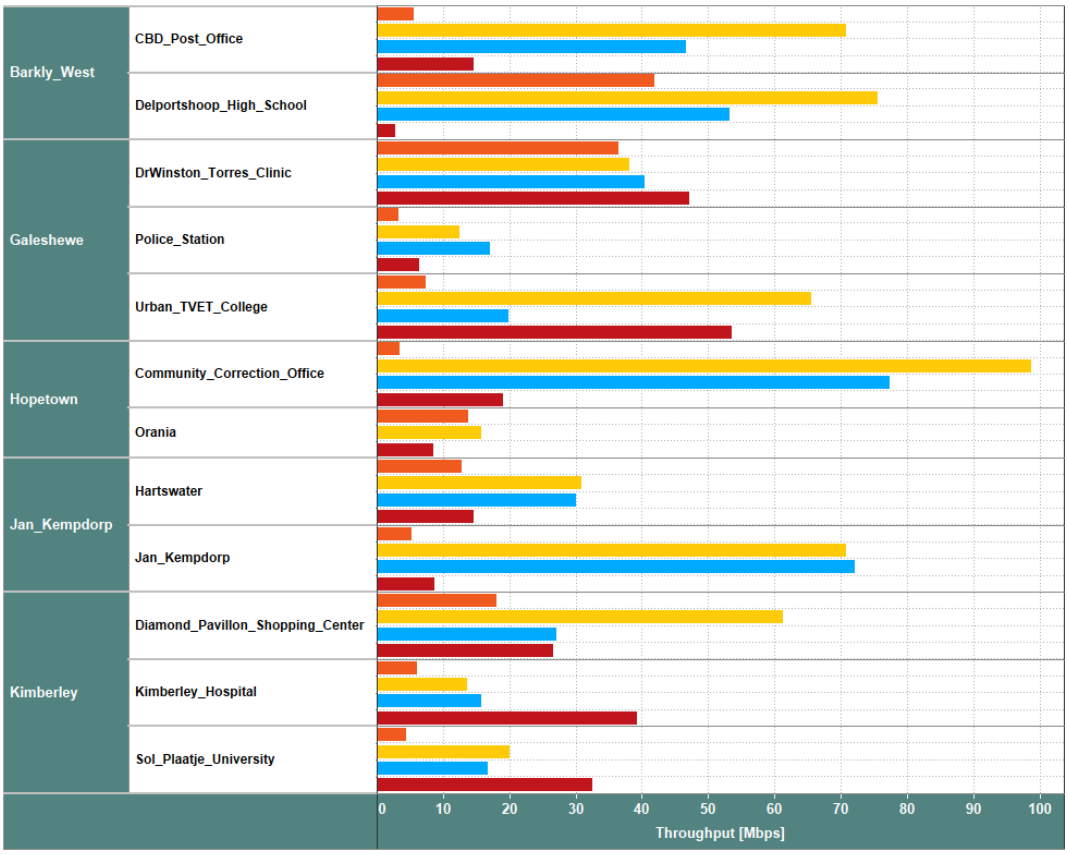


Figure 61. 4G Preferred HTTP Capacity Download Throughput Results per Stationary Point (Mbps)

4.2.2.3. 4G Preferred Stationary FTP Download

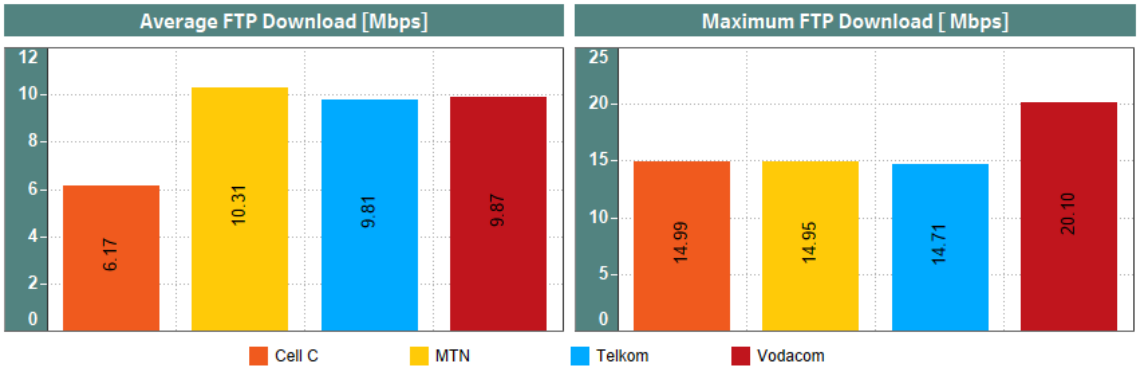


Figure 62. Stationary 4G Preferred average FTP Download Throughput Overall Results (Mbps)

Figure 62 shows that for overall results MTN achieved the highest stationary FTP download average throughput for followed by Vodacom, Telkom, and Cell C in descending order.

Figure 63 shows 4G Preferred FTP download throughput per stationary point.

Figure 63. 4G preferred average FTP Download Throughput Results per Static Point (Mbps)

4.2.2.4. 4G Preferred Stationary HTTP Upload

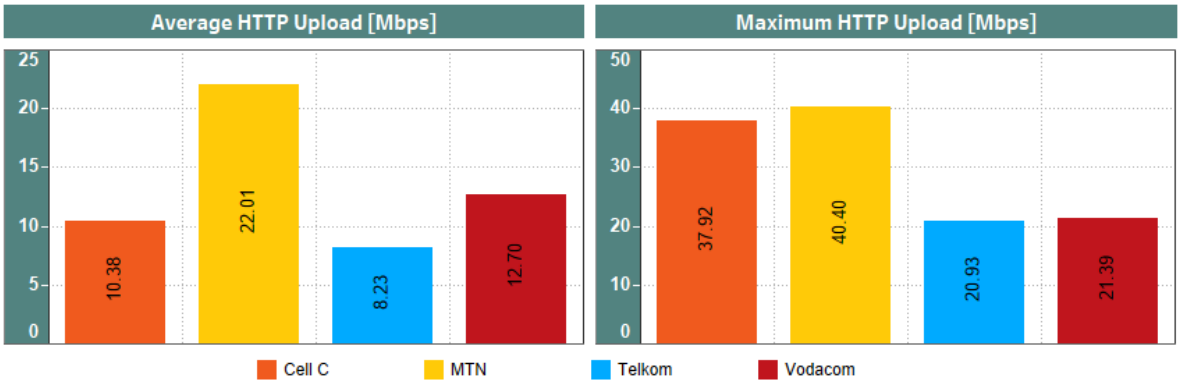


Figure 64. Stationary 4G Preferred average HTTP Upload Throughput Overall Results (Mbps)

Figure 64 shows that for overall results MTN had the highest stationary average HTTP upload throughput followed by Vodacom, Cell C and Telkom in descending order.

Figure 65 shows 4G Preferred average HTTP upload throughput per stationary point.

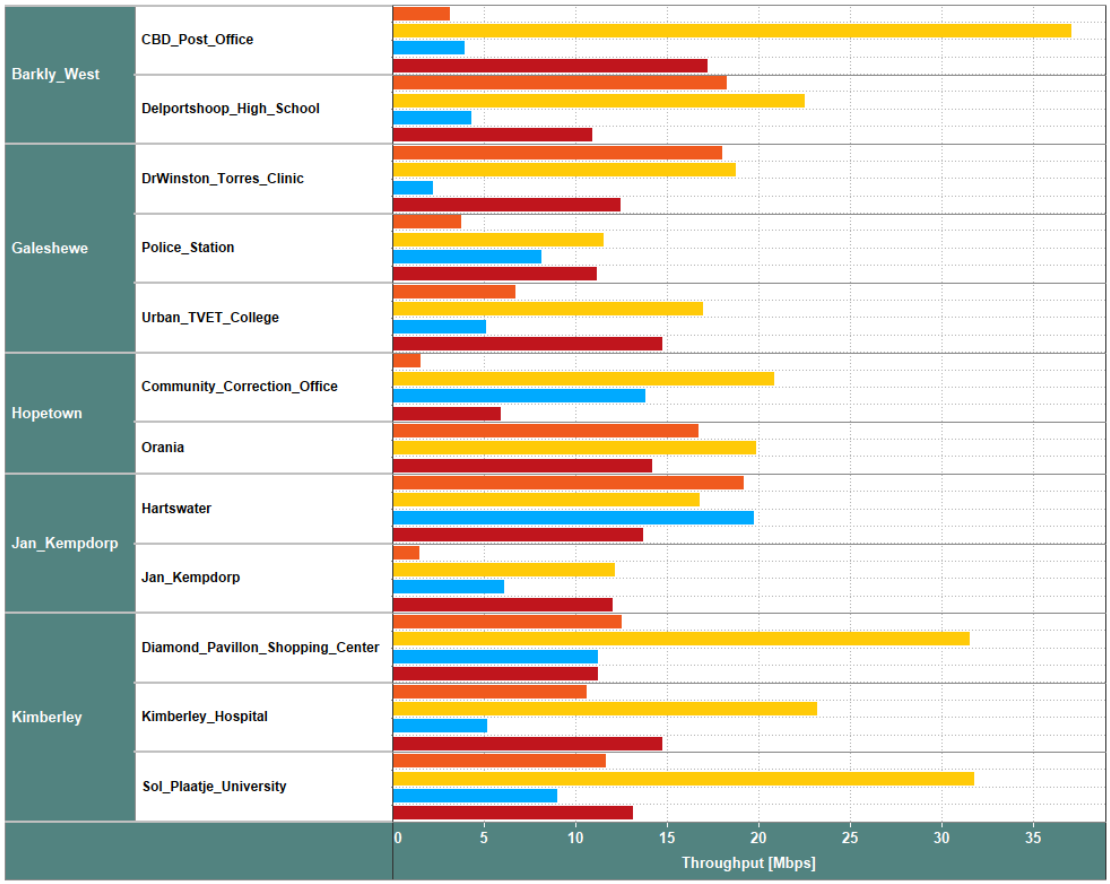


Figure 65. 4G Preferred HTTP Upload Overall Throughput Results per Static Point (Mbps)

4.2.2.5. 4G Preferred Stationary Capacity Upload

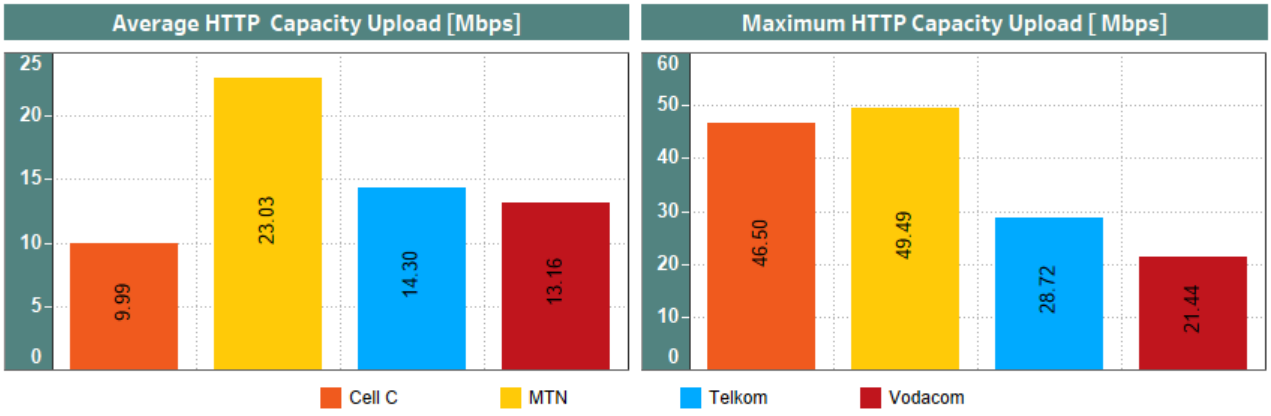


Figure 66. Stationary 4G Preferred HTTP Capacity Upload Throughput Overall Results (Mbps)

Figure 66 shows that for overall results MTN had the highest stationary HTTP capacity upload average throughput followed by Telkom, Vodacom and then Cell C in descending order.

Figure 67 shows 4G Preferred HTTP capacity upload throughput per stationary point.

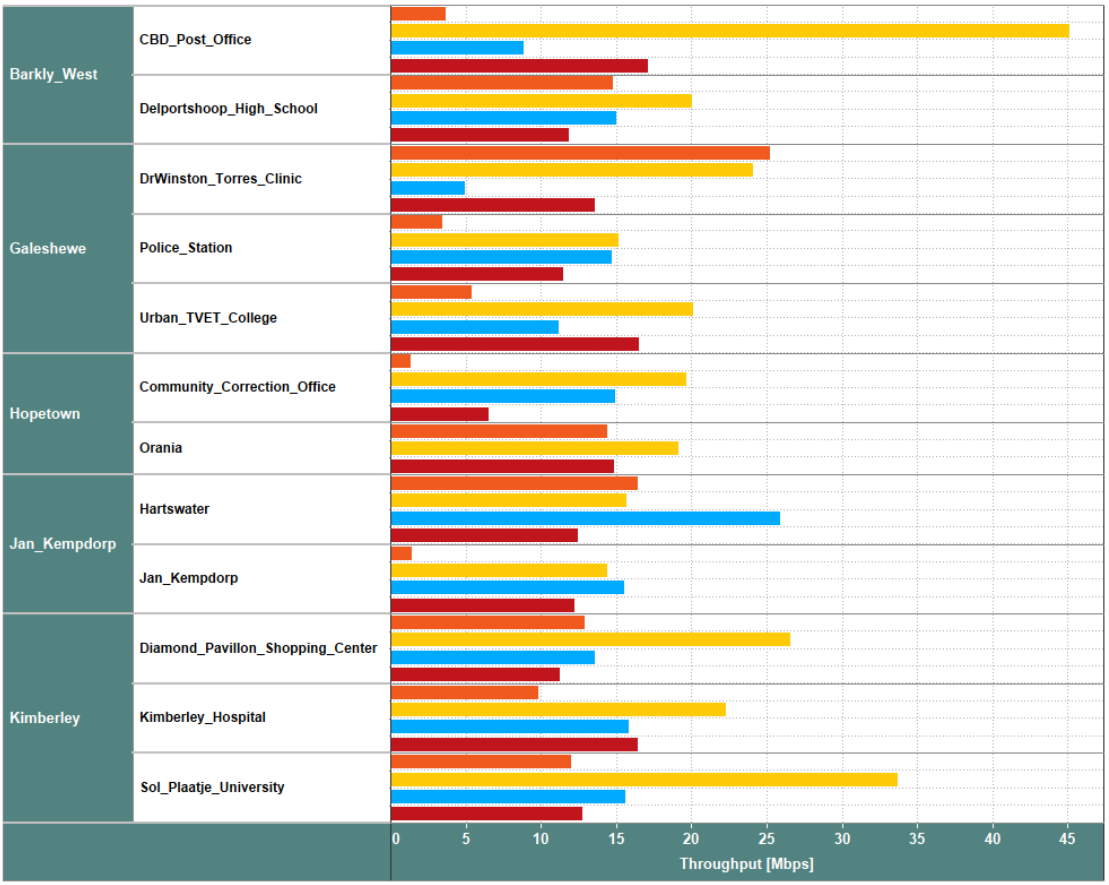


Figure 67. Stationary 4G Preferred HTTP Capacity Upload Overall Results per Static Point (Mbps)

4.2.2.6. 4G Preferred Stationary FTP Upload

The following charts provide a graphical view of the results obtained/highlighted in Table 9.

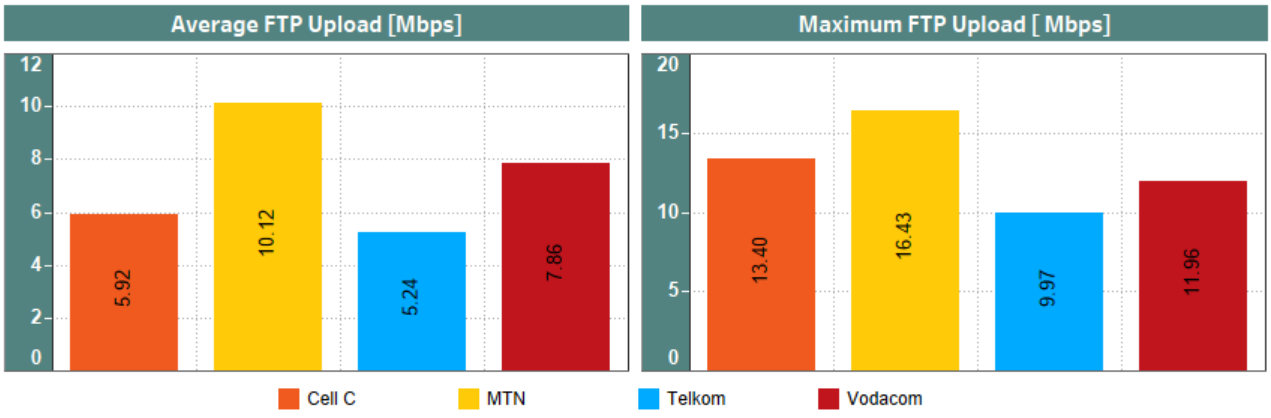


Figure 68. Stationary 4G Preferred FTP Upload Throughput Overall Results (Mbps)

Figure 68 shows that for overall results MTN had the highest stationary average FTP upload throughput followed by Vodacom, Cell C and Telkom in a descending order.

Figure 69 shows 4G Preferred FTP upload throughput per stationary point.

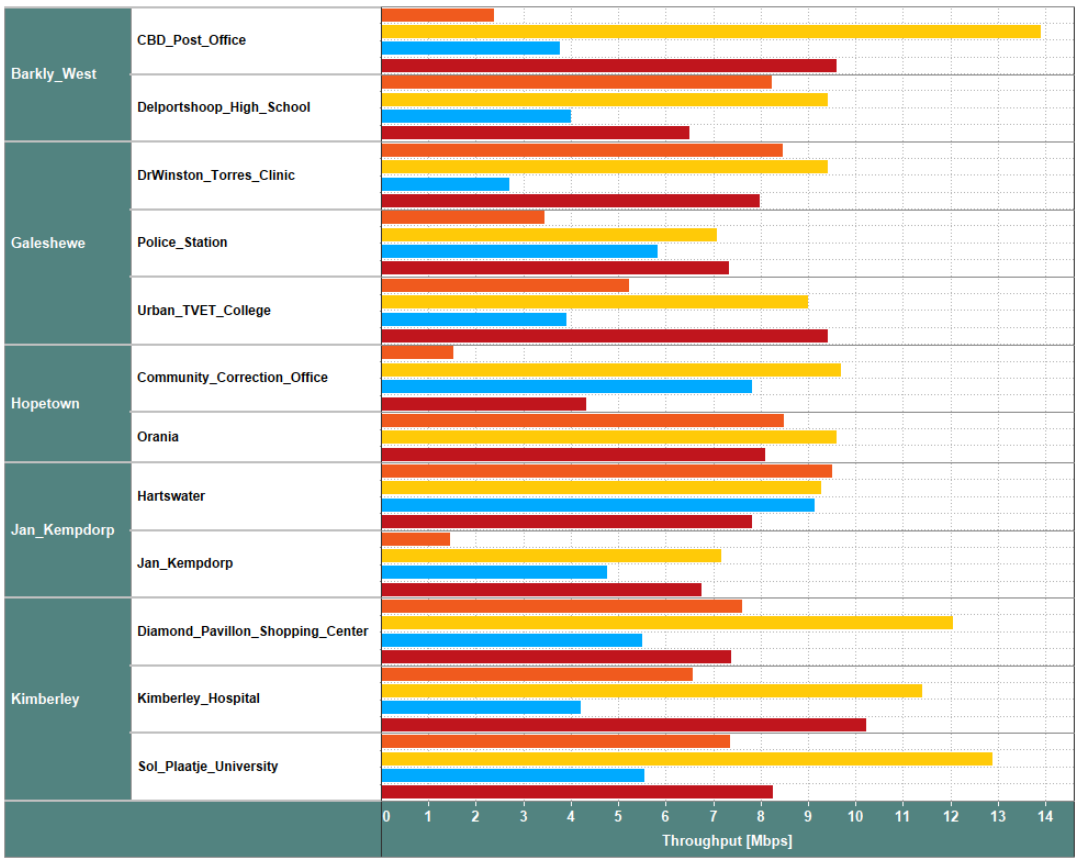


Figure 69. 3G Preferred FTP Upload Throughput results per Stationary Points (Mbps)

4.2.2.7. 4G Preferred Stationary YouTube Results

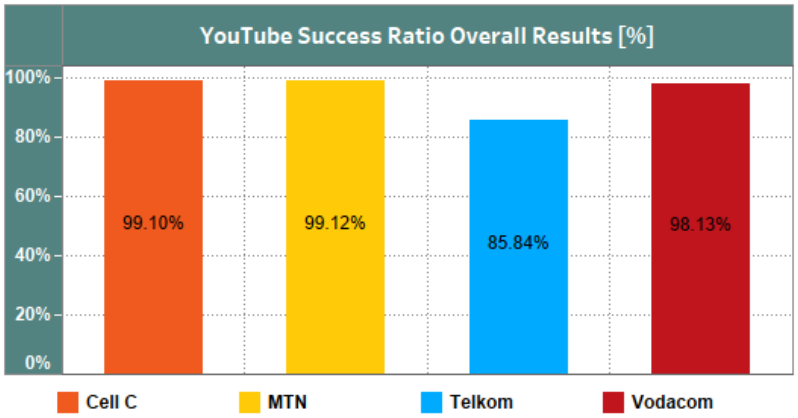


Figure 70. 4G Preferred YouTube Success Ratio Overall results [%]

Figure 70 shows MTN achieved the best 4G Preferred YouTube Overall Success ratio followed by Cell C, Vodacom, and Telkom in a descending order.

Figure 71 shows 4G Preferred YouTube Success ratio per stationary point.

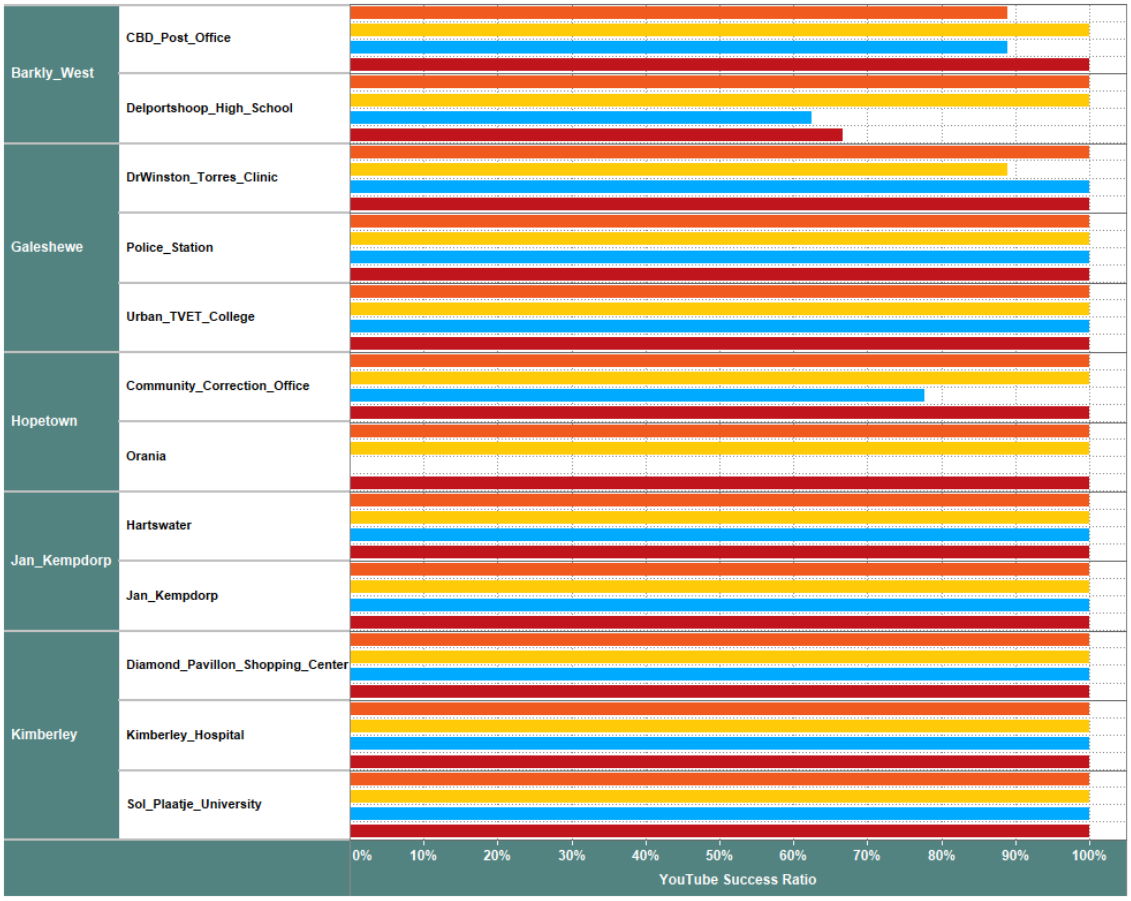


Figure 71. 4G Preferred YouTube Success Ratio results per Stationary Point [%]

4.2.2.8. 4G Preferred Stationary Web Browsing Page Download Time

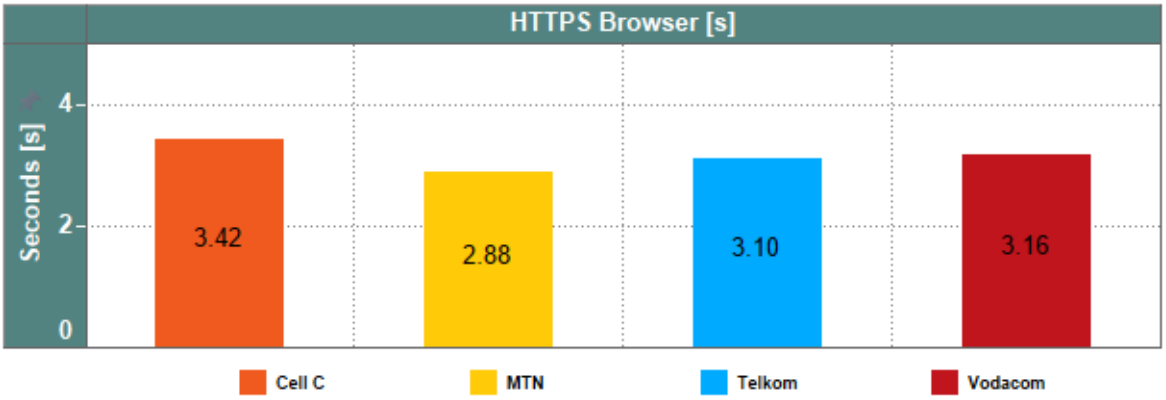


Figure 72. 4G Preferred HTTPS Web Browsing Overall Results (s

Figure 72 depicts Overall results where MTN achieved the fastest web browsing page load/download time (s) followed by Telkom, Vodacom, and Cell C.

Figure 73 shows 4G Preferred HTTPS web browsing page load time (s) per stationary point.

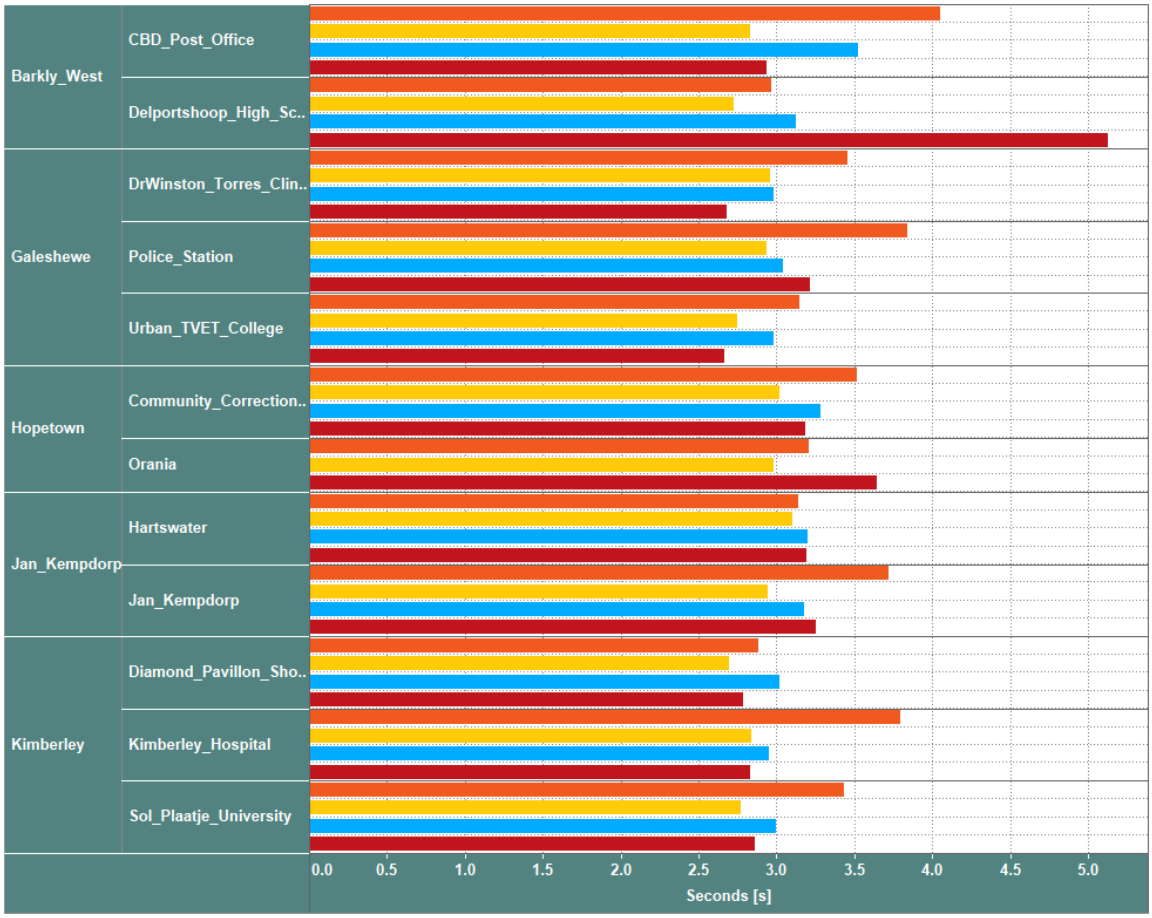


Figure 73. 4G Preferred HTTPS Web Browsing Results per Stationary Point[s]

4.2.2.9. 4G Preferred Stationary Ping Results

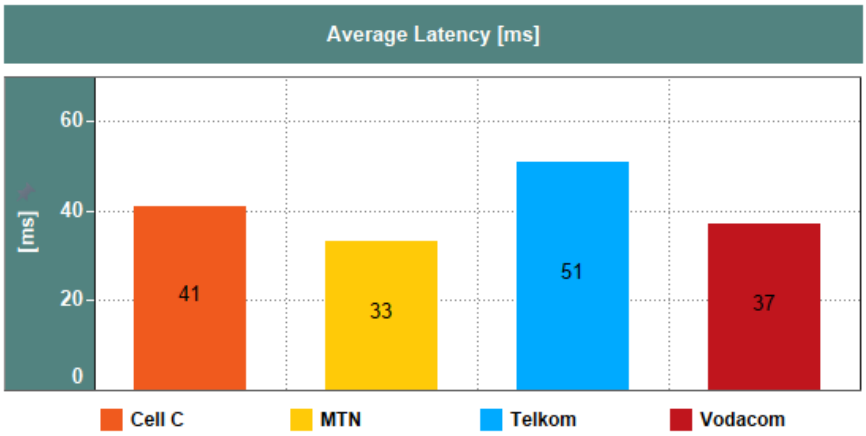


Figure 74. 4G Preferred Average Ping Overall Results (ms)

Figure 74 depicts Overall results where MTN had the lowest ping latency followed by Vodacom, Cell C and Telkom.

Figure 75 shows 4G Preferred shows 4G Preferred Average Ping Latency results per stationary point.

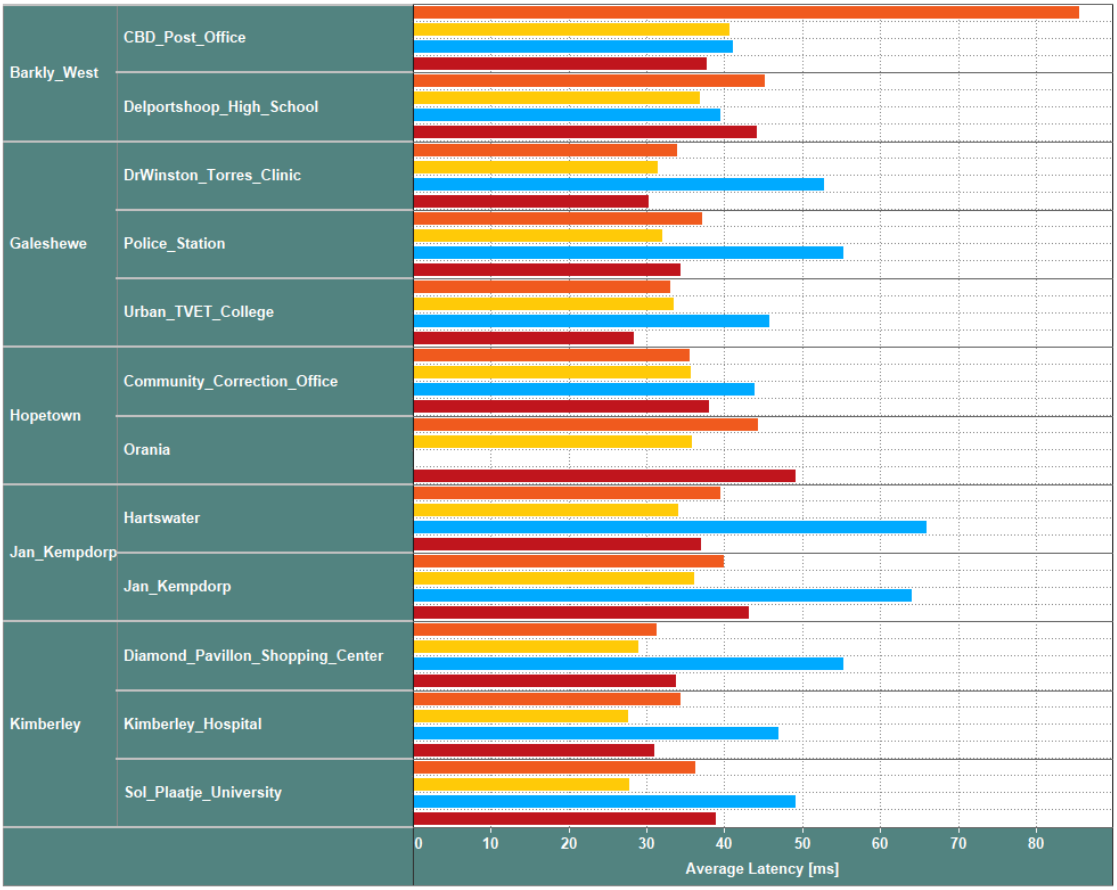


Figure 75. 4G Preferred Average Ping Results per Stationary Point (ms)

Signal Strength

4.2.3. Signal Strength Breakdown

Table 10 list the parameters defined by the 3GPP standards to measure signal strength and signal quality in the cellular network industry. The test devices are configured in '3G Preferred' and '4G Preferred' modes.

Table 10: Signal Strength Explanation

Technology	Signal Strength		Signal Quality	
	Metric	Comment	Metric	Comment
LTE	RSRP	Average LTE signal level [dBm] for best-measured LTE serving cell. High negative value represents poor signal strength (e.g., -130) and low negative value represents good signal strength (e.g., -85).	SINR	Average LTE signal quality [dB] for best-measured LTE serving cell. A high positive value represents good signal quality (e.g., 20) and a low negative value represents poor signal quality (e.g., <0).
3G	RSCP	Average 3G signal level [dBm] for the best measured 3G serving cell. High negative value represents poor signal strength (e.g., -130) and low negative value represents good signal strength (e.g., -85).	EcNo	Average 3G signal quality [dB] for the best measured 3G serving cell. High negative value represents bad/poor EcNo (e.g., -18) and low negative value represents good EcNo (e.g., -8).
2G	RxLev	Average 2G signal level [dBm] for the best measured 2G serving cell. A high negative value represents poor signal strength (e.g., -130) and a low negative value represents good signal strength (e.g., -85)	RxQual	Average 2G signal quality measured with a numeric scale for the best-measured 2G serving cell. A high positive value represents poor quality (e.g., 7) and a low positive value represents good quality (e.g., 0)

4.2.4. Overall RF Signal Levels

Table 11 depicts the technology distribution per operator. GSM or 2G samples are limited to only areas that had no 3G coverage in both test scenarios.

Table 11: Technology Coverage Footprints

3G Preferred Technology				
	Cell C	MTN	Telkom	Vodacom
UMTS	99.95%	99.39%	98.93%	99.88%
GSM	0.05%	0.61%	1.07%	0.12%

4G Preferred Technology				
	Cell C	MTN	Telkom	Vodacom
LTE	84.56%	92.92%	77.49%	89.30%
UMTS	15.44%	6.76%	21.43%	10.67%
GSM		0.32%	1.05%	0.03%

Table 11 depicts coverage levels. It must be noted that all the levels in the tables below are limited to the areas where those technology/ technologies were available.

Table 12: Signal Level and Quality Reference Information

LTE Coverage

RSRP [dBm]				
	Cell C	MTN	Telkom	Vodacom
Avg	-90.54	-91.66	-96.24	-90.48
Max	-50.00	-51.30	-42.30	-50.00
Min	-141.00	-141.00	-141.00	-141.00

SINR [dB]				
	Cell C	MTN	Telkom	Vodacom
Avg	10.81	10.97	11.58	6.63
Max	40.00	39.80	37.50	37.10
Min	-18.00	-20.00	-19.00	-19.00

3G Coverage

RSCP [dbm]				
	Cell C	MTN	Telkom	Vodacom
Ave	-84.73	-85.20	-86.78	-84.59
Max	-32.0	-36.0	-42.3	-37.5
Min	-123.0	-125.2	-134.0	-121.6

EcNo [db]				
	Cell C	MTN	Telkom	Vodacom
Ave	-9.84	-9.91	-8.51	-9.66
Max	0.30	-0.50	-1.10	-1.30
Min	-24.00	-24.00	-24.00	-24.00

Table 12 shows that Vodacom had the best signal quality on LTE and Telkom had the best signal quality on 3G. Cell C had the best coverage on both LTE and 3G.

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.

3G Preferred measurements

In terms of the overall results for 3G preferred Mobile Drive Test, Vodacom leads in HTTP download and in FTP download throughput. Vodacom achieved the lowest overall Latency and fastest web browsing page load time.
The 3G preferred results per area show that:

a) Vodacom leads in HTTP download throughput in two tested areas; Barkly West and Jan Kempdorp, MTN leads in Galeshewe and Kimberley. Telkom achieved the highest average download throughput in Hopetown.
b) Vodacom leads in FTP upload throughput in Barkly West, Hopetown, and Jan Kempdorp and MTN had the highest FTP Download throughput in Galeshewe and Kimberley.

For Stationary Points, Telkom achieved the highest HTTP Download throughput at 5 stationary points, Vodacom led in 4 areas, MTN led in 3 stationary points.

4G Preferred measurements

In terms of the overall results for 4G Preferred Mobile Drive Test, MTN leads in HTTP download, HTTP Upload, FTP download, FTP Upload and both Capacity DL and UL test throughput. MTN achieved the lowest overall Latency and web page load time. MTN achieved the highest YouTube Success Ratio.

The 4G Preferred results per area show that; MTN leads in HTTP download, HTTP Upload and HTTP Capacity Download, FTP Download throughput in all the tested areas; MTN also achieved lowest Latency and fastest browsing page load time in all the tested areas.

For Stationary Points, MTN achieved the highest HTTP Download throughput at most stationary points except at Kimberley Hospital and Plaatje University where Vodacom led in HTTP Download Throughput for the two areas. MTN also achieved highest HTTP Upload throughput at most stationary points except at Hartswater in Jan Kempdorp where Telkom led in HTTP Upload Throughput.

6.1

6. Appendix 1: Mobile operators' feedback on the report

6.1. Vodacom

Vodacom provided feedback and network improvement plans that are in place for all areas.

- Barkley West – Data failures was experienced on Delportshoop, Holpan, Windsorton town, Barkley West, and Riverton sites respectively. The data failure was experienced due to poor coverage, thus affecting throughput. There is a mountainous terrain causing line of site challenges and a new site in Windsorton town is live since December 2021 it has addressed issues experienced. Cell range extension and five additional sites are part of the solutions to improve data performance.
- Galeshewe - The data failures happened under adequate radio frequency conditions and modernization/L900 activation took place after the ICASA drive test. The sites are taking too much traffic and there isn't adequate capacity. RF optimization was done after modernization and areas improved. There is also a new site planned for future in Roodepan to relieve congestion. A new site in Adamantia is also planned to close the capacity gaps.
- Jan Kempdorp – The poor performance was due to lack of dominance issues in the area. During the drive test the area had high unavailability and sites are without backup power due to vandalism. Coverage challenges impacted throughput speeds significantly and optimisation has been done as a short-term solution on surrounding sites to try and resolve the dominance problem this has been able to alleviate coverage challenges. Long term solution is to build a new site in the areas, Tselaathuto and Jan Kempdorp.
- Kimberley – The failure happened under adequate radio frequency conditions. Modernization/L900 activation was implemented on serving sites in the area post trial period. The sites in the area are highly loaded due to increase in traffic thus affecting overall performance and Data KPI's. A short-term solution is to do an RF optimization and L900 activation. A new site Diamond oval went live in December to close capacity gaps. A new site Adamantia went live in December to close capacity gaps. New sites are in progress of being built is in Bunn and Galeshewe ext 6.
- Hopetown –Poor performance was due to bad coverage in the area. This is a result of only 1 sector facing the whole of Hopetown area and there isn't sufficient coverage which results in data performance degradation. Four (4) new sites are planned inside Hopetown to address all issues and deployment of L2100 in the area will improve capacity and throughputs.

6.2. MTN

MTN has indicated that it will remain committed to the improvement of the network quality even in areas where performance was good, thereby improving the end user mobile voice service experience.

- Kimberley – 98.3% of the area tested is served by LTE. Post measurements analysis revealed three critical areas where there is poor coverage that resulted in lower throughputs experienced during the drive test. Antenna optimisation methods will be implemented immediately to improve data coverage. MTN has planned a new site to improve coverage significantly in the long-term.

- Galeshewe – 99.9% of the drive test area is served by LTE. There were no major data coverage issues observed after drive test analysis.

- Barkly West – Post measurements analysis revealed that the poor coverage in the area was due to a fast handover that occurs from a 3G/4G site to a 2G-only site. MTN will implement optimisation methods to address this problem immediately. MTN will also upgrade the existing 2G-only site in the area to a 3G/4G site to improve data coverage. L900 will be integrated on another site to improve data coverage.

- Jan Kempdorp – 96.2% of the drive test area is served by LTE. There were three areas with data coverage holes, which resulted to lower throughputs experienced during the drive tests. MTN has planned a new site, which will be built in 2023 to address the data coverage issue in the area.

- Hopetown – 81.3% of the drive test area is covered by LTE. Two areas with coverage holes were identified after measurements. A new sector will be added to address the coverage holes. L900 will also be integrated in the serving site to further improve throughputs in the area**.**

6.3. Cell C

Cell C in its response indicated that it notes the findings of the Authority and will continue to engage with its national roaming service provider to improve coverage in areas identified with poor performance.

- Kimberley – 90% of data traffic is on LTE. Low throughput sites (LTE) will be highlighted to roaming partners. Cell C to engage with Roaming Partner, with regards to lack of 4G Coverage in the area.

- Galeshewe – 95% of data traffic is on LTE. Low throughput sites (LTE) will be highlighted to roaming partners. Cell C to engage with Roaming Partner, with regards to lack of 4G Coverage in the area. Investigate possible site failures.

- Barkly West – Low throughput sites (LTE) will be highlighted to roaming partners. Site in Barkley West LTE was added end of Aug 2021 and integrated Sept 2021.Cell C to engage with Roaming Partner, with regards to lack of 3G & 4G Coverage in the area.

- Jan Kempdorp – Average throughput speeds improved in Feb 2022. Rural area is prone to power / network availability failures. Low throughput sites (LTE) will be highlighted to roaming partners. Cell C to engage with Roaming Partner, with regards to 3G and 4G Coverage.

- Hopetown – Rural area is prone to power / network failures. Limited number of sites and coverage in large low populated rural area. Low throughput sites (LTE) will be highlighted to roaming partners. Other low throughput areas because of roaming on 2G and low signal levels. Cell C to engage with Roaming Partner, with regards to lack of 3G Coverage in the area. Investigate possible site failures.

6.4. 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 they will be engaging with the roaming partners to resolve issues and improve customer experience.

The operator noted that for 3G preferred test, it observed 19% of samples on 2G which impacted data performance on roaming, impacting HTTP and FTP downloads. High 2G roaming percentage was mostly observed in Hopetown and Barkly West due to lack of sites in those areas. Telkom will address the issues with the roaming partner to improve customer experience.

Poor quality on 3G will be resolved through optimization of the network and further engagement with the roaming partners to improve overall performance. Some of the issues were caused by flapping sites and high resource utilization which will be resolved thorough battery installation and further upgrades where practically possible.

Telkom had an average of 8 Mbps for 4G preferred measurements. The operator had a total of 11% samples on 2G and 20% on 3G which caused low performance mostly in Hopetown, Barkly West and Galeshewe. The operator had overall 40% samples in poor coverage (samples <-95dBm) averaging at -104dBm. To mitigate the limited coverage, Telkom will investigate further expanding the coverage footprint by planning sites in the tested areas and continue to engage with its roaming partner to resolve the data performance. Telkom was mostly roaming in Barkly West and Hopetown, and this resulted in poor coverage.

Telkom has 15 sites at different roll-out phases within the tested areas. Four (4) will be in service by the first quarter of 2021/2022 financial year, depending on landlord's approvals. There are 70 upgrades planned for the province ranging from low-band deployment that will improve coverage footprint to high-capacity upgrades that will also improve throughput and service KPIs.

Power upgrades project is underway on UMTS sites network wide which will improve site capacity and the outdoor coverage footprint and indoor coverage penetration. The recent onboarding of another roaming partner will help to close identified coverage gaps.

7. Appendix 2 – Performance per Area

7.1. 3G Preferred Mobile Test Results

7.1.1. 3G Preferred Average Throughput

Table 13: 3G Preferred Average Throughput per Area

		Barkly West	Galeshewe	Hopetown	Jan Kempdorp	Kimberley	Average
HTTP DL Throughput - Avg [Mbps]	**Cell C**	5.05	4.23	5.27	4.22	5.96	4.94
	MTN	5.20	5.29	5.24	5.28	7.26	5.73
	Telkom	8.09	4.27	9.13	5.50	5.88	6.01
	Vodacom	9.41	3.73	8.52	5.75	4.83	6.46
HTTP UL Throughput - Avg [Mbps]	**Cell C**	1.75	1.94	1.90	1.82	2.77	2.05
	MTN	1.70	1.93	1.93	1.79	2.65	2.02
	Telkom	2.68	1.74	3.08	1.80	2.04	2.07
	Vodacom	2.18	1.48	1.92	1.29	1.91	1.74
HTTP DL Capacity Throughput - Avg [Mbps]	**Cell C**	5.42	5.17	6.18	4.32	7.00	5.57
	MTN	5.97	5.66	7.06	5.89	8.80	6.70
	Telkom	12.50	4.43	15.96	6.64	7.50	7.92
	Vodacom	8.86	3.74	9.58	6.51	4.60	6.63
HTTP UL Capacity Throughput - Avg [Mbps]	**Cell C**	2.16	2.42	2.69	2.18	3.06	2.48
	MTN	2.03	2.51	2.30	2.22	3.26	2.48
	Telkom	3.12	1.99	2.86	2.12	2.48	2.38
	Vodacom	2.86	1.56	2.47	1.75	1.86	2.08
FTP DL Throughput - Avg [Mbps]	**Cell C**	2.83	2.13	2.63	2.21	3.05	2.59
	MTN	3.36	3.59	3.45	3.38	4.56	3.69
	Telkom	4.88	2.80	4.96	3.46	3.58	3.68
	Vodacom	5.23	2.29	5.24	3.70	2.98	3.91
FTP UL Throughput - Avg [Mbps]	**Cell C**	1.27	1.28	1.45	1.32	1.72	1.41
	MTN	1.17	1.35	1.28	1.24	1.79	1.38
	Telkom	1.77	1.19	2.06	1.22	1.41	1.41
	Vodacom	1.66	1.17	1.44	1.12	1.41	1.36

7.1.2. 3G Preferred Web Page Download Time

Table 14: 3G Preferred HTTPS Webpage download times per area

		Barkly West	Galeshewe	Hopetown	Jan Kempdorp	Kimberley	Average
HTTPs Kepler [s]	Cell C	6.98	8.79	7.11	8.04	6.41	7.44
	MTN	6.66	7.18	6.78	7.28	6.22	6.82
	Telkom	6.15	7.41	6.38	7.74	6.67	7.09
	Vodacom	6.61	8.31	7.16	7.09	7.43	7.25
HTTPs Mobile Kepler [s]	Cell C	1.55	2.49	1.45	2.94	1.48	2.02
	MTN	1.44	1.65	1.71	2.17	1.22	1.64
	Telkom	1.05	2.43	2.78	2.16	1.31	1.89
	Vodacom	1.23	2.32	1.68	1.82	2.32	1.86
Google [s]	Cell C	3.54	4.34	3.64	4.19	3.02	3.71
	MTN	3.67	4.68	4.12	4.59	3.29	4.04
	Telkom	2.09	4.85	2.29	3.71	3.22	3.48
	Vodacom	2.99	5.25	3.50	3.79	4.68	3.96
MSN[s]	Cell C	3.17	3.79	3.44	3.88	3.13	3.46
	MTN	3.13	3.18	2.74	3.26	2.80	3.05
	Telkom	2.85	3.65	2.94	3.39	3.09	3.25
	Vodacom	2.37	3.90	2.66	3.00	3.35	3.01
News24[s]	Cell C	5.22	6.30	5.42	6.25	5.20	5.64
	MTN	4.65	5.69	5.62	5.55	4.58	5.14
	Telkom	4.66	6.41	5.70	6.18	5.17	5.71
	Vodacom	4.43	6.96	5.51	5.37	5.26	5.36

7.1.3. 3G Preferred YouTube Results

Table 15: 3G Preferred YouTube Success ratio results per area

		Barkly West	Galeshewe	Hopetown	Jan Kempdorp	Kimberley	Average
YouTube Success Ratio [%]	Cell C	96.04%	71.43%	86.89%	82.86%	98.00%	88.10%
	MTN	95.96%	100.00%	85.94%	96.64%	100.00%	96.44%
	Telkom	52.58%	80.26%	46.67%	85.25%	86.87%	72.69%
	Vodacom	94.44%	80.30%	92.54%	96.77%	89.42%	91.68%

Table 16. 3G Preferred YouTube MOS Quality results per area

		Barkly West	Galeshewe	Hopetown	Jan Kempdorp	Kimberley	Grand Total
YouTube Quality MOS	Cell C	3.92	3.86	3.95	3.88		3.90
	MTN	4.09	4.03	4.07	4.03	4.16	4.08
	Telkom	4.18	4.01	4.20	4.07	4.10	4.09
	Vodacom	4.18	3.86	4.07	4.05		4.06

Table 17. 3G Preferred YouTube Access time results per area

		Barkly West	Galeshewe	Hopetown	Jan Kempdorp	Kimberley	Average
YouTube Access Time [s]	Cell C	12.69	16.41	11.04	14.82	13.48	13.68
	MTN	7.79	9.27	8.52	9.93	7.16	8.53
	Telkom	6.03	12.28	5.20	10.60	9.98	9.64
	Vodacom	6.42	13.43	5.66	8.69	11.04	8.86

Table 18: 3G Preferred YouTube Video resolution results

		Barkly West	Galeshewe	Hopetown	Jan Kempdorp	Kimberley	Average
YouTube Average Resolution [Pixels]	Cell C	816.61	747.25	816.59	810.51	801.56	801.27
	MTN	925.75	861.30	880.83	843.79	967.18	899.69
	Telkom	1000.04	794.79	1017.70	879.55	877.05	895.35
	Vodacom	975.18	792.11	986.08	890.78	804.88	896.16

7.1.4. 3G Preferred Ping/RTT Results

Table 19: 3G Preferred Ping Latency per area

		Barkly West	Galeshewe	Hopetown	Jan Kempdorp	Kimberley	Grand Total
Google ICMP (32 bytes) Ping [ms]	Cell C	78	63	68	95	78	78
	MTN	86	98	108	116	102	102
	Telkom	100	178	191	215	188	182
	Vodacom	48	88	76	56	89	70
Independent Server ICMP (32 bytes) Ping [ms]	Cell C	79	135	123	134	141	122
	MTN	88	100	185	148	108	121
	Telkom	68	110	84	87	80	86
	Vodacom	53	88	73	74	80	73

7.2. 4G Preferred Mobile Test Results

7.2.1. 4G Preferred Average Throughput

Table 20: 4G Preferred Average throughput per area

		Barkly West	Galeshewe	Hopetown	Jan Kempdorp	Kimberley	Grand Total
HTTP DL Throughput - Avg [Mbps]	**Cell C**	13.48	12.83	8.52	7.07	13.08	11.10
	MTN	51.94	42.24	45.02	33.96	45.39	43.13
	Telkom	25.66	16.14	25.88	17.65	15.58	18.35
	Vodacom	18.96	31.91	20.19	15.19	26.36	22.63
HTTP UL Throughput - Avg [Mbps]	**Cell C**	8.68	11.52	3.68	5.60	9.44	8.20
	MTN	23.57	21.71	12.19	17.16	21.30	19.74
	Telkom	6.34	5.22	14.70	6.11	4.44	6.09
	Vodacom	11.92	11.64	6.32	7.81	10.22	9.81
HTTP DL Capacity Throughput - Avg [Mbps]	**Cell C**	15.42	14.50	13.84	8.65	10.63	12.29
	MTN	69.26	56.79	69.18	41.58	57.32	57.08
	Telkom	56.59	21.40	55.19	29.79	27.03	32.16
	Vodacom	22.64	41.59	20.02	17.03	40.95	29.52
HTTP UL Capacity Throughput - Avg [Mbps]	**Cell C**	8.11	13.31	3.74	5.38	9.61	8.40
	MTN	25.12	24.32	12.83	20.49	18.92	20.94
	Telkom	14.69	8.54	16.92	9.01	7.28	9.63
	Vodacom	11.95	13.45	6.45	8.78	12.54	10.95
FTP DL Throughput - Avg [Mbps]	**Cell C**	6.34	6.57	5.06	4.27	6.22	5.72
	MTN	12.07	10.78	9.83	9.81	10.80	10.68
	Telkom	10.59	8.35	9.65	8.28	8.27	8.70
	Vodacom	9.69	12.19	10.65	7.87	11.44	10.28
FTP UL Throughput - Avg [Mbps]	**Cell C**	4.29	6.64	2.46	3.24	5.85	4.71
	MTN	9.56	10.37	6.63	8.10	9.44	9.01
	Telkom	4.37	3.69	8.15	3.66	3.15	3.94
	Vodacom	6.50	7.46	4.07	4.97	6.79	6.12

7.2.2. 4G Preferred Web Page Download Time

Table 21: 4G Preferred HTTPS Webpage download times per area

		Barkly West	Galeshewe	Hopetown	Jan Kempdorp	Kimberley	Grand Total
HTTPs Kepler [s]	Cell C	6.52	6.36	7.47	7.13	6.68	6.77
	MTN	6.34	6.11	6.20	6.43	6.13	6.25
	Telkom	6.51	6.74	6.22	6.86	6.77	6.72
	Vodacom	6.65	6.68	6.73	6.75	6.62	6.68
HTTPs Mobile Kepler [s]	Cell C	1.05	0.95	1.16	1.96	1.23	1.31
	MTN	0.75	0.76	0.88	1.37	0.77	0.93
	Telkom	1.55	0.98	1.36	1.44	1.65	1.39
	Vodacom	0.91	0.75	1.44	1.11	1.10	1.03
Google [s]	Cell C	3.04	2.58	3.93	3.75	3.10	3.21
	MTN	1.76	1.80	2.30	2.05	1.68	1.88
	Telkom	1.76	2.27	1.87	2.27	2.39	2.21
	Vodacom	2.28	1.78	2.14	2.76	1.99	2.20
MSN [s]	Cell C	3.11	2.63	3.39	3.43	3.02	3.09
	MTN	2.32	2.26	2.53	2.35	2.33	2.34
	Telkom	2.64	2.56	2.54	2.93	2.69	2.71
	Vodacom	2.81	2.91	2.90	2.86	2.31	2.75
News24 [s]	Cell C	5.05	4.21	5.21	5.01	4.59	4.75
	MTN	4.00	3.81	4.56	4.06	3.55	3.92
	Telkom	4.91	4.18	5.28	4.75	4.00	4.42
	Vodacom	4.78	4.26	5.11	4.55	3.81	4.42

7.2.3. 4G Preferred YouTube Results

Table 22: 4G Preferred YouTube Success Ratio results per area

		Barkly West	Galeshewe	Hopetown	Jan Kempdorp	Kimberley	Grand Total
YouTube Success Ratio [%]	Cell C	99.01%	99.09%	86.67%	92.44%	99.13%	96.04%
	MTN	98.06%	100.00%	90.91%	100.00%	100.00%	98.50%
	Telkom	49.48%	89.72%	38.33%	91.34%	92.79%	76.89%
	Vodacom	97.12%	98.20%	90.77%	96.03%	95.54%	95.95%

Table 23: 4G Preferred YouTube MOS quality results per area

		Barkly West	Galeshewe	Hopetown	Jan Kempdorp	Kimberley	Grand Total
YouTube Quality MOS	Cell C	4.11	4.14	4.11	4.02	4.15	4.10
	MTN	4.18	4.19	4.19	4.16	4.19	4.18
	Telkom	4.19	4.18	4.20	4.15	4.18	4.18
	Vodacom	4.15	4.20	4.17	4.16	4.19	4.17

Table 24: 4G Preferred YouTube Access time results per area

		Barkly West	Galeshewe	Hopetown	Jan Kempdorp	Kimberley	Grand Total
YouTube Access Time [s]	Cell C	8.18	5.93	8.56	10.53	7.34	8.07
	MTN	4.07	4.08	5.18	4.67	4.22	4.39
	Telkom	4.40	4.79	3.47	5.34	4.92	4.86
	Vodacom	7.09	5.54	7.49	6.67	7.70	6.83

Table 25: 4G Preferred YouTube video resolution results

		Barkly West	Galeshewe	Hopetown	Jan Kempdorp	Kimberley	Grand Total
YouTube Average Resolution {pixels]	Cell C	935.74	977.02	889.13	853.70	956.53	928.45
	MTN	1004.65	1003.91	998.24	992.13	1007.05	1001.24
	Telkom	1017.02	1005.71	1016.90	1000.47	1009.00	1007.13
	Vodacom	960.16	1021.35	1006.23	985.43	1011.22	996.82

7.2.4. 4G Preferred Ping Results

Table 26: 4G Preferred Ping Latency per area

		Barkly West	Galeshewe	Hopetown	Jan Kempdorp	Kimberley	Grand Total
Google ICMP (32 bytes) Ping [ms]	Cell C	49	32	44	44	34	40
	MTN	36	30	47	46	31	37
	Telkom	73	59	38	70	67	65
	Vodacom	45	44	48	50	34	44
Independent Server ICMP (32 bytes) Ping [ms]	Cell C	90	39	49	53	42	54
	MTN	44	36	70	43	38	44
	Telkom	64	48	36	72	52	57
	Vodacom	55	38	43	41	35	42

7.3. 3G Stationary Test Results

7.3.1. 3G Preferred Throughput

Table 27. Table 26: 3G Preferred Throughput results per area

		Barkly West		Galeshewe			Hopetown		Jan_Kempdorp		Kimberley			Grand Total
		CBD Post Office	Delportshoop High School	Dr Winston Torres Clinic	Police Station	Urban TVET College	Community Correction Office	Orania	Hartswater	Jan Kempdorp Point1	Diamond Pavilion Shopping Center	Kimberley Hospital	Sol Plaatje University	
HTTP DL Throughput - Avg [Mbps]	Cell C	4.50	4.94	5.44	8.09	7.53	1.07	7.28	2.86	7.94	2.45	5.61	5.07	5.26
	MTN	5.11	5.81	5.70	10.74	6.39	2.94	8.33	4.28	9.38	4.12	5.37	6.90	6.40
	Telkom	9.60	10.17	10.07	6.01	2.31	9.03	6.82	6.70	0.00	4.40	6.23	6.22	7.30
	Vodacom	11.35	9.95	6.38	4.25	0.28	11.41	13.58	6.50	12.79	3.38	2.01	3.84	7.89
HTTP UL Throughput - Avg [Mbps]	Cell C	2.82	2.35	0.93	2.87	3.17	0.37	2.14	2.04	3.66	2.49	2.85	2.16	2.31
	MTN	2.80	1.72	1.04	3.28	3.11	0.49	2.83	2.20	3.81	2.24	2.23	2.16	2.33
	Telkom	2.83	3.79	3.70	2.15	1.23	3.20	1.92	1.88	0.00	1.96	1.60	1.62	2.40
	Vodacom	2.38	2.25	1.81	2.10	0.42	3.00	3.74	3.67	3.72	1.92	1.64	1.48	2.47
HTTP DL Capacity Throughput - Avg [Mbps]	Cell C	6.21	4.52	5.16	10.78	4.95	1.45	9.50	2.48	7.68	2.45	5.48	6.17	5.76
	MTN	4.64	6.28	6.87	13.61	8.50	3.56	9.93	4.16	13.53	4.87	5.96	8.51	7.72
	Telkom	13.31	28.92	21.36	6.85	2.53	15.88	7.31	8.89	0.00	5.99	7.44	6.20	11.79
	Vodacom	12.20	11.36	7.16	4.90	0.26	11.00	16.81	5.48	16.92	2.33	2.81	4.00	8.92
HTTP UL Capacity Throughput - Avg [Mbps]	Cell C	3.16	2.96	1.29	3.76	2.53	0.97	2.69	2.09	5.08	2.43	3.60	2.62	2.83
	MTN	3.50	2.53	1.30	4.03	3.54	0.96	3.22	2.50	5.07	2.74	2.94	2.86	2.95
	Telkom	3.42	4.50	4.42	2.54	1.58	3.78	2.35	2.16	0.00	2.78	1.64	2.81	2.96
	Vodacom	3.33	2.37	2.75	2.64	0.50	3.79	4.18	3.77	4.85	2.31	2.28	2.21	3.11
FTP DL Throughput - Avg [Mbps]	Cell C	3.00	2.25	3.05	5.08	2.45	1.45	2.89	1.79	4.74	1.13	2.72	2.01	2.82
	MTN	3.53	4.57	3.35	5.63	4.32	2.40	5.21	2.83	5.55	2.73	3.87	4.74	4.13
	Telkom	5.95	6.14	5.85	4.19	1.65	5.35	4.05	4.33	0.00	4.12	4.25	4.38	4.70
	Vodacom	6.51	5.74	4.93	3.06	0.27	6.36	7.47	4.20	8.12	2.64	2.02	2.71	4.91
FTP UL Throughput - Avg	Cell C	1.58	1.61	0.82	1.84	1.95	0.39	1.45	1.37	2.42	1.58	1.85	1.47	1.53
	MTN	1.80	1.42	0.82	2.03	1.98	0.42	1.72	1.60	2.47	1.76	1.71	1.47	1.61
	Telkom	1.94	2.30	2.34	1.23	0.93	2.21	1.30	1.41	0.00	1.31	1.07	1.41	1.62
	Vodacom	1.64	1.60	1.69	1.32	0.35	2.21	2.34	2.84	2.13	1.06	1.58	1.34	1.78

7.3.2. 3G Preferred Web Page Time

Table 28: 3G Preferred HTTPS web page time results

		Barkly West		Galeshewe			Hopetown		Jan_Kempdorp		Kimberley			Grand Total
		CBD Post Office	Delportshoop High School	Dr Winston Torres Clinic	Police Station	Urban TVET College	Community Correction Office	Orania	Hartswater	Jan Kempdorp Point1	Diamond Pavilion Shopping Center	Kimberley Hospital	Sol Plaatje University	
HTTPs Kepler [s]	Cell C	6.50	6.43	6.43	6.78	7.61	7.49	6.20	10.12	6.29	6.29	6.33	6.49	6.87
	MTN	6.26	6.33	15.84	6.34	6.22	6.15	6.16	6.84	6.17	5.96	6.10	5.94	6.68
	Telkom	6.11	6.16	6.82	6.18	6.77	6.09		6.07	6.24	6.41	6.28	6.23	6.29
	Vodacom	6.29	6.24	20.34	6.96	6.47	6.38	6.45	6.14	6.12	6.01	6.30	6.76	6.79
HTTPs Mobile Kepler [s]	Cell C	1.48	0.91	1.13	5.62	4.83	2.88	0.89	4.02	0.88	1.03	1.08	1.18	2.10
	MTN	1.29	1.25	2.41	1.16	1.15	1.10	1.09	1.43	1.06	1.00	1.19	1.20	1.22
	Telkom	0.99	0.95	2.09	0.91	1.97	0.92		0.91	1.16	1.49	0.99	1.04	1.19
	Vodacom	0.86	1.06	9.67	1.76	1.45	1.12	1.04	1.08	0.79	1.15	0.96	1.29	1.29
Google [s]	Cell C	3.90	2.55	2.72	5.27	2.78	3.42	2.80	6.49	2.71	3.03	4.80	3.00	3.50
	MTN	3.29	3.03	2.61	4.46	2.65	3.46	3.00	5.33	2.99	2.73	3.50	2.93	3.30
	Telkom	2.04	1.90	5.50	2.95	2.87	2.04		2.25	3.06	2.73	3.20	2.69	2.67
	Vodacom	2.43	3.24		4.84	2.85	2.57	3.02	2.30	2.38	3.35	2.90	5.83	3.20
MSN [s]	Cell C	3.65	2.65	2.79	4.25	2.75	2.88	2.66	3.95	3.06	2.85	3.19	3.34	3.12
	MTN	2.66	2.48	4.83	3.06	2.53	2.70	2.47	3.69	2.51	2.41	2.89	2.57	2.77
	Telkom	2.97	2.65	6.43	2.70	3.14	2.83		2.84	2.90	2.79	2.54	2.62	2.99
	Vodacom	3.04	2.49		3.08	2.69	2.81	2.11	1.95	1.96	2.32	2.92	5.66	2.81
News24 [s]	Cell C	4.83	4.18	3.94	5.79	4.75	5.92	4.29	4.87	5.13	3.90	4.79	5.49	4.83
	MTN	5.05	4.03	3.53	3.68	3.81	4.30	5.47	5.66	4.75	3.75	4.04	3.50	4.35
	Telkom	4.30	4.37	7.12	4.76	6.17	4.93		4.65	5.48	4.27	4.18	4.18	4.81
	Vodacom	4.35	4.14		5.07	4.03	3.97	3.99	4.86	4.16	3.80	3.68	6.34	4.36

7.3.3. 3G Preferred YouTube Results

Table 29: 3G Preferred YouTube Success ratio results

		Barkly West		Galeshewe			Hopetown		Jan_Kempdorp		Kimberley			Grand Total
		CBD Post Office	Delportshoop High School	Dr Winston Torres Clinic	Police Station	Urban TVET College	Community Correction Office	Orania	Hartswater	Jan Kempdorp Point1	Diamond Pavilion Shopping Center	Kimberley Hospital	Sol Plaatje University	
YouTube Success Ratio	Cell C	85.71%	100.00%	60.00%	25.00%	100.00%	83.33%	100.00%	80.00%	100.00%	100.00%	88.89%	100.00%	90.11%
	MTN	100.00%	100.00%	80.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	99.03%
	Telkom	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%		100.00%	100.00%	100.00%	100.00%	100.00%	90.20%
	Vodacom	88.89%	100.00%		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	88.89%	94.00%

Table 30: 3G Preferred YouTube MOS quality results

		Barkly West		Galeshewe			Hopetown		Jan Kempdorp		Kimberley			Grand Total
		CBD Post Office	Delportshoop High School	Dr Winston Torres Clinic	Police Station	Urban TVET College	Community Correction Office	Orania	Hartswater	Jan Kempdorp Point1	Diamond Pavilion Shopping Center	Kimberley Hospital	Sol Plaatje University	
YouTube Quality MOS	Cell C													
	MTN	4.08	4.20	4.20	4.16	4.20	4.20	4.19	4.07	4.20	4.20	4.20	4.20	4.18
	Telkom	4.20	4.20	3.65	4.19	4.18	4.20		4.20	4.20	4.19	4.20	4.20	4.17
	Vodacom													

Table 31: 3G Preferred YouTube access time results

		Barkly West		Galeshewe			Hopetown		Jan_Kempdorp		Kimberley			Grand Total
		CBD Post Office	Delportshoop High School	Dr Winston Torres Clinic	Police Station	Urban TVET College	Community Correction Office	Orania	Hartswater	Jan Kempdorp Point1	Diamond Pavilion Shopping Center	Kimberley Hospital	Sol Plaatje University	
YouTube Access Time (s)	Cell C	14.84	7.24	20.99	28.03	20.78	23.13	7.48	17.83	15.78	6.66	14.20	7.43	13.54
	MTN	6.62	6.10	6.18	10.31	5.64	6.51	5.25	11.21	4.94	4.28	8.06	6.67	6.65
	Telkom	5.49	4.55	20.62	7.87	8.85	4.27		4.92	7.11	7.00	6.30	7.06	6.95
	Vodacom	4.49	5.63		15.17	10.71	4.86	4.11	6.18	3.75	8.48	7.06	15.51	7.43

Table 32: 3G Preferred YouTube Video resolution results

		Barkly West		Galeshewe			Hopetown		Jan_Kempdorp		Kimberley			Grand Total
		CBD Post Office	Delportshoop High School	Dr Winston Torres Clinic	Police Station	Urban TVET College	Community Correction Office	Orania	Hartswater	Jan Kempdorp Point1	Diamond Pavilion Shopping Center	Kimberley Hospital	Sol Plaatje University	
YouTube Average Resolution [pixels]	Cell C	811.00	975.90	755.33	569.33	804.33	741.60	952.56	660.33	787.38	1008.22	681.14	973.00	852.10
	MTN	809.57	966.44	1026.00	921.50	1016.56	1026.00	999.50	821.00	1015.40	1008.33	994.00	1008.22	976.35
	Telkom	1026.00	1026.00	527.25	957.86	925.44	1026.00		1026.00	1000.40	970.33	1001.11	979.78	974.11
	Vodacom	1022.00	1010.13		792.00	795.00	1026.00	998.00	995.43	1026.00	927.38	973.89	643.50	947.41

7.3.4. 3G Preferred Ping/RTT Results

Table 33: 3G Preferred Ping Latency results

		Barkly West		Galeshewe			Hopetown		Jan_Kempdorp		Kimberley			Grand Total
		CBD Post Office	Delportshoop High School	Dr Winston Torres Clinic	Police Station	Urban TVET College	Community Correction Office	Orania	Hartswater	Jan Kempdorp Point1	Diamond Pavilion Shopping Center	Kimberley Hospital	Sol Plaatje University	
Google ICMP (32 bytes) Ping (ms)	**Cell C**	47	47	44	48	70	48	43	106	43	41	491	43	91
	MTN	56	49	94	49	42	95	94	56	44	42	211	39	72
	Telkom	180	191	151	135	208	269		125	142	167	228	196	184
	Vodacom	42	185	111	42	44	48	47	58	43	45	41	51	62
Independent Server ICMP (32 bytes) Ping (ms)	**Cell C**	104	48	40	51	45	48	94	103	80	44	209	45	77
	MTN	53	57	42	44	47	45	47	286	116	41	195	42	79
	Telkom	54	55	73	113	84	52		58	79	65	206	66	82
	Vodacom	54	50		46	44	49	48	45	49	47	56	50	49

7.4. 4G Stationary Test Results

7.4.1. 4G Preferred Throughput

Table 34: 4G Preferred Throughput per area

		Barkly West		Galeshewe			Hopetown		Jan_Kempdorp		Kimberley			Grand Total
		CBD Post Office	Delportshoop High School	Dr Winston Torres Clinic	Police Station	Urban TVET College	Community Correction Office	Orania	Hartswater	Jan Kempdorp Point1	Diamond Pavilion Shopping Center	Kimberley Hospital	Sol Plaatje University	
HTTP DL Throughput - Avg [Mbps]	Cell C	4.44	26.80	16.12	3.74	12.15	3.68	10.91	13.52	4.63	25.26	7.83	6.30	11.22
	MTN	50.58	60.71	30.88	13.15	49.13	63.20	16.24	26.61	48.98	46.37	18.37	18.70	36.34
	Telkom	26.32	31.53	13.13	14.86	18.40	24.93	0.00	18.71	30.93	14.45	14.95	14.23	19.91
	Vodacom	19.76	2.15	41.37	8.68	49.45	19.18	8.66	13.26	11.34	25.76	40.87	28.58	22.97
HTTP UL Throughput - Avg [Mbps]	Cell C	3.18	18.29	18.04	3.78	6.74	1.54	16.72	19.19	1.49	12.54	10.61	11.70	10.38
	MTN	37.11	22.53	18.75	11.52	17.00	20.85	19.89	16.79	12.18	31.56	23.22	31.82	22.01
	Telkom	3.98	4.32	2.24	8.18	5.16	13.86	0.00	19.77	6.12	11.25	5.20	8.99	8.23
	Vodacom	17.21	10.93	12.46	11.15	14.76	5.92	14.17	13.74	12.07	11.23	14.77	13.16	12.70
HTTP DL Capacity Throughput - Avg [Mbps]	Cell C	5.62	41.82	36.54	3.24	7.43	3.42	13.78	12.82	5.34	18.08	6.10	4.51	12.61
	MTN	70.82	75.51	38.20	12.52	65.52	98.74	15.85	30.86	70.87	61.24	13.61	20.10	46.87
	Telkom	46.69	53.29	40.37	17.16	19.94	77.38	0.00	30.15	72.09	27.19	15.72	16.68	36.95
	Vodacom	14.68	2.74	47.21	6.41	53.55	19.06	8.51	14.68	8.79	26.65	39.35	32.50	23.36
HTTP UL Capacity Throughput - Avg [Mbps]	Cell C	3.65	14.82	25.23	3.43	5.39	1.38	14.43	16.43	1.43	12.91	9.81	11.99	9.99
	MTN	45.12	20.05	24.07	15.19	20.16	19.65	19.17	15.66	14.38	26.61	22.33	33.68	23.03
	Telkom	8.85	15.01	4.93	14.75	11.17	14.93	0.00	25.91	15.57	13.58	15.85	15.61	14.30
	Vodacom	17.10	11.84	13.62	11.47	16.50	6.56	14.84	12.48	12.25	11.28	16.48	12.73	13.16
FTP DL Throughput - Avg [Mbps]	Cell C	4.64	11.35	8.47	2.62	5.88	2.85	8.15	6.54	4.04	10.64	5.15	3.90	6.17
	MTN	13.30	10.95	9.45	7.00	10.93	11.03	8.70	9.62	11.03	12.67	9.69	9.46	10.31
	Telkom	11.62	12.39	10.72	8.25	9.18	12.17	0.00	8.53	9.99	8.93	8.72	8.28	9.81
	Vodacom	10.40	1.50	16.94	5.65	14.27	9.37	4.50	8.30	6.93	12.66	13.15	13.12	9.87
FTP UL Throughput - Avg [Mbps]	Cell C	2.39	8.23	8.46	3.45	5.23	1.53	8.50	9.50	1.47	7.60	6.58	7.35	5.92
	MTN	13.90	9.41	9.41	7.08	8.99	9.69	9.61	9.27	7.17	12.05	11.41	12.88	10.12
	Telkom	3.78	4.01	2.71	5.84	3.90	7.83	0.00	9.13	4.77	5.50	4.22	5.55	5.24
	Vodacom	9.60	6.50	7.98	7.34	9.41	4.33	8.11	7.82	6.75	7.38	10.22	8.26	7.86

7.4.2. 4G Preferred Web Page Download Time

Table 35: 4G Preferred HTTPS Web page download time results

		Barkly West		Galeshewe			Hopetown		Jan_Kempdorp		Kimberley			Grand Total
		CBD Post Office	Delportshoop High School	Dr Winston Torres Clinic	Police Station	Urban TVET College	Community Correction Office	Orania	Hartswater	Jan Kempdorp Point1	Diamond Pavilion Shopping Center	Kimberley Hospital	Sol Plaatje University	
HTTPs Kepler [s]	Cell C	6.33	6.26	7.22	7.31	6.43	6.31	6.37	6.33	6.21	6.35	6.54	6.33	6.49
	MTN	6.06	6.05	6.14	6.18	6.15	6.05	6.11	6.13	6.09	6.04	6.05	6.00	6.09
	Telkom	6.20	6.19	6.29	6.38	6.31	6.23		6.24	6.29	6.44	6.36	6.34	6.30
	Vodacom	6.34	8.40	6.32	6.56	6.37	6.54	6.64	6.48	6.57	6.48	6.43	6.49	6.61
HTTPs Mobile Kepler [s]	Cell C	1.64	0.67	0.77	0.94	0.73	0.92	0.67	0.72	1.02	0.59	0.91	0.73	0.85
	MTN	0.65	0.61	0.67	0.67	0.60	0.70	0.67	0.69	0.70	0.66	0.70	0.70	0.67
	Telkom	0.72	0.74	0.75	0.72	0.81	0.68		0.76	0.84	0.73	0.71	0.75	0.75
	Vodacom	0.80	1.40	0.65	0.78	0.58	0.66	0.92	0.78	0.83	0.64	0.68	0.69	0.77
Google [s]	Cell C	4.24	1.56	2.48	2.83	2.33	3.01	2.00	2.17	3.19	1.80	3.94	3.84	2.79
	MTN	1.54	1.43	1.91	1.90	1.53	1.84	1.89	1.89	1.75	1.54	1.87	1.72	1.74
	Telkom	1.61	1.38	1.75	1.81	1.74	1.64		2.10	2.02	1.96	1.95	1.96	1.84
	Vodacom	1.62	5.85	1.30	2.55	1.41	2.06	3.42	2.28	2.57	1.61	1.73	1.67	2.23
MSN [s]	Cell C	2.96	2.27	2.79	3.21	2.54	2.95	2.69	2.59	3.46	2.46	2.65	2.71	2.77
	MTN	2.20	1.96	2.34	2.32	2.11	2.43	2.21	2.73	2.40	2.10	2.31	2.21	2.28
	Telkom	2.49	2.26	2.50	2.75	2.57	2.74		2.46	2.58	2.48	2.43	2.39	2.51
	Vodacom	2.26	4.60	1.89	2.28	1.82	2.15	2.72	2.51	2.30	1.95	2.11	2.20	2.37
News24 [s]	Cell C	5.09	4.06	4.01	4.90	3.71	4.39	4.32	3.88	4.70	3.23	4.93	3.56	4.22
	MTN	3.70	3.58	3.73	3.63	3.35	4.09	4.04	4.07	3.77	3.13	3.27	3.22	3.63
	Telkom	5.96	4.95	3.61	3.54	3.46	4.97		4.43	4.16	3.48	3.31	3.54	4.02
	Vodacom	3.68	5.64	3.27	3.89	3.16	4.52	4.53	3.92	4.01	3.26	3.23	3.26	3.82

7.4.3. 4G Preferred YouTube Results

Table 36: 4G Preferred YouTube Success Ratio Results

		Barkly West		Galeshewe			Hopetown		Jan_Kempdorp		Kimberley			Grand Total
		CBD Post Office	Delportshoop High School	Dr Winston Torres Clinic	Police Station	Urban TVET College	Community Correction Office	Orania	Hartswater	Jan Kempdorp Point1	Diamond Pavilion Shopping Center	Kimberley Hospital	Sol Plaatje University	
YouTube Success Ratio [%]	Cell C	88.89%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	99.10%
	MTN	100.00%	100.00%	88.89%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	99.12%
	Telkom	88.89%	62.50%	100.00%	100.00%	100.00%	77.78%		100.00%	100.00%	100.00%	100.00%	100.00%	85.84%
	Vodacom	100.00%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	98.13%

Table 37: 4G Preferred YouTube MOS quality results

		Barkly West		Galeshewe			Hopetown		Jan_Kempdorp		Kimberley			Grand Total
		CBD Post Office	Delportshoop High School	Dr Winston Torres Clinic	Police Station	Urban TVET College	Community Correction Office	Orania	Hartswater	Jan Kempdorp Point1	Diamond Pavilion Shopping Center	Kimberley Hospital	Sol Plaatje University	
YouTube Quality MOS	Cell C	4.01	4.20	4.19	3.96	4.19	4.06	4.20	4.20	4.18	4.20	3.96	4.20	4.13
	MTN	4.20	4.19	4.20	4.19	4.20	4.19	4.18	4.20	4.20	4.20	4.20	4.19	4.19
	Telkom	4.20	4.20	4.20	4.20	4.20	4.20		4.20	4.20	4.20	4.20	4.20	4.20
	Vodacom	4.20	3.78	4.20	4.17	4.20	4.20	4.00	4.20	4.18	4.20	4.20	4.20	4.16

Table 38: 4G Preferred YouTube Access time results

		Barkly West		Galeshewe			Hopetown		Jan_Kempdorp		Kimberley			Grand Total
		CBD Post Office	Delportshoop High School	Dr Winston Torres Clinic	Police Station	Urban TVET College	Community Correction Office	Orania	Hartswater	Jan Kempdorp Point1	Diamond Pavilion Shopping Center	Kimberley Hospital	Sol Plaatje University	
YouTube Access Time (s)	Cell C	13.86	3.69	4.25	12.52	6.46	9.95	6.00	4.53	7.87	4.29	9.77	9.96	7.74
	MTN	3.69	3.75	5.03	5.41	3.95	3.85	5.61	4.28	4.25	3.68	4.27	4.20	4.33
	Telkom	8.43	5.17	4.04	4.63	4.40	3.56		4.03	3.65	4.27	4.59	4.39	4.60
	Vodacom	6.19	20.60	5.49	9.98	9.48	10.66	11.34	4.73	6.01	5.07	5.09	6.16	7.76

Table 39: 4G Preferred YouTube video resolution results

		Barkly West		Galeshewe			Hopetown		Jan_Kempdorp		Kimberley			Grand Total
		CBD Post Office	Delportshoop High School	Dr Winston Torres Clinic	Police Station	Urban TVET College	Community Correction Office	Orania	Hartswater	Jan Kempdorp Point1	Diamond Pavilion Shopping Center	Kimberley Hospital	Sol Plaatje University	
YouTube Average Resolution [pixels]	Cell C	773.89	1022.00	1000.38	716.86	982.22	834.29	1010.00	1014.30	954.89	1026.00	926.63	994.10	945.65
	MTN	1014.22	999.38	995.50	1008.33	1010.10	1008.33	995.10	1020.70	1008.33	1010.10	1026.00	1010.10	1009.22
	Telkom	1018.43	1019.60	1026.00	1026.00	1026.00	1026.00		1026.00	1026.00	1026.00	1026.00	1026.00	1025.11
	Vodacom	1026.00	586.60	1026.00	944.00	1026.00	1026.00	846.14	1026.00	984.56	1026.00	1026.00	1026.00	982.92

7.4.4. 4G Preferred Ping/RTT Results

Table 40: 4G Preferred Ping Latency results per area

		Barkly West		Galeshewe			Hopetown		Jan_Kempdorp		Kimberley			Total
		CBD Post Office	Delportshoop High School	Dr Winston Torres Clinic	Police Station	Urban TVET College	Community Correction Office	Orania	Hartswater	Jan Kempdorp Point1	Diamond Pavilion Shopping Center	Kimberley Hospital	Sol Plaatje University	
Google ICMP (32 bytes) Ping (ms)	**Cell C**	54	34	30	36	29	33	42	39	39	29	32	33	36
	MTN	27	36	27	28	31	33	31	30	35	25	24	25	29
	Telkom	43	41	51	61	48	44		64	67	56	51	49	52
	Vodacom	38	44	30	33	28	38	50	36	42	33	31	39	37
Independent Server ICMP (32 bytes) Ping (ms)	**Cell C**	118	57	37	39	38	38	47	40	41	34	37	40	47
	MTN	55	38	36	36	36	38	42	38	38	33	31	31	37
	Telkom	40	38	54	50	44	44		68	62	55	43	50	50
	Vodacom	37	44	30	35	29	38	48	38	44	35	31	39	37

8. Appendix 3 – RF Measurements

8.1.1. 3G Preferred Map Plots

8.1.1.1. Data Technology

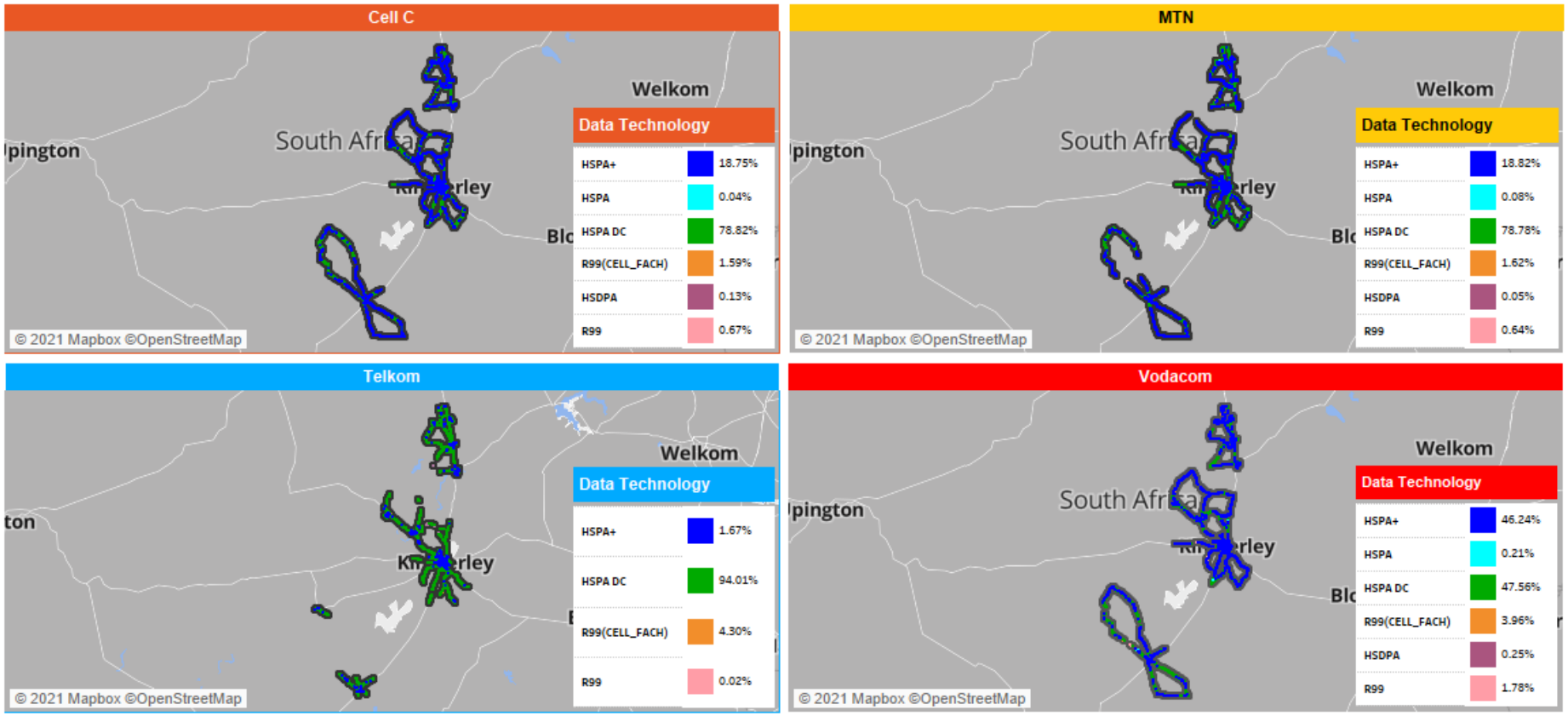


Figure 76. 3G Preferred Data Technology Map

8.1.1.2. RSCP

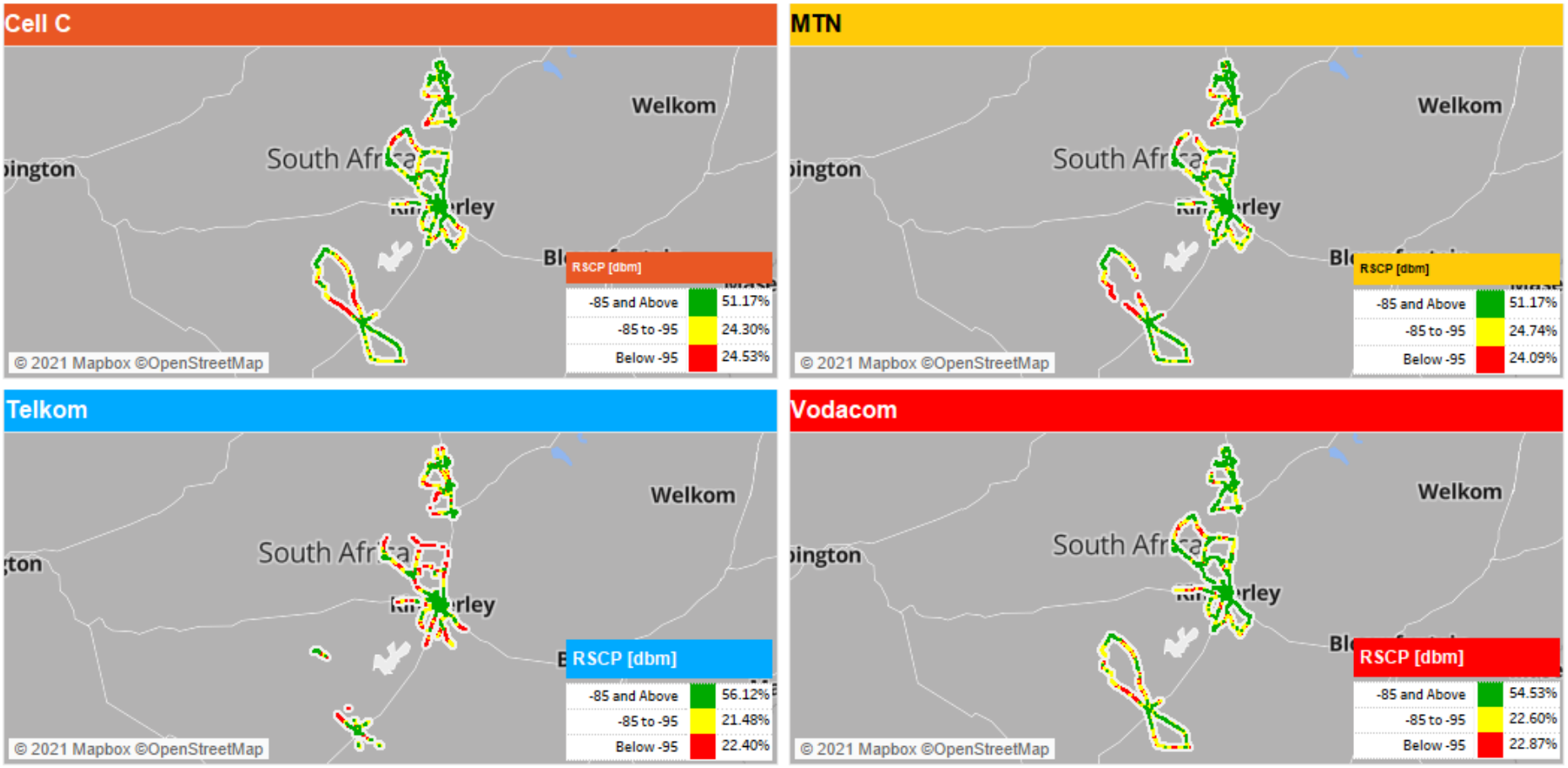


Figure 77. 3G Preferred RSCP

8.1.1.3. Eclo

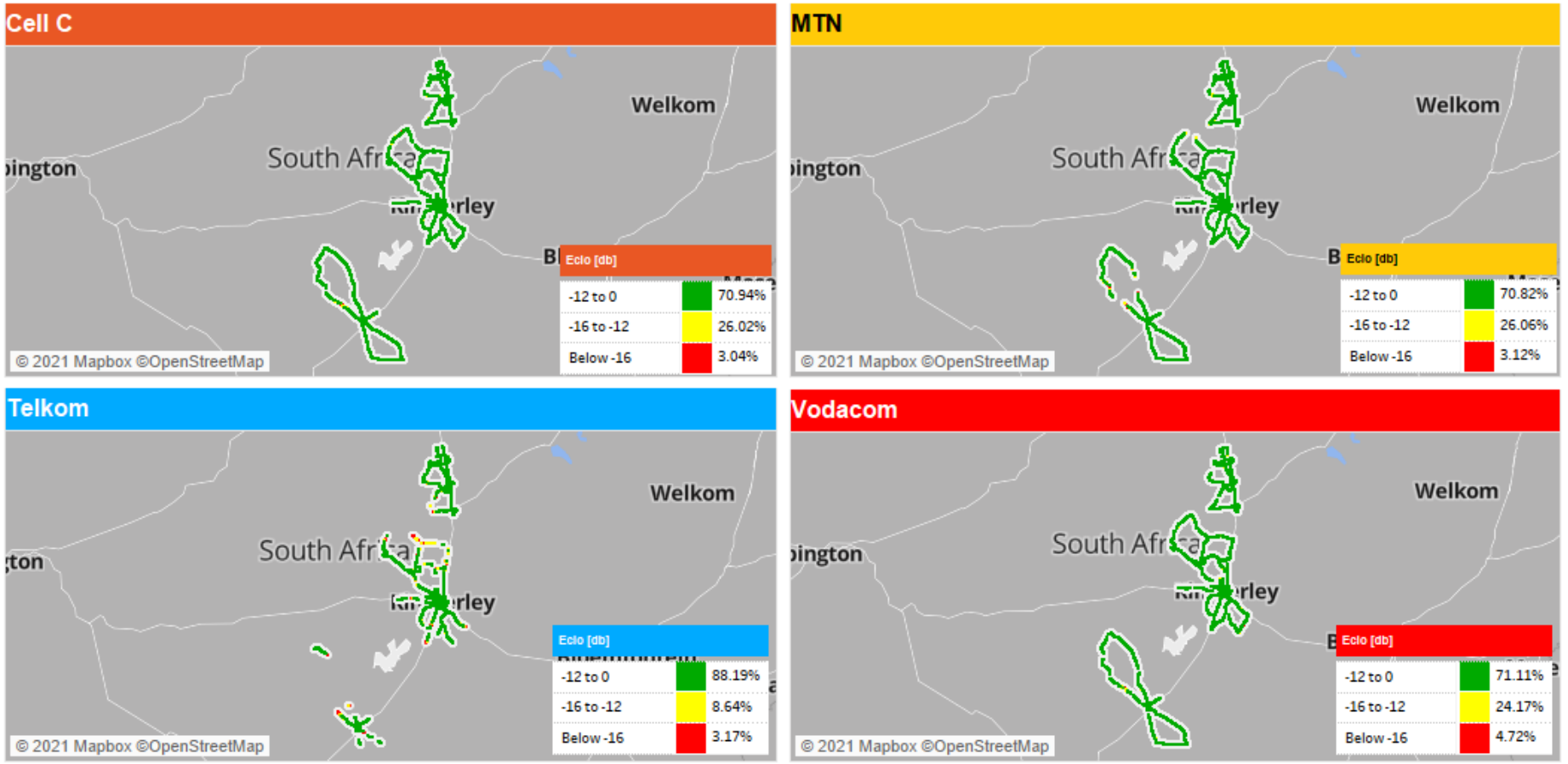


Figure 78. 3G Preferred Eclo

8.1.2. 4G Preferred Map Plots

8.1.2.1. Data Technology

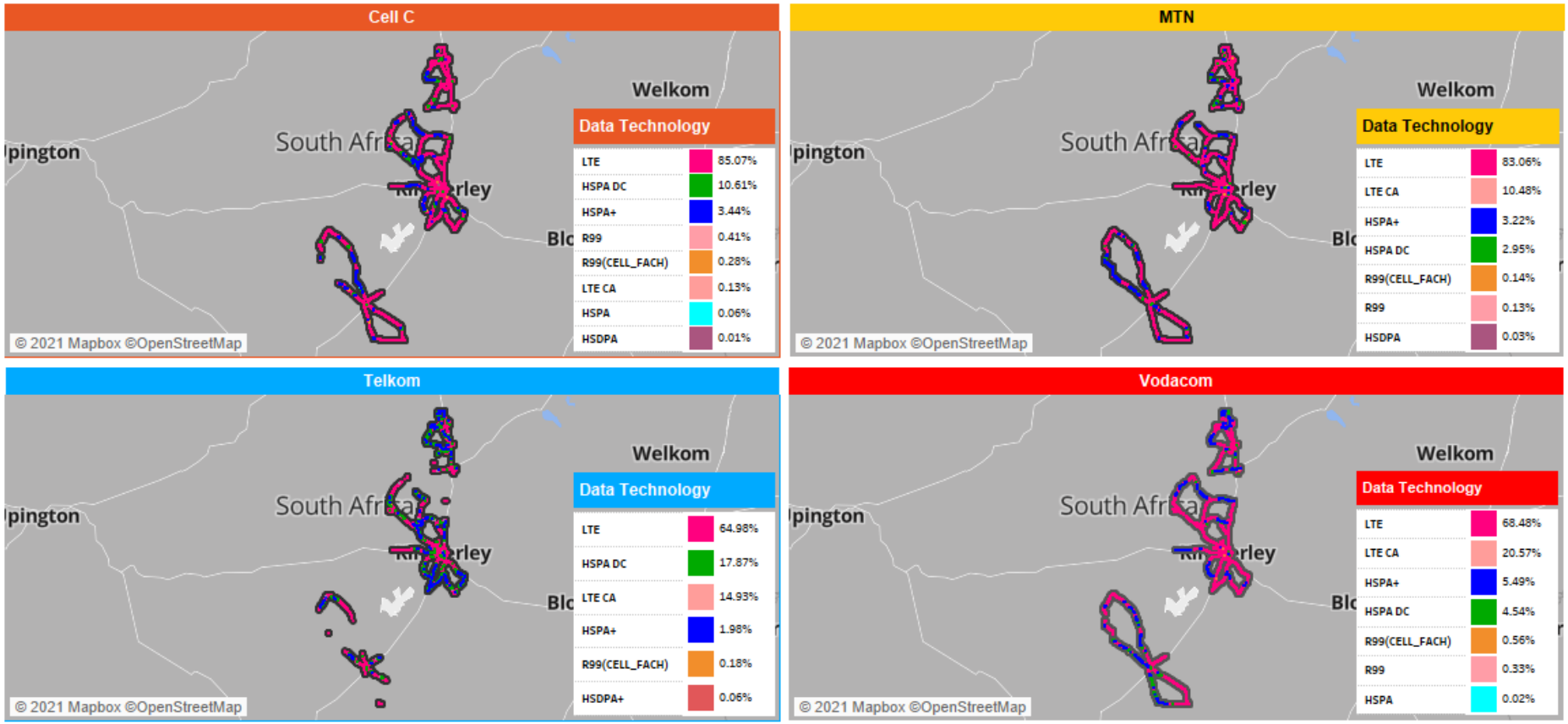


Figure 79. 4G Preferred Data Technology

8.1.2.2. RSRP

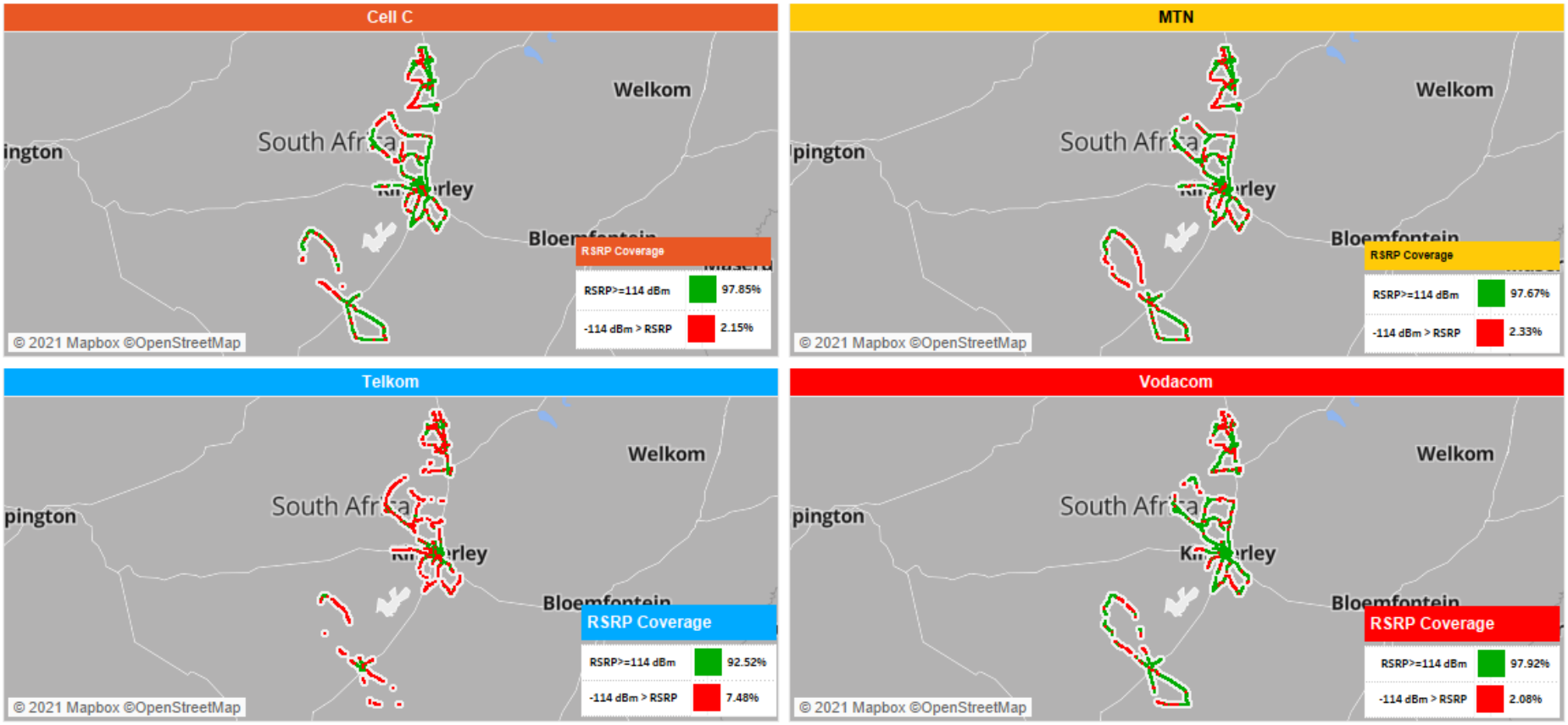


Figure 80. 4G Preferred LTE RSRP

8.1.2.3. SINR

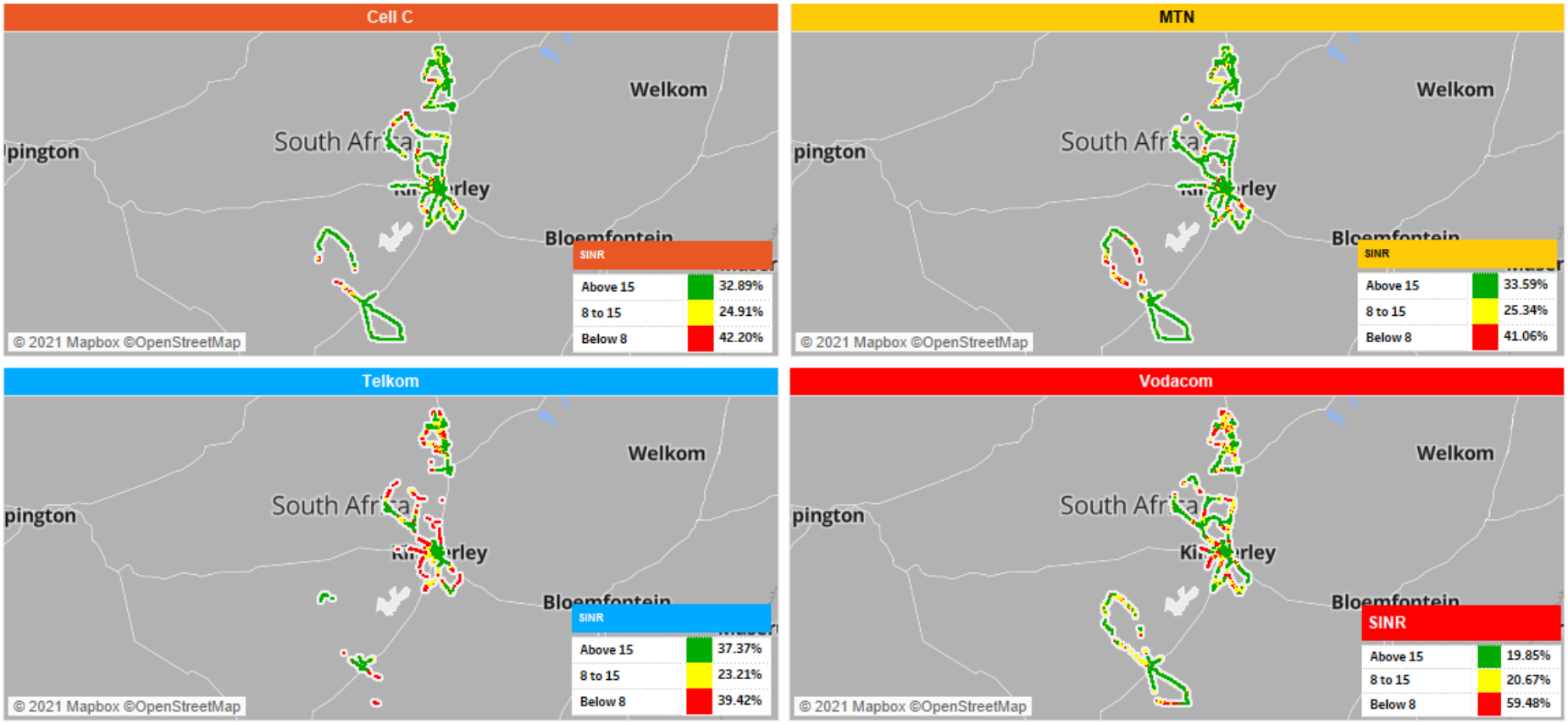


Figure 81. 4G Preferred LTE SINR

9. Appendix 4 – Statistical Counts

8.1 3G Preferred Mobile Data Drive Test Samples Count

		Cell C	MTN	Telkom	Vodacom
File Transfer	HTTP Download	371	368	255	344
	HTTP Upload	369	371	253	357
	HTTP Capacity Download	365	366	253	347
	HTTP Capacity Upload	370	375	247	357
	FTP Download	364	362	245	342
	FTP Upload	370	366	250	348
HTTPS Browser	Google	345	361	237	328
	HTTPs Kepler	368	364	243	347
	HTTPs Mobile Kepler	371	373	245	353
	MSN	359	368	238	336
	News24	341	349	226	317
Latency	Google ICMP Ping	1,829	1,840	1,242	1,774
	Independent Server ICMP Ping	1,671	1,697	1,237	1,722
YT	YouTube	341	368	342	355

Figure 82. Statistical Count - 3G Preferred Data Test

8.2. 4G Preferred Mobile Data Drive Test Samples Count

		Cell C	MTN	Telkom	Vodacom
File Transfer	HTTP Download	388	402	300	402
	HTTP Upload	391	403	290	398
	HTTP Capacity Download	389	403	296	400
	HTTP Capacity Upload	395	409	293	401
	FTP Download	388	407	288	365
	FTP Upload	388	404	295	396
HTTPS Browser	Google	382	401	284	395
	HTTPs Kepler	390	402	291	397
	HTTPs Mobile Kepler	393	404	292	400
	MSN	389	402	285	394
	News24	375	389	262	381
Latency	Google ICMP Ping	1,951	2,021	1,439	2,009
	Independent Server ICMP Ping	1,770	1,901	1,470	1,931
YT	YouTube	395	410	384	401

Figure 83. Statistical Count - 4G Preferred Data Test