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2021/2022 Quarter 2: Mobile Data Quality of Service Report – Eastern Cape Province

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List of Abbreviations

GSM	Global System for Mobile Communications
ICASA	Independent Communications Authority of South Africa
dBm	decibel milliwatts
KPI	Key Performance Indicator
LTE	Long Term Evolution
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) appointed 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 Eastern Cape Province. The measurements were carried out between 1 and 29 September 2021, covering a total distance of over 1571 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, Telkom leads in HTTP download throughput, FTP download throughput and being the fastest in browser page load time for HTTPS protocol. MTN leads in HTTP upload throughput and 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 all 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 Eastern 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 Eastern 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 Eastern Cape.

The QoS monitoring was conducted in areas that fall under the OR Tambo District Municipality. The areas of interest that were selected within this municipality were Gomolo, Lusikisiki, Mvumelwano, Payne and Sibangweni. These 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 Eastern Cape Province.

1 ICASA Strategic Plan 2020/21 – 2024/25

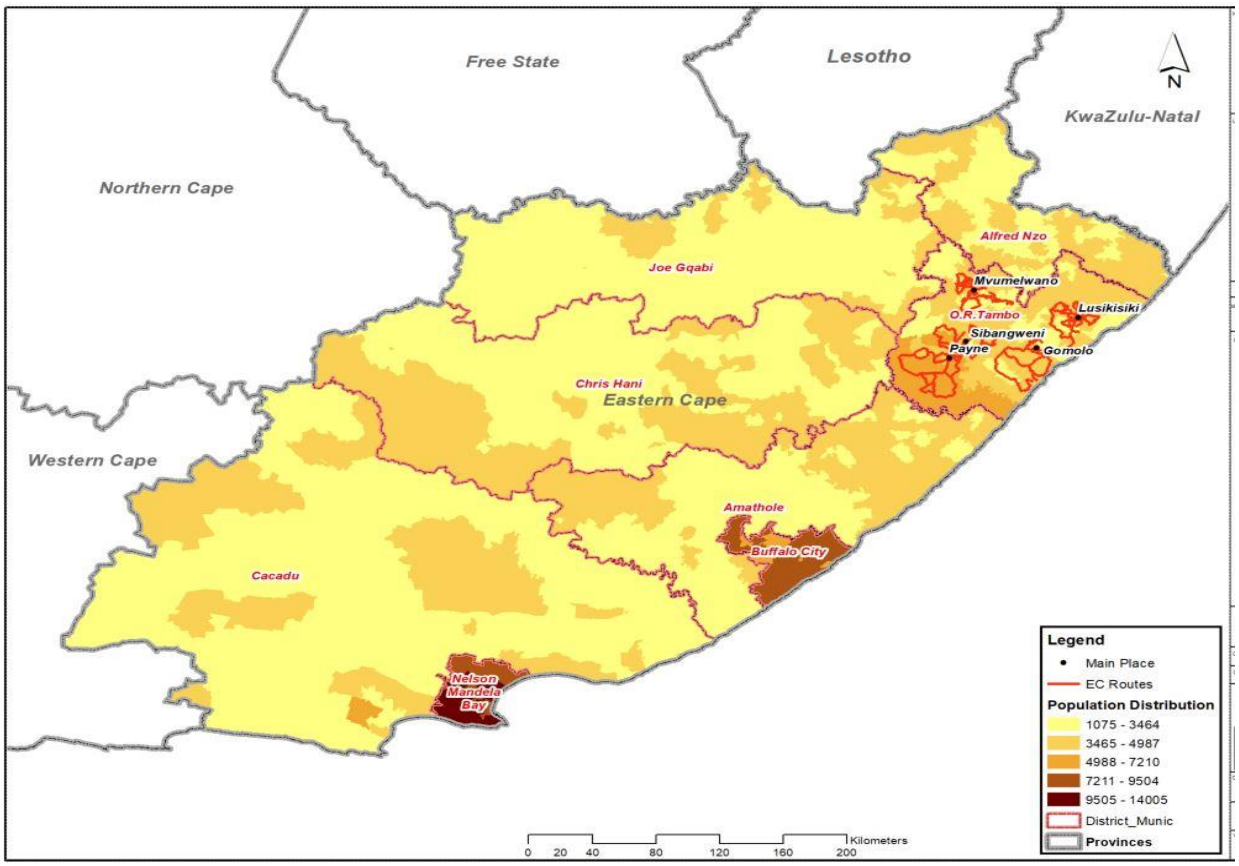


Figure 1. Eastern Cape Province Route Map with Population Distribution

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 Eastern 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**
O R Tambo	Sibangweni	06/09/2021 and 09/09/2021
	Mvumelwano	10/09/2021 and 13/09/2021
	Lusikisiki	15/09/2021 and 16/09/2021
	Payne	02/09/2021 and 03/09/2021
	Gomolo	14/09/2021 and 17/09/2021

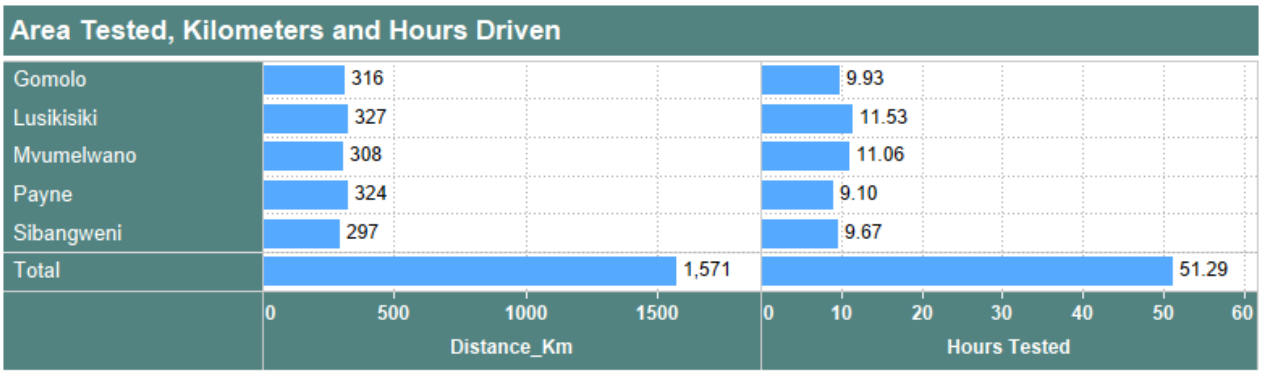
Table 3: Static Points tested

Routes and Dates		
District	**Static Points**	**Dates**
O R Tambo	**Payne:** Mqanduli Village Primary School Qokolweni SS School	1/9/2021
	Payne: Upper Tabase JS School Maggongweni	3/9/2021
	Sibangweni: Nelson Mandela Academic Hospital	3/9/2021
	Sibangweni: Lutoli JS School Ngangelizwe Police Station	4/9/2021
	Mvumelwano: Little Flower Secondary School Police Station Tina Falls	11/9/2021
	Police Station Tina Falls	12/9/2021
	Lusikisiki: Bambisanani Hospital Nkqubela Primary School	16/09/2021
	St Elizabeth's Hospital	17/09/2021

Routes and Dates		
	Gomolo: King Sabatha Dalindyebo FET College St Barnabas Provincial Hospital	11/9/2021
	Sandi SS School Ntsundwane	17/09/2021

Table 4 shows the total distance covered in each area 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.

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

These location types include shopping centres, municipal and malls, business districts and exhibition areas

3.4.2. Quality Control

It is important to ensure that the test environment functions correctly throughout the benchmarking 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, 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.

Test Case	Key Measurements	Test Description
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 Capacity Upload throughput speeds are measured.	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' 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.

Test Case	Key Measurements	Test Description
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: ○ MSN.com – **HTTPS Protocol** ○ News24.com – **HTTPS Protocol** ○ 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*
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?

Test Case	Key Measurements	Test Description
		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: Gomolo, Lusikisiki, Mvumelwano, Payne and Sibangweni.

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]	3.84	4.87	5.07	4.3
	HTTP UL Throughput – Average [Mbps]	1.68	1.76	1.66	1.59
	Capacity DL Throughput – Average [Mbps]	4.01	5.09	5.81	4.61
	Capacity UL Throughput – Average [Mbps]	2.07	2.01	2.03	1.96
	FTP DL Throughput – Average [Mbps]	1.96	2.56	2.82	2.36
	FTP UL Throughput – Average [Mbps]	1.17	1.16	1.1	0.97
HTTPS Browser	Overall HTTPS Browsing Web Page Load Time [s]	5.73	5.23	4.94	5.24
	Kepler Page [s]	9.54	8.30	8.47	8.32
	Mobile Kepler Page [s]	3.17	2.51	2.44	2.82
	MSN [s]	4.24	3.72	3.34	3.54
	Google [s]	4.87	5.26	4.29	5.01
	News24 [s]	6.96	6.49	6.28	6.84
Data Latency	Overall Average Ping Latency [ms]	185	181	140	137
	Average Ping – Google Website [s]	171	138	177	128
	Average Ping – Independent Server [s]	201	233	101	146
YouTube	YouTube Successful Ratio [%]	79.73%	88.27%	86.69%	86.28%
	YouTube Number of Freezing	82	81	64	72
	YouTube Average Resolution [pixels]	756.82	739.79	823.51	807.93
	YouTube Access Time [s]	14.32	11.51	11.01	11.53
	YouTube Quality MOS	3.83	3.87	3.96	3.92

In Table 6, the value in the green blocks indicates the operator that is leading in that specific KPI. Telkom led in 13 of the KPIs, followed by MTN which led in 3 KPIs. The results are based on the overall samples collected from where the operators have coverage. Telkom lacked coverage in some parts of Gomolo, Lusikisiki and Payne.

4.1.1.1. 3G Preferred File Transfer Results

4.1.1.1.1. 3G Preferred HTTP Download

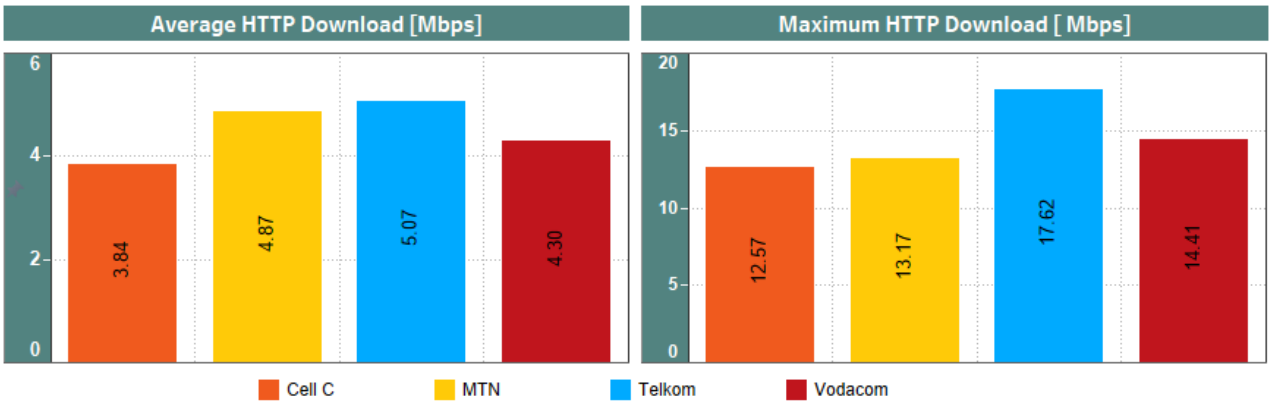


Figure 4. 3G Preferred – HTTP Download Throughput Overall results (Mbps)

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

Figure 5 shows the results per area. Telkom achieved the highest results for average HTTP download throughput in Lusikisiki, Payne and Sibangweni, MTN achieved the highest throughput in Gomolo and Mvumelwano.

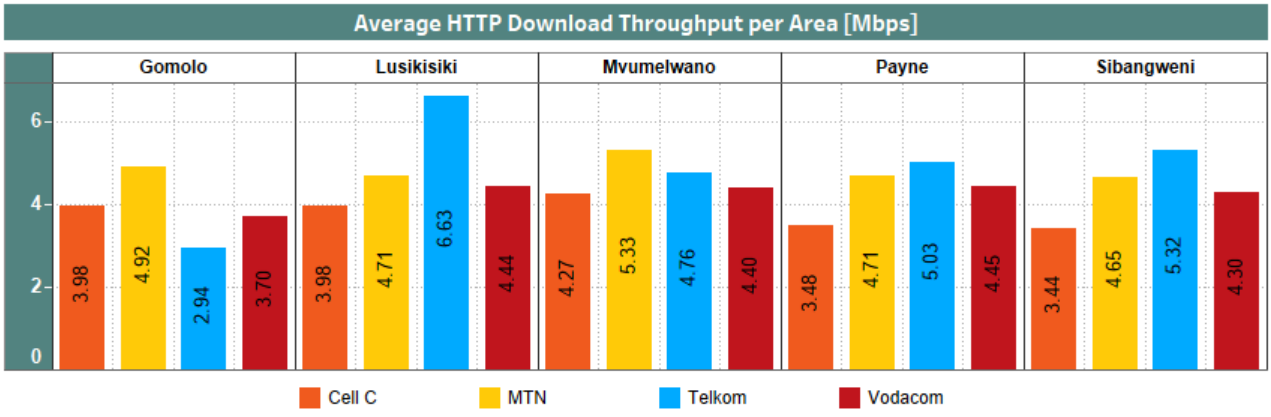


Figure 5. 3G Preferred – average HTTP Download Throughput results per Area (Mbps)

4.1.1.1.2. 3G Preferred HTTP Capacity Download

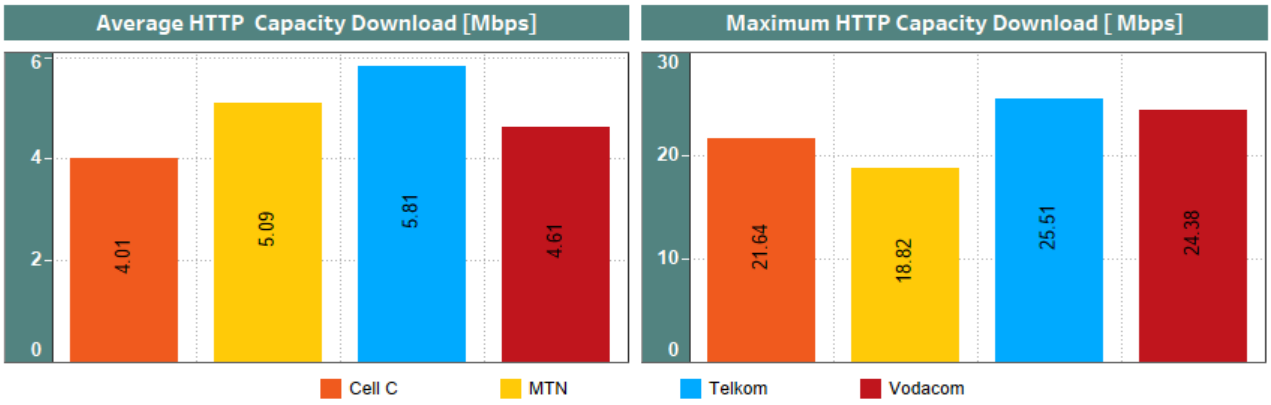


Figure 6. 3G Preferred – HTTP Capacity Download Throughput Overall results (Mbps)

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

Figure 7 shows the results per area. Telkom achieved the highest results for average HTTP download throughput in Lusikisiki, Payne and Sibangweni, MTN had the highest throughput in Gomolo and Mvumelwano.

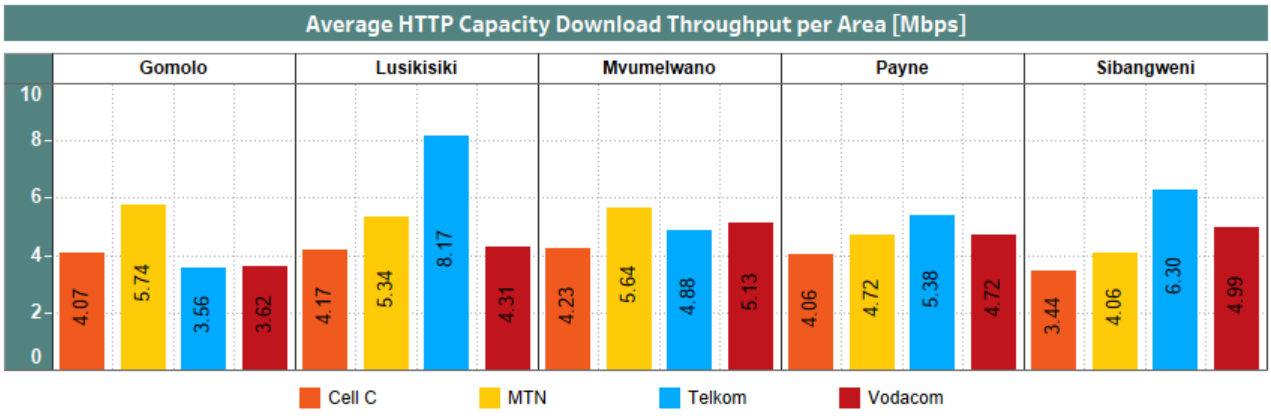


Figure 7. 3G Preferred – Average HTTP Capacity Download Throughput results per Area (Mbps)

4.1.1.1.3. 3G Preferred FTP Download

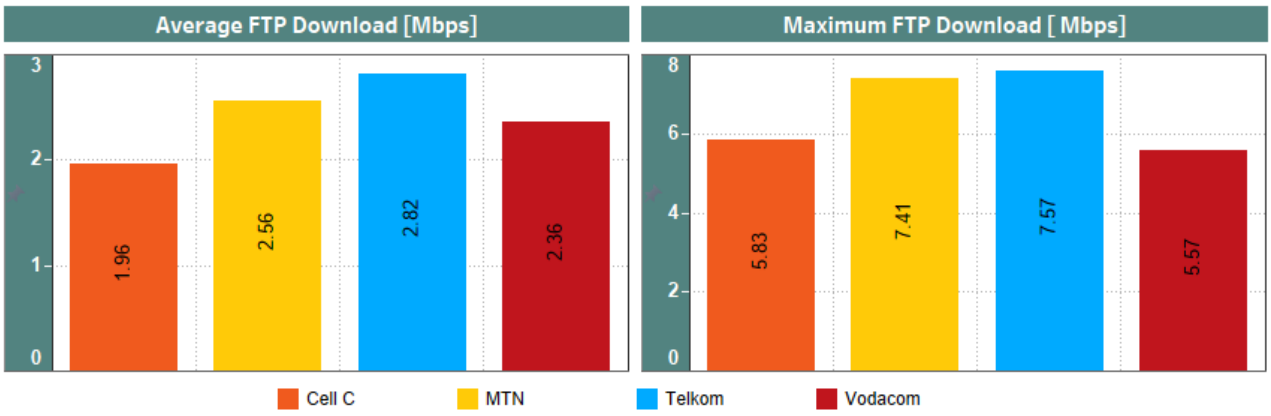


Figure 8. 3G Preferred – FTP Download Throughput Overall results (Mbps)

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

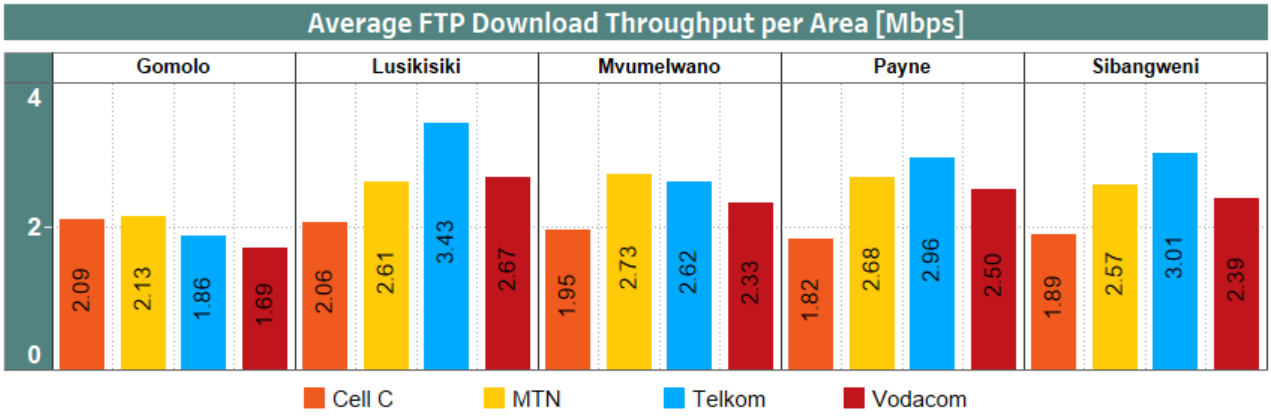


Figure 9. 3G Preferred – average FTP Download Throughput results per Area (Mbps)

Figure 9 shows the results per area. Telkom achieved the highest results for average FTP download throughput in Lusikisiki, Payne and Sibangweni. MTN had the highest throughput in Gomolo and Mvumelwano.

4.1.1.1.4. 3G Preferred HTTP Upload

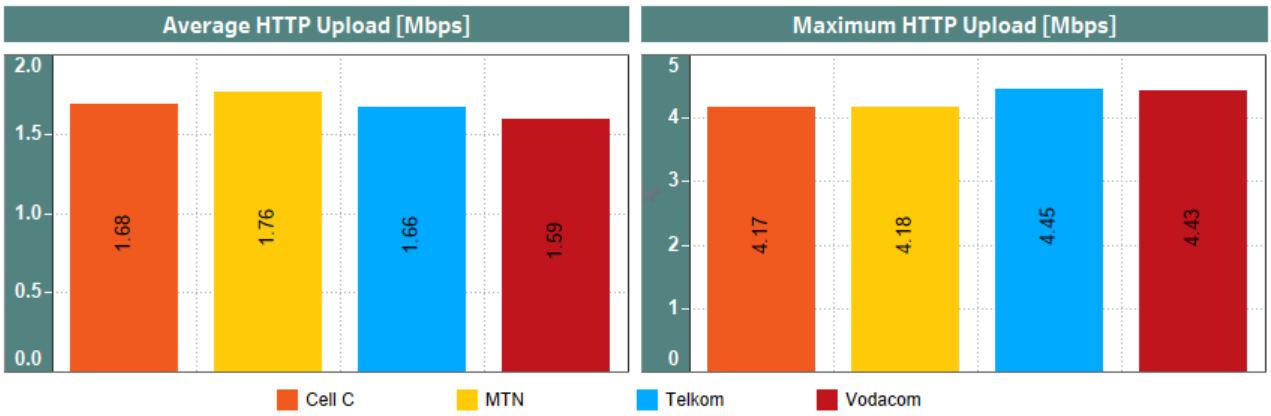


Figure 10.3G Preferred – HTTP Upload Throughput Overall results (Mbps)

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 results achieved by each operator. The results show that MTN achieved the highest results for average HTTP upload throughput followed by Cell C, Telkom, and Vodacom. Telkom led in the max HTTP upload throughput followed by Vodacom, MTN and Cell C.

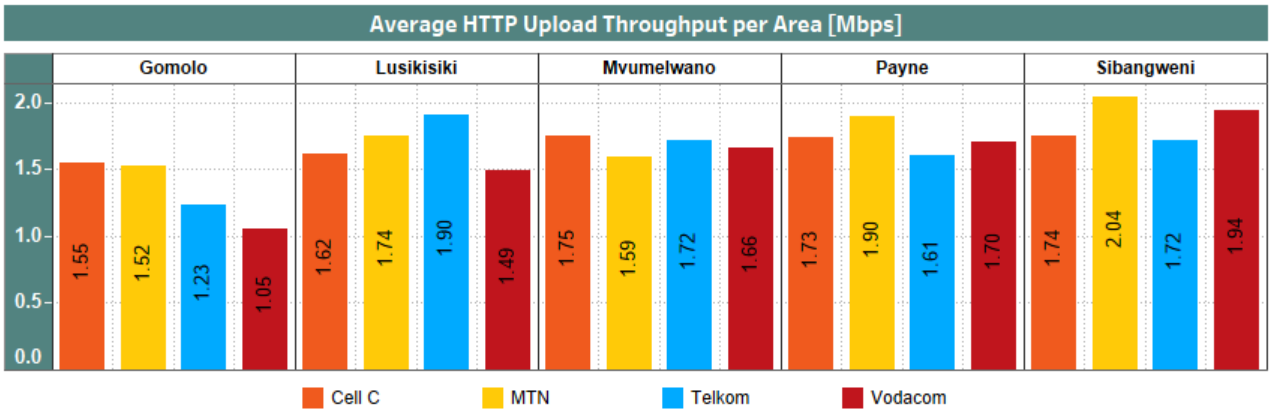


Figure 11. 3G Preferred – HTTP Upload Throughput results per Area (Mbps)

Figure 11 shows results per area for average HTTP Upload throughput. Telkom achieved the highest results for average HTTP Upload throughput in Lusikisiki. Cell C led in Gomolo and Mvumelwano; and MTN achieved the highest results in Payne and Sibangweni.

4.1.1.1.5. 3G Preferred HTTP Capacity Upload

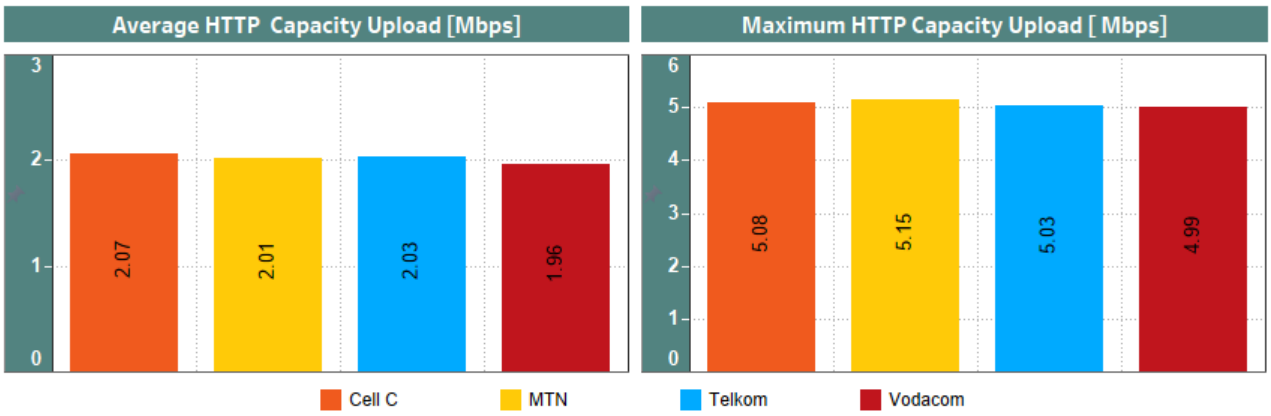


Figure 12. 3G Preferred – HTTP Capacity Upload throughput Overall results (Mbps)

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 results achieved by each operator. Results in Figure 12 show that all operators almost achieved identical overall average throughputs for HTTP Capacity upload test.

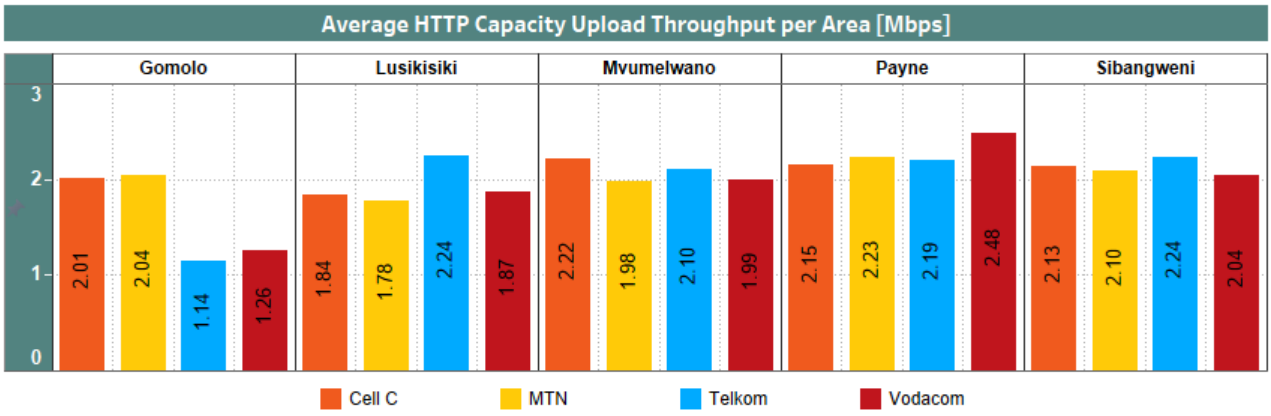


Figure 13. 3G Preferred – File Transfer Upload throughput results per Area (Mbps)

Figure 13 show results per area per operator. MTN achieved the highest results for average HTTP Capacity upload throughput in Gomolo, Cell C had the highest in Mvumelwano, Telkom led in the other two areas (Lusikisiki and Sibangweni) while Vodacom had the highest in Payne.

4.1.1.1.6. 3G Preferred FTP Upload

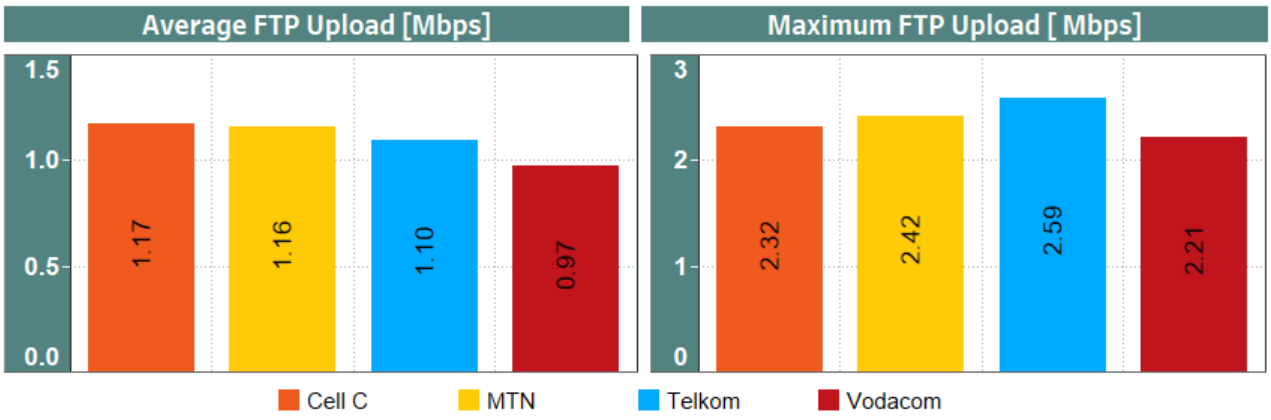


Figure 14. 3G Preferred – FTP Upload Throughput Overall results (Mbps)

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 results achieved by each operator per KPI. Results shows that all operators had almost similar results for average FTP Upload, however Telkom led in maximum FTP upload throughput followed by MTN, Cell C and then Vodacom in descending order.

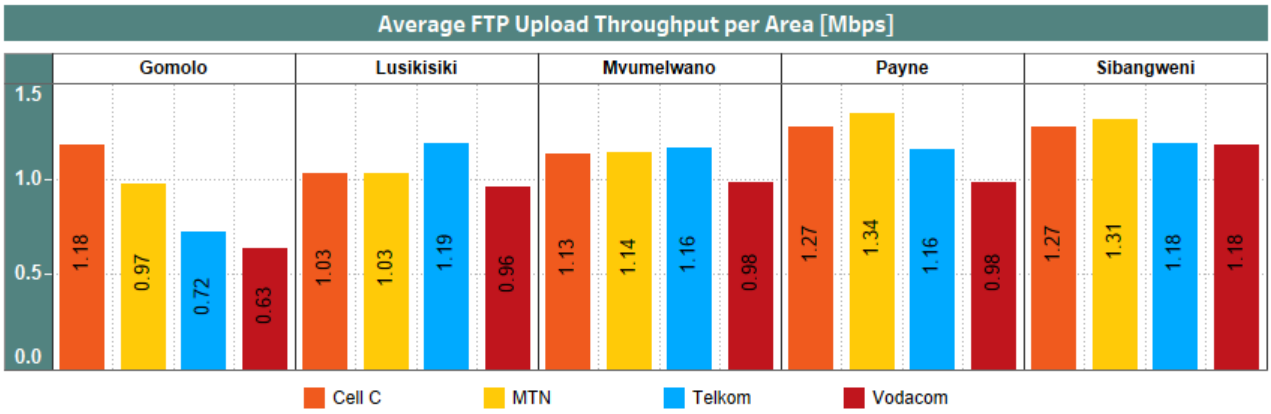


Figure 15. 3G Preferred – FTP Upload Throughput results per Area (Mbps)

Results in Figure 15 show that Telkom led in Lusikisiki and Mvumelwano, MTN led in Payne and Sibangweni. Cell C showed highest average FTP Upload throughput in Gomolo, Telkom achieved the highest results in Lusikisiki and Mvumelwano.

4.1.1.2. 3G Preferred YouTube Results

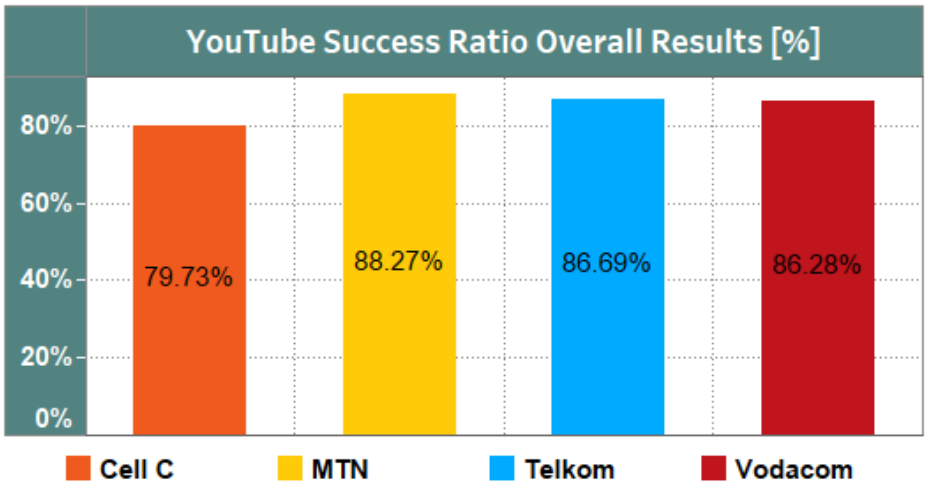


Figure 16. 3G Preferred – YouTube Success Ratio Overall results [%]

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

Figure 17 shows 3G Preferred YouTube Success Ratio per area. MTN achieved the highest YouTube Success Ratio results in Gomolo, Lusikisiki and Mvumelwano. Both Telkom and Vodacom achieved the highest YouTube Success Ratio results in Payne, Vodacom also achieved the highest in Sibangweni.

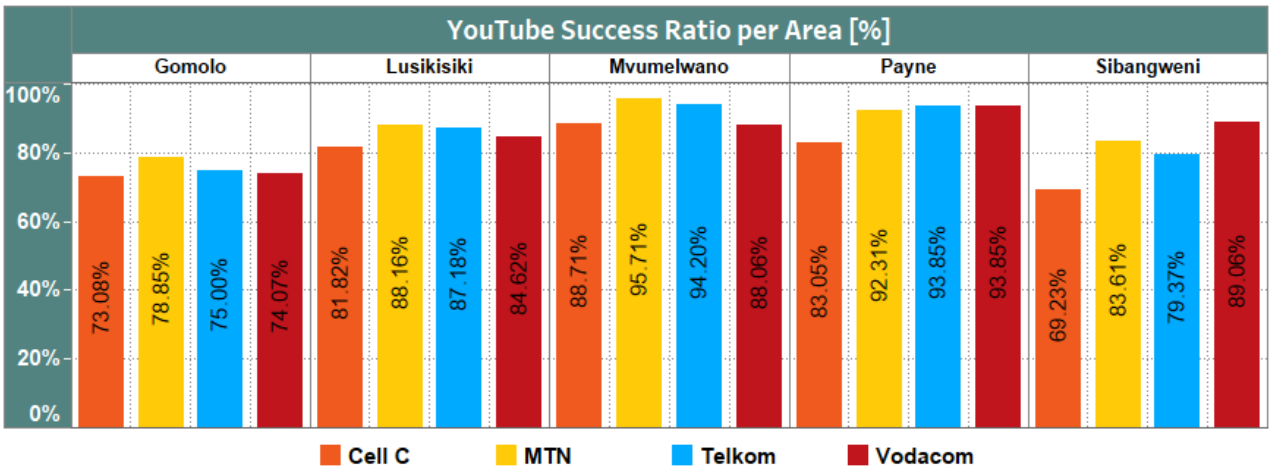


Figure 17. 3G Preferred – YouTube Success Ratio results per Area [%]

4.1.1.3. 3G Preferred Web Browsing Page Download Time

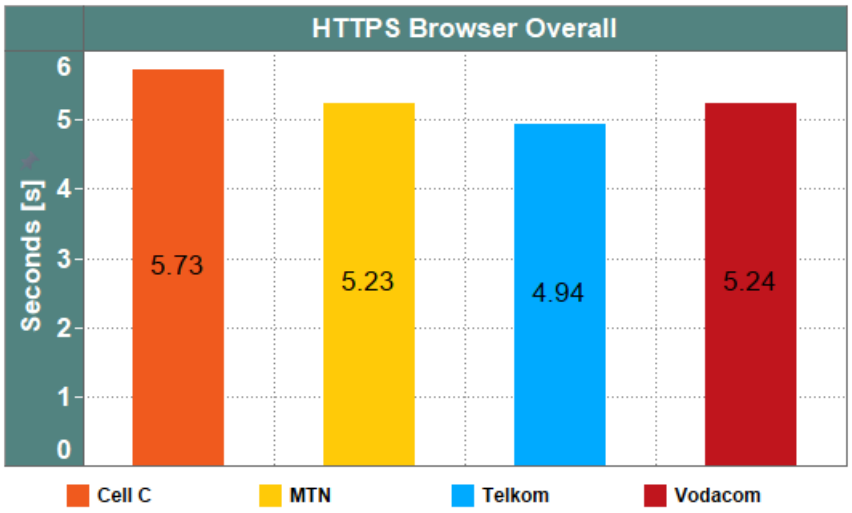


Figure 18. 3G Preferred – HTTPS Web Browsing Overall Results [s]

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

Figure 19 shows 3G Preferred web browsing page loading time for HTTPS protocol per area. Telkom had the fastest browser page load time in Lusikisiki, Mvumelwano, Payne and Sibangweni with limited number of samples. MTN had the fastest browser page load time for HTTPS protocol in Gomolo.

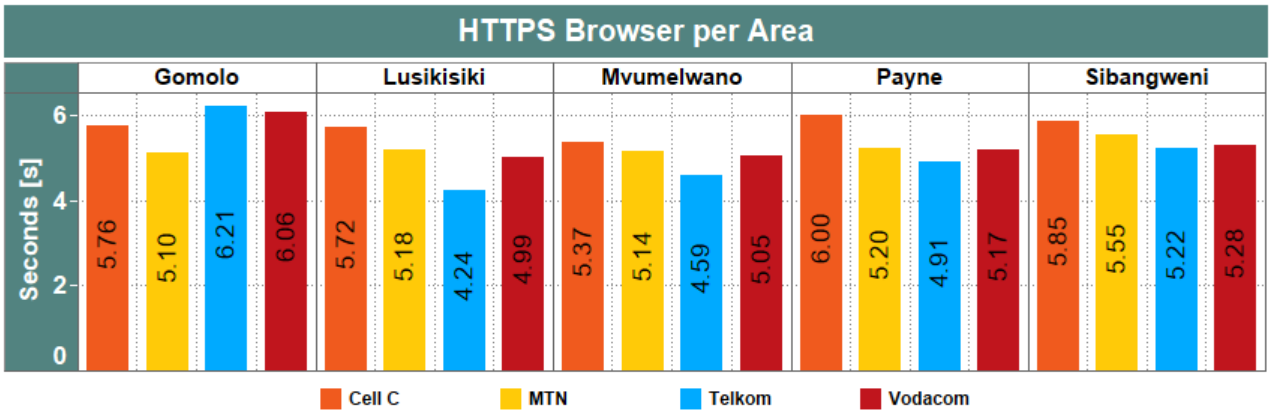


Figure 19. 3G Preferred – HTTPS Web Browsing Results per Area [s]

4.1.1.4. 3G Preferred Ping Latency Results

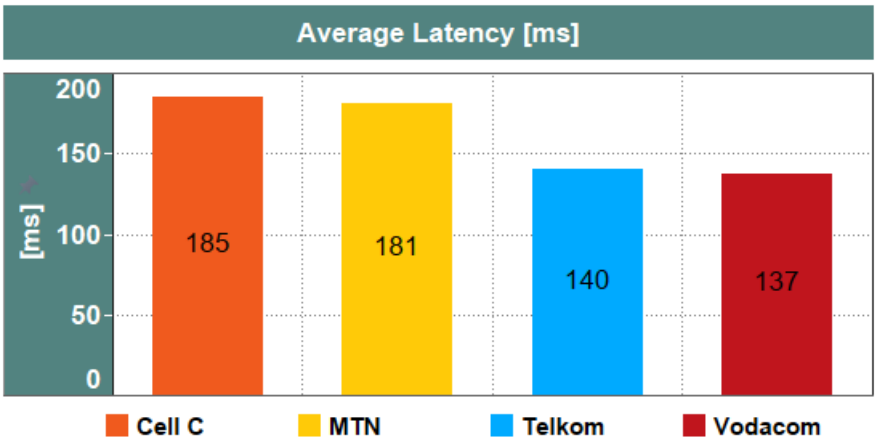


Figure 20. 3G Preferred – Average Latency Overall Results (ms)

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

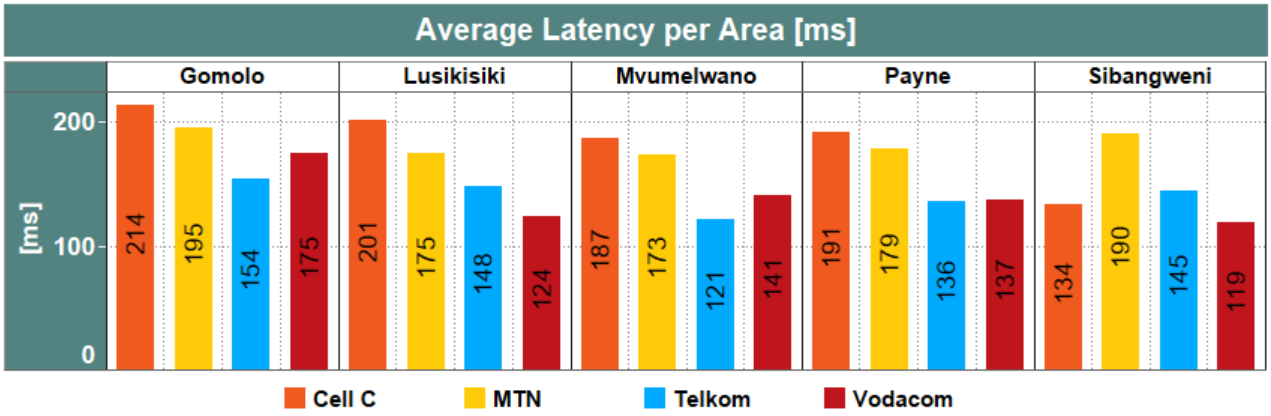


Figure 21. 3G Preferred – Average Latency Results per Area (ms)

Figure 21 shows results per area for the ping tests. Vodacom achieved the lowest latency in Lusikisiki and Sibangweni and Telkom had the lowest latency in Gomolo, Mvumelwano and Payne.

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 the technology is available, move to UMTS in the absence of LTE and finally GSM in the absence of both the LTE and 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]	3.62	28.77	10.12	13.93
	HTTP UL Throughput – Average [Mbps]	3.75	16.45	5.27	7.61
	Capacity DL Throughput – Average [Mbps]	3.89	42.71	16.12	17.84
	Capacity UL Throughput – Average [Mbps]	3.89	20.95	6.16	7.88
	FTP DL Throughput – Average [Mbps]	2.08	7.9	6.18	6.68
	FTP UL Throughput – Average [Mbps]	2.6	7.26	3.52	4.79
HTTPS Browser	Overall HTTPS Browsing Web Page Load Time [s]	5.46	3.45	3.92	3.72
	Kepler Page [s]	7.99	6.62	7.05	7.15
	Mobile Kepler Page [s]	2.50	1.18	1.57	1.19
	MSN [s]	6.05	2.56	2.65	2.58
	Google [s]	4.52	2.35	3.22	2.80
	News24 [s]	6.41	4.56	5.19	4.99
Latency	Overall Average Ping Latency [ms]	73	71	94	73
	Average Ping – Google Website [ms]	71	77	103	69
	Average Ping – Independent Server [ms]	75	66	84	76
YouTube	YouTube Successful Ratio [%]	86.76%	97.86%	82.35%	91.93%
	YouTube Number of Freezing	51	11	66	30
	YouTube Average Resolution [pixels]	756.18	1014.13	965.47	953.43
	YouTube Access Time [s]	11.54	4.49	7.30	7.19
	YouTube Quality MOS	3.91	4.17	4.12	4.11

In table 7, the values in the green blocks indicate which operator is leading in that KPI. MTN led in nineteen (19) of the KPIs and achieved best performance for tests done in 4G Preferred mode.

4.1.2.1. 4G Preferred File Transfer Results

4.1.2.1.1. 4G Preferred HTTP Download

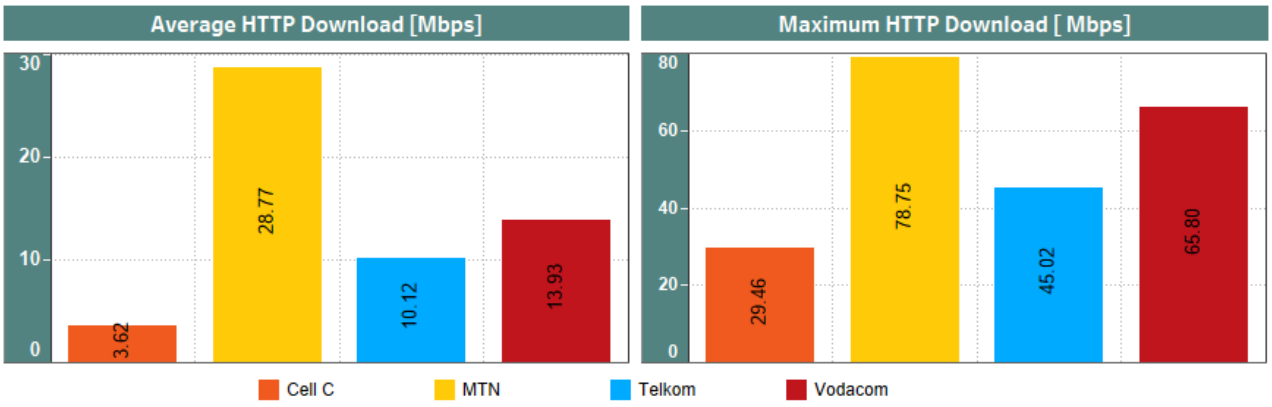


Figure 22. 4G Preferred – HTTP Download Throughput Overall Results (Mbps)

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

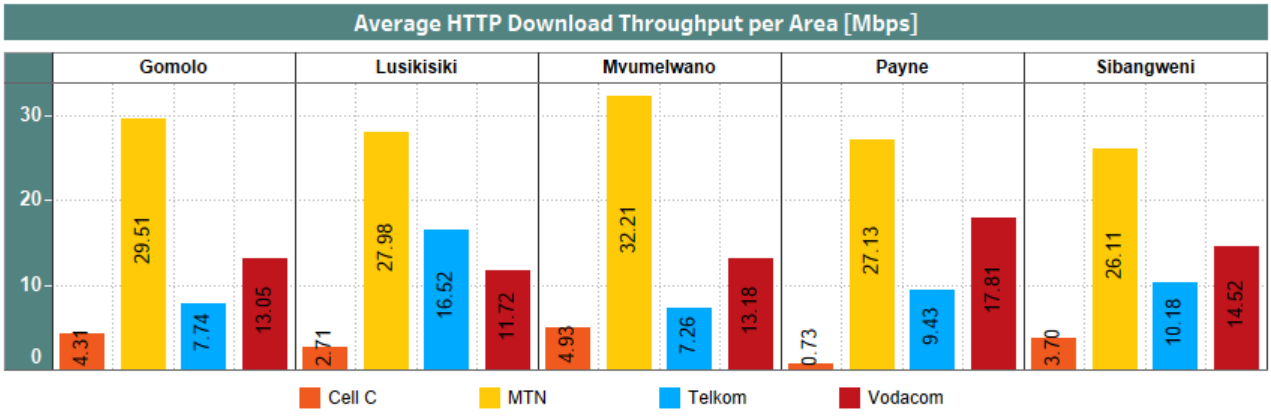


Figure 23. 4G Preferred – average HTTP Download Throughput results per Area (Mbps)

Figure 23 shows that MTN achieved the highest results for average HTTP download throughput in all the 5 areas 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

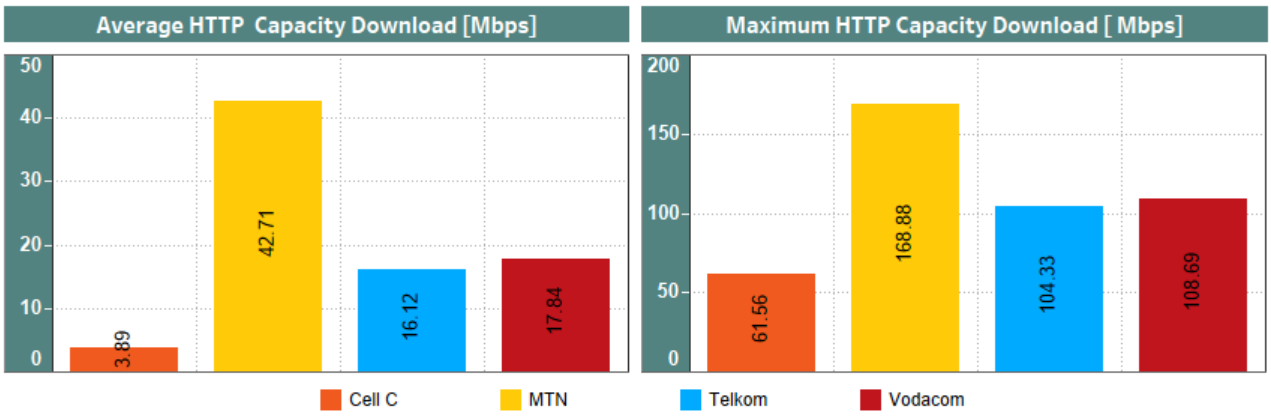


Figure 24. 4G Preferred – HTTP Capacity Download Throughput Overall Results (Mbps)

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

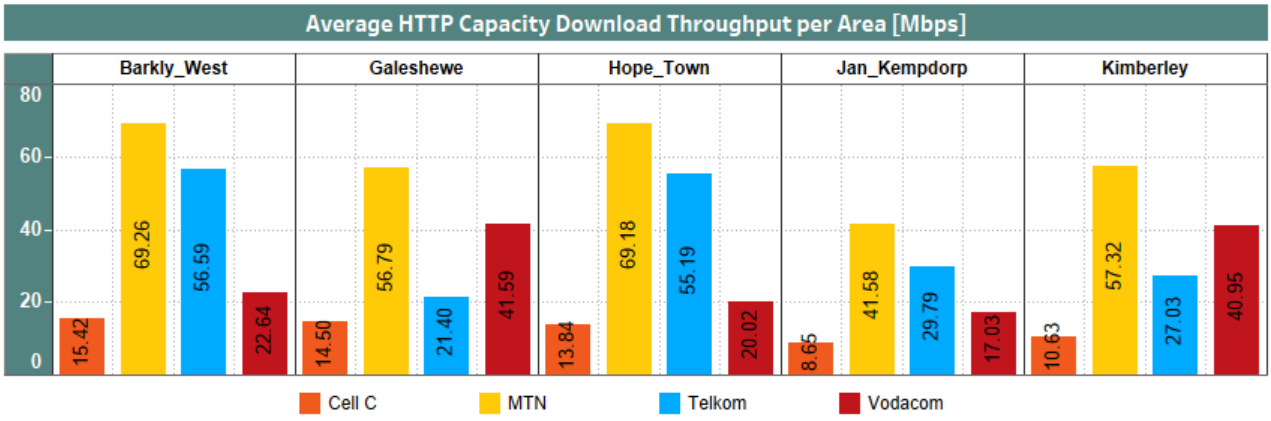


Figure 25. 4G Preferred – average HTTP Capacity Download Throughput results per Area (Mbps)

Figure 25 shows that MTN achieved the highest results for HTTP Capacity Download throughputs in all the tested areas. Cell C had the lowest average HTTP capacity download throughput in all the tested areas.

4.1.2.1.3. 4G Preferred FTP Download

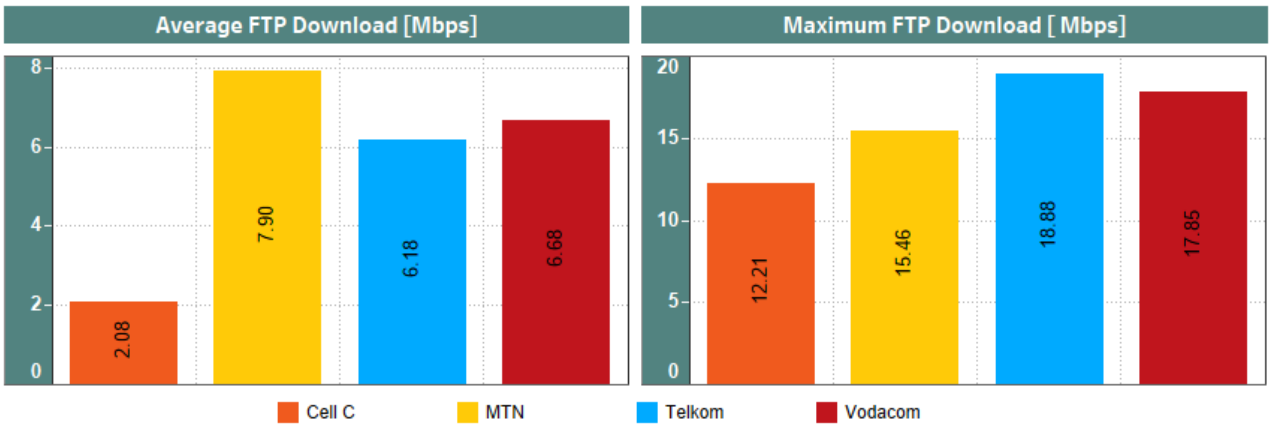


Figure 26.4G Preferred - average FTP Download Throughput Overall Results (Mbps)

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

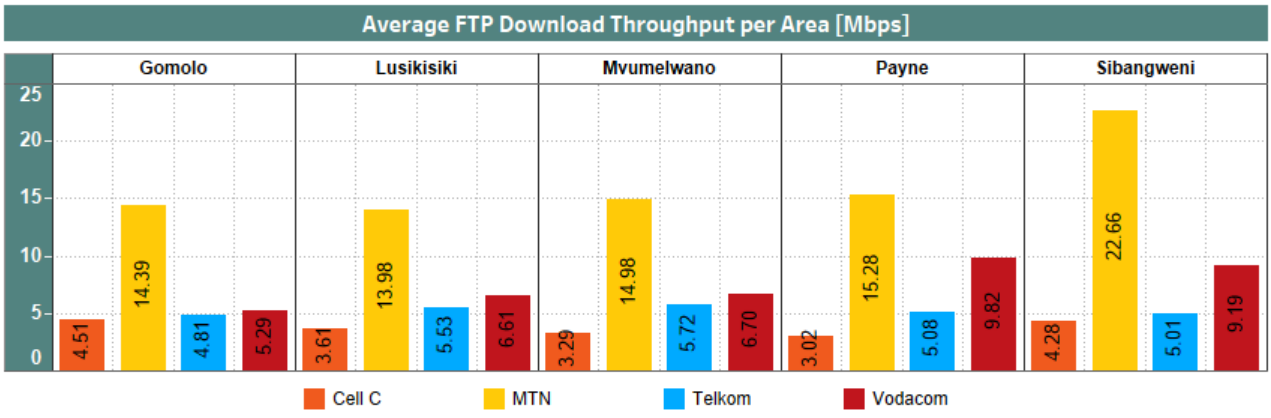


Figure 27. 4G Preferred – average FTP Download Throughput Results per Area (Mbps)

Figure 27 shows that MTN achieved the highest results for average FTP download throughput in all 5 tested areas, followed by Vodacom, Telkom, and Cell C in their respective descending order.

4.1.2.1.4. 4G Preferred HTTP Upload

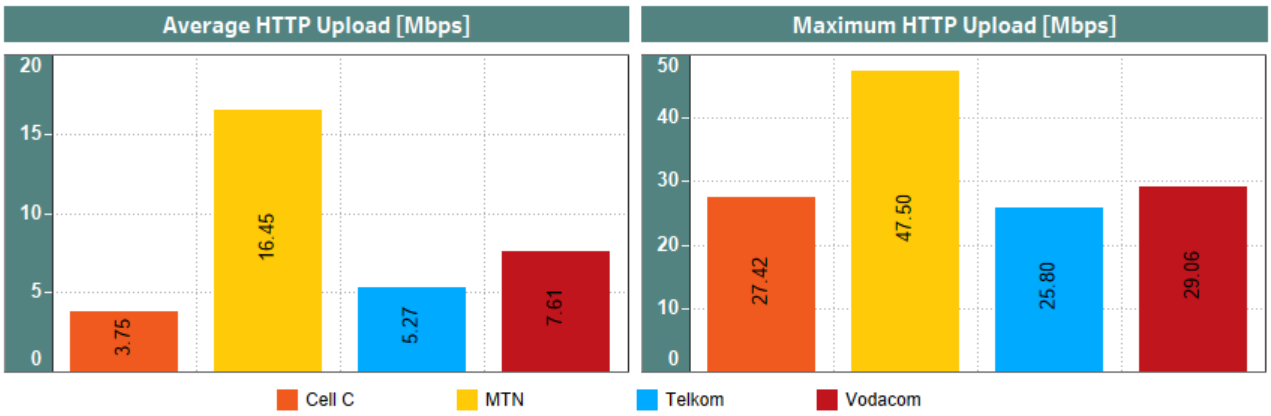


Figure 28. 4G Preferred – HTTP Upload Throughput Overall Results (Mbps)

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

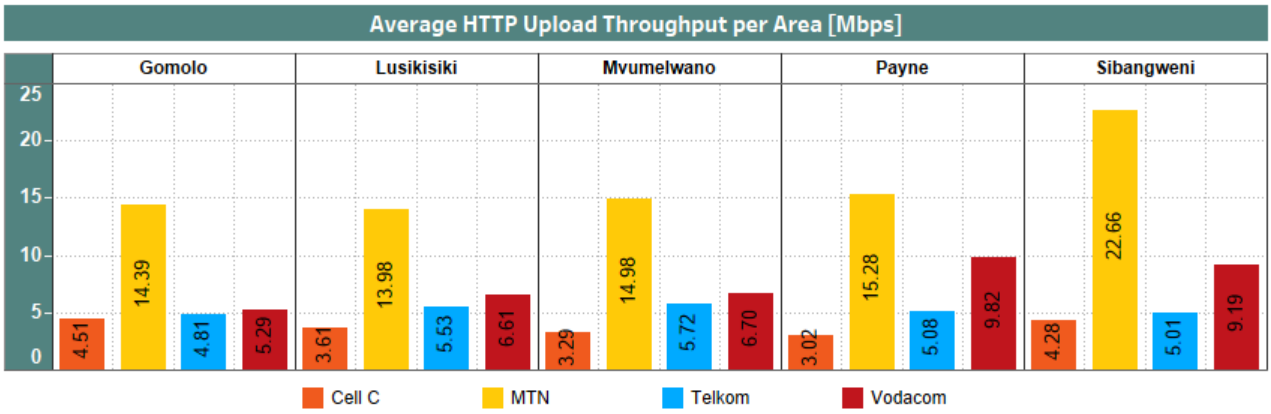


Figure 29. 4G Preferred – HTTP Upload Throughput Results per Area (Mbps)

Figure 29 shows test results per area per operator. MTN achieved the highest results for average HTTP Upload throughput results in Gomolo, Lusikisiki, Mvumelwano, Payne and Sibangweni.

4.1.2.1.5. 4G Preferred HTTP Capacity Upload

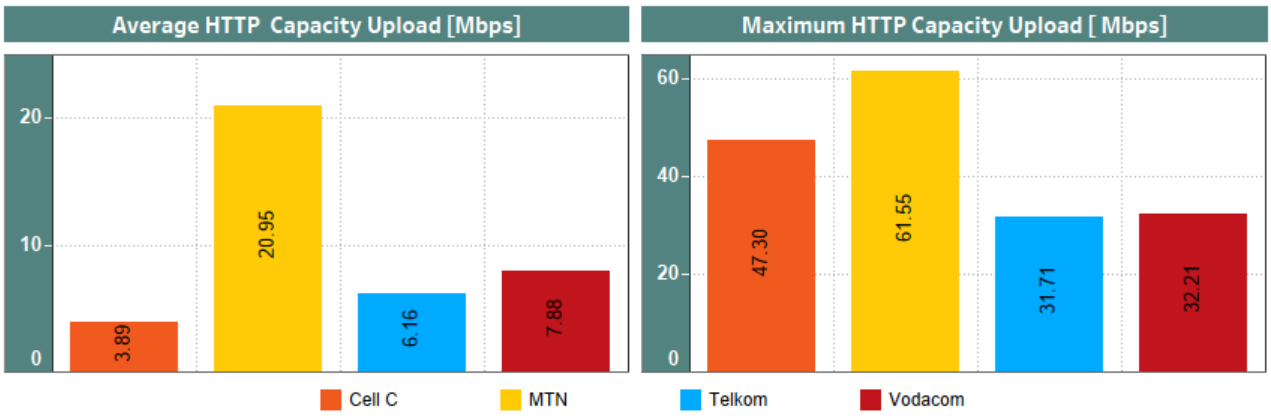


Figure 30. 4G Preferred – HTTP Capacity Upload Overall Results (Mbps)

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

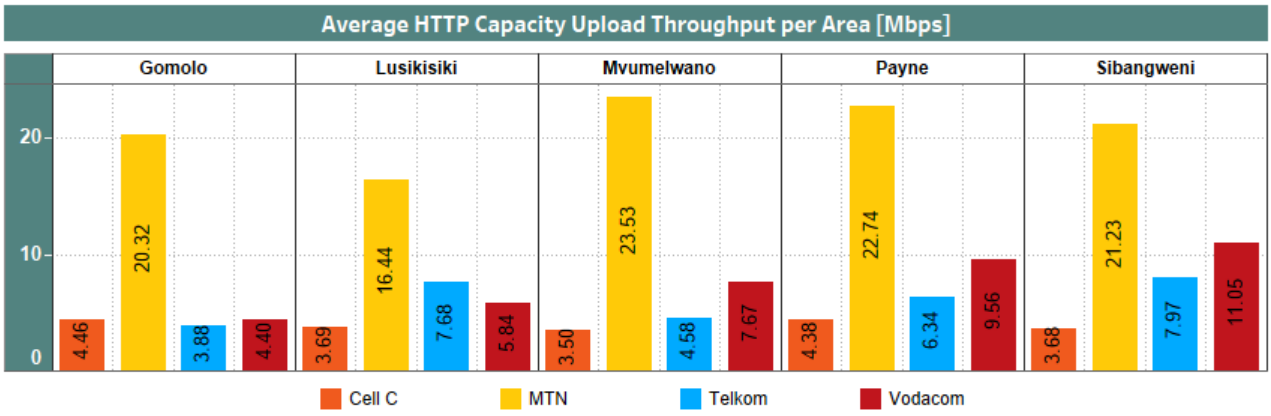


Figure 31. 4G Preferred average HTTP Capacity Upload Results per Area (Mbps)

Figure 31 shows results per area per operator. MTN achieved the highest results for average HTTP Capacity Upload in all the five areas; Gomolo, Lusikisiki, Mvumelwano, Payne and Sibangweni.

4.1.2.1.6. 4G Preferred FTP Upload

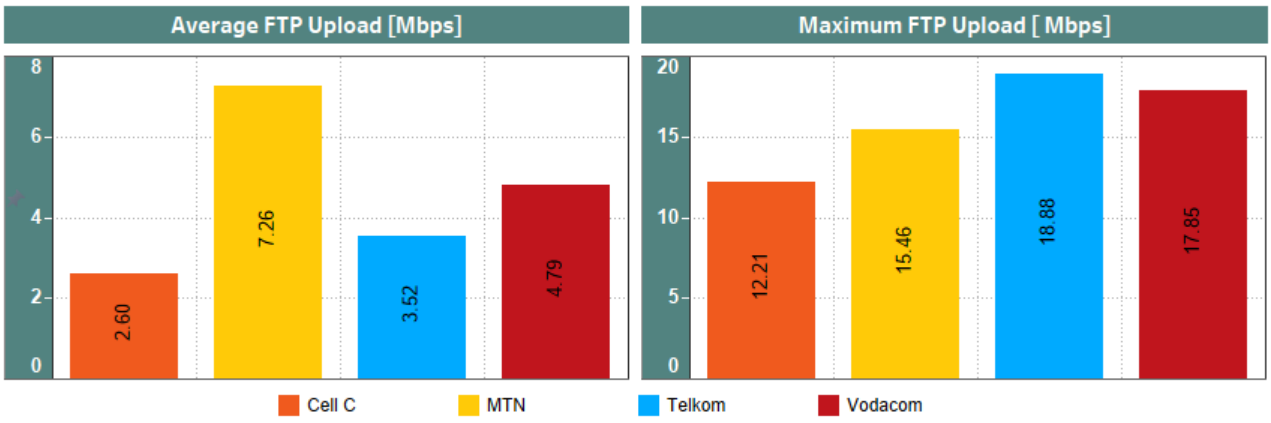


Figure 32. 4G Preferred FTP Upload Overall Results (Mbps)

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

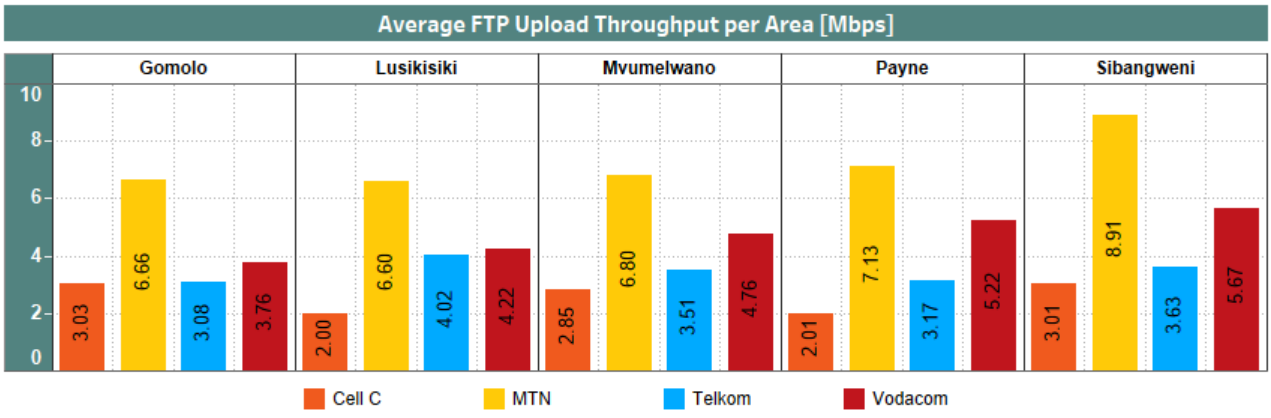


Figure 33. 4G Preferred - Average FTP Upload Results per Area

Figure 33 shows that MTN achieved the highest results for average FTP Upload in all 5 tested areas Gomolo, Lusikisiki, Mvumelwano, Payne and Sibangweni.

4.1.2.2. 4G Preferred YouTube Results

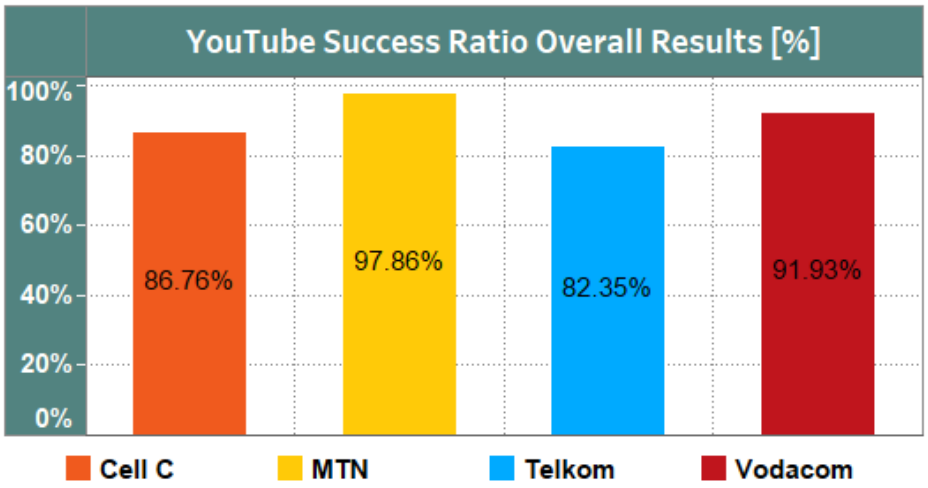


Figure 34. 4G Preferred – YouTube Success Ratio Overall results (%)

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

Figure 35 shows 4G Preferred YouTube Success Ratio per area. MTN had the highest YouTube Success Ratio in five of the tested areas; Gomolo, Lusikisiki, Mvumelwano, Payne and Sibangweni. Vodacom was on par with MTN in Mvumelwano.

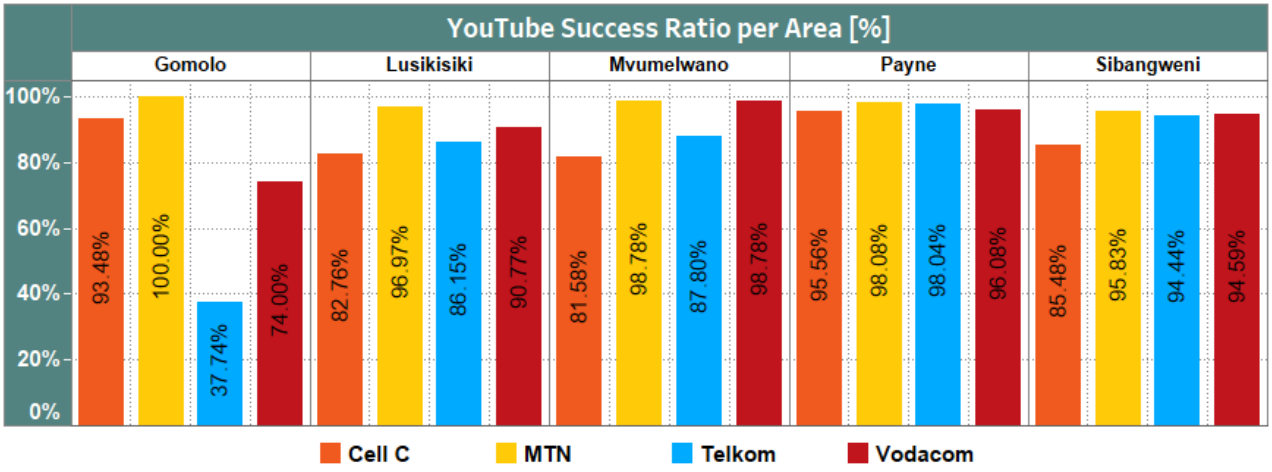


Figure 35. 4G Preferred – YouTube Success Ratio results per Area [%]

4.1.2.3. 4G Preferred Web Browsing Page Download Time

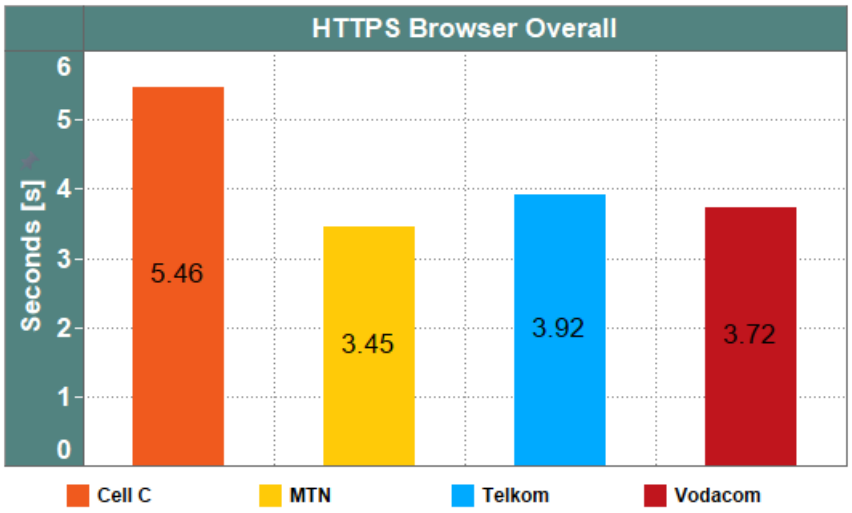


Figure 36. 4G Preferred – Web Browsing Page load Time Overall Result (s)

Figure 36 depicts 4G Preferred overall web browser page load time on 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 five tested areas.

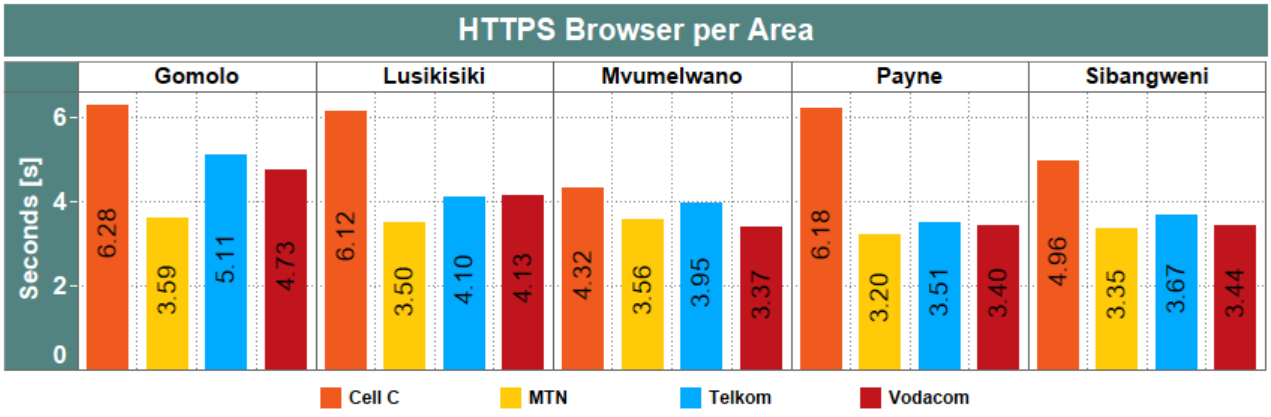


Figure 37. 4G Preferred – HTTPS Web Browsing Page load Time Results per Area (s)

4.1.2.4. 4G Preferred Ping Latency Results

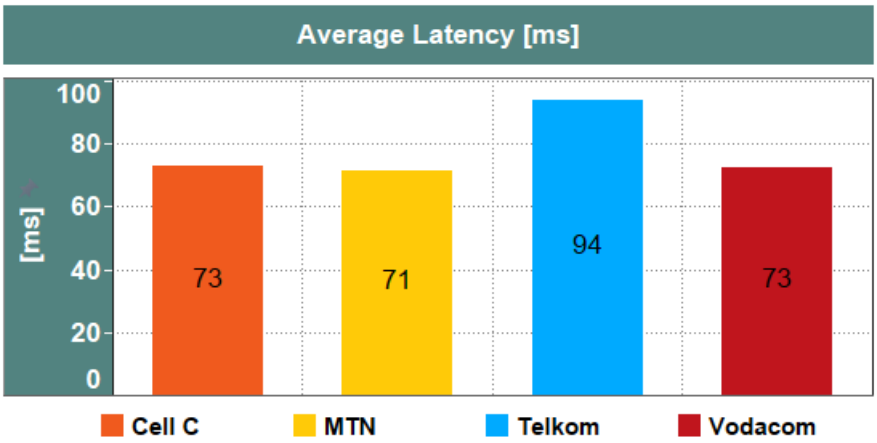


Figure 38. 4G Preferred Average Ping Latency Overall Result (ms)

Figure 38 shows that MTN achieved the best latency in overall results followed by Vodacom and Cell C which are on par, and Telkom in ascending order.

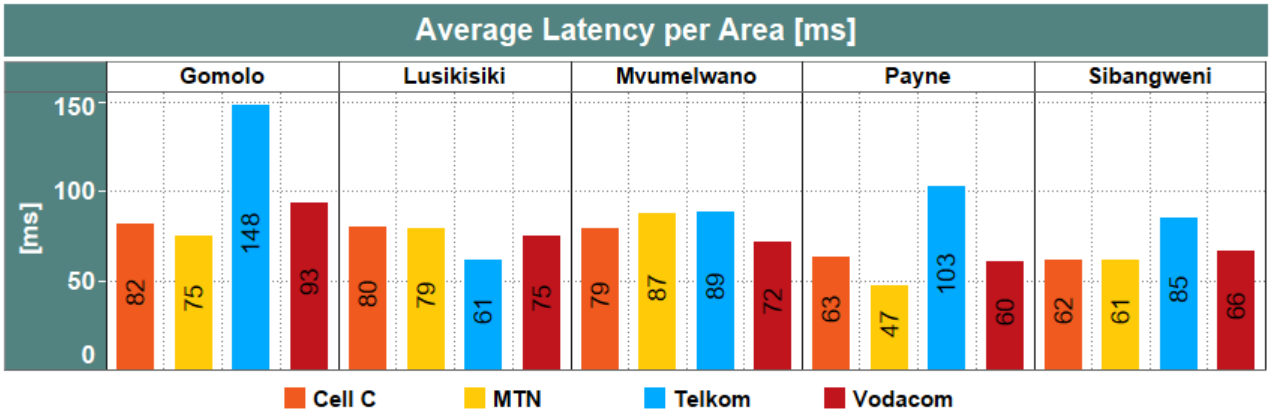


Figure 39. 4G Preferred – Average Ping Latency Result per Area (ms)

Figure 39 shows that MTN had the lowest latency for ping tests in Gomolo, Payne and Sibangweni. Telkom had the lowest latency in Lusikisiki, and Vodacom achieved the lowest latency in Mvumelwano.

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]	5.37	6.29	6.14	5.62
	HTTP UL Throughput – Average [Mbps]	2.19	2.08	1.94	1.87
	Capacity DL Throughput – Average [Mbps]	6.16	8.38	9.52	6.32
	Capacity UL Throughput – Average [Mbps]	2.37	2.33	2.55	2.49
	FTP DL Throughput – Average [Mbps]	2.67	3.53	3.83	3.24
	FTP UL Throughput – Average [Mbps]	1.3	1.42	1.27	1.24
HTTPS Browser	Overall HTTPS Browsing Web Page Load Time [s]	4.96	4.43	3.87	4.37
	Kepler Page [s]	8.16	7.11	6.64	6.96
	Mobile Kepler Page [s]	2.43	2.13	1.16	1.55
	MSN [s]	4.00	3.17	2.52	3.04
	Google [s]	4.25	4.29	3.61	4.57
	News24 [s]	6.02	5.43	5.45	5.85
Latency	Overall Average Ping Latency [ms]	146	144	129	123
	Average Ping – Google Website [ms]	140	135	184	125
	Average Ping – Independent Server [ms]	151	155	73	122
YouTube	YouTube Successful Ratio [%]	94.90%	97.17%	99.07%	92.59%
	YouTube Number of Freezings	10	9	2	7
	YouTube Average Resolution [pixels]	826.18	843.75	904.98	845.32
	YouTube Access Time [s]	11.69	8.52	8.51	9.99
	YouTube Quality MOS	3.94	4.06	4.11	4.07

In Table 8, the values in the green blocks indicate which operator is leading in that KPI. Telkom led in most of KPIs. MTN achieved the highest overall HTTP Download throughput Vodacom had the lowest overall Latency.

4.2.1.1. 3G Preferred Stationary HTTP Download

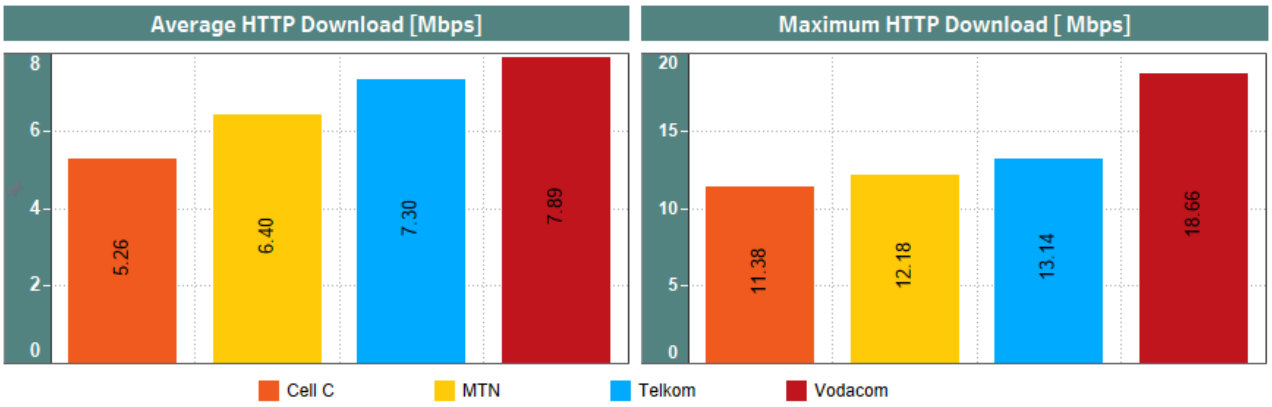


Figure 40. Stationary 3G Preferred – HTTP Download Throughput Overall results (Mbps)

Figure 40 shows that for overall results Vodacom had 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 41 shows 3G Preferred average HTTP download throughput per stationary point.

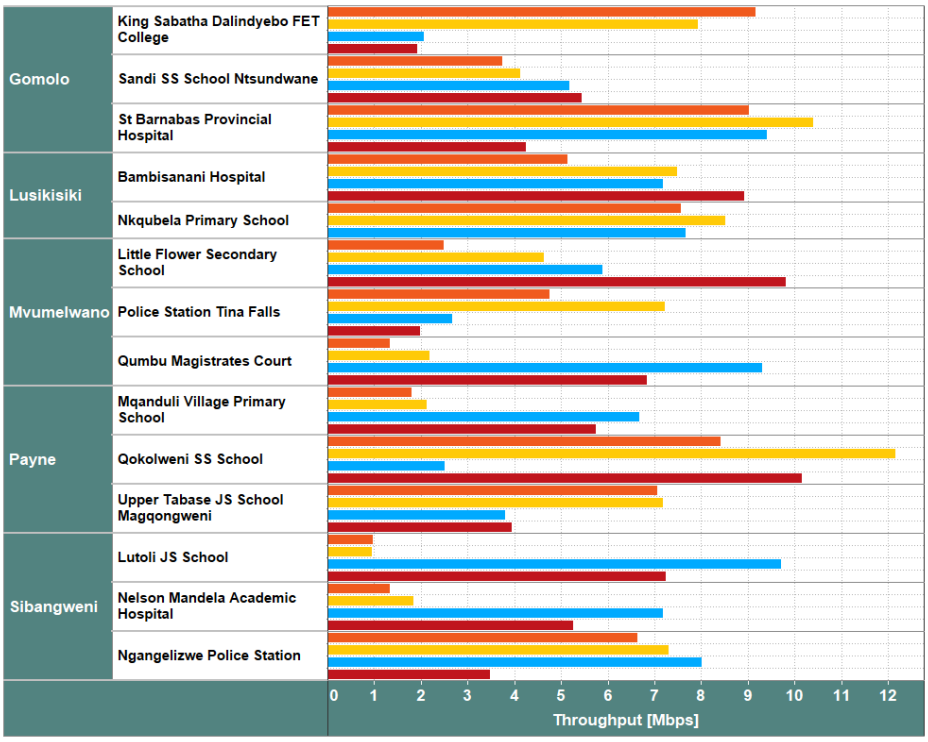


Figure 41. 3G Preferred – average HTTP Download Throughput results per Stationary Point (Mbps)

4.2.1.2. 3G Preferred Stationary Capacity Download

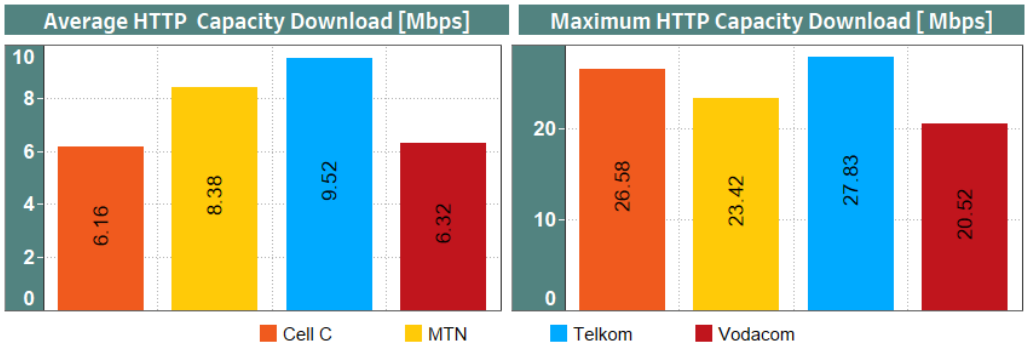


Figure 42. Stationary 3G Preferred – average HTTP Capacity Download Throughput Overall results (Mbps)

Figure 42 shows that Telkom has the highest stationary HTTP capacity download throughput for both average and maximum HTTP capacity download throughput. For average HTTP capacity download throughput Telkom was the highest followed by MTN, Cell C and Vodacom in descending order. For maximum HTTP capacity download throughput Telkom was the highest followed by Cell C, MTN and Vodacom in descending order.

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

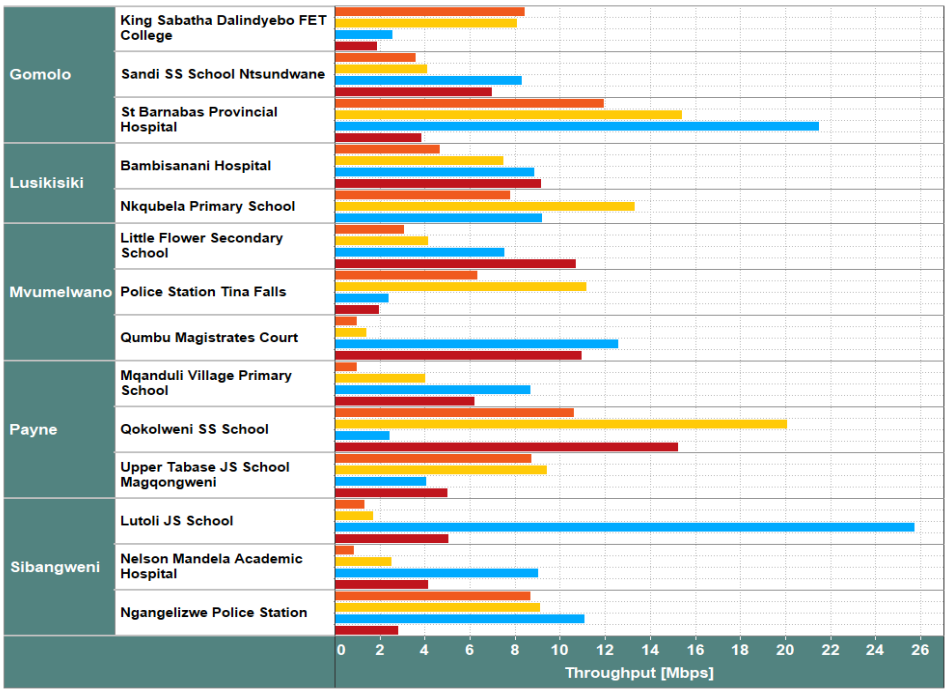


Figure 43. 3G Preferred – average HTTP Capacity Download Throughput results per Stationary Points (Mbps)

4.2.1.3. 3G Preferred Stationary FTP Download

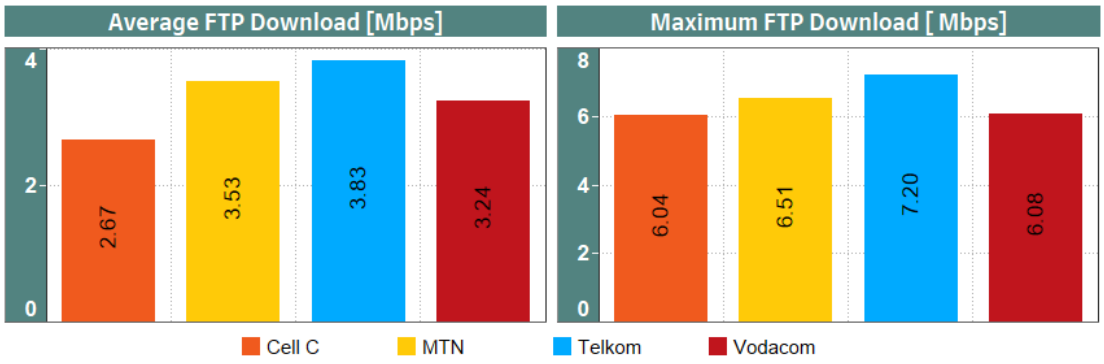


Figure 44. Stationary 3G Preferred – FTP Download Throughput Overall results (Mbps)

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

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

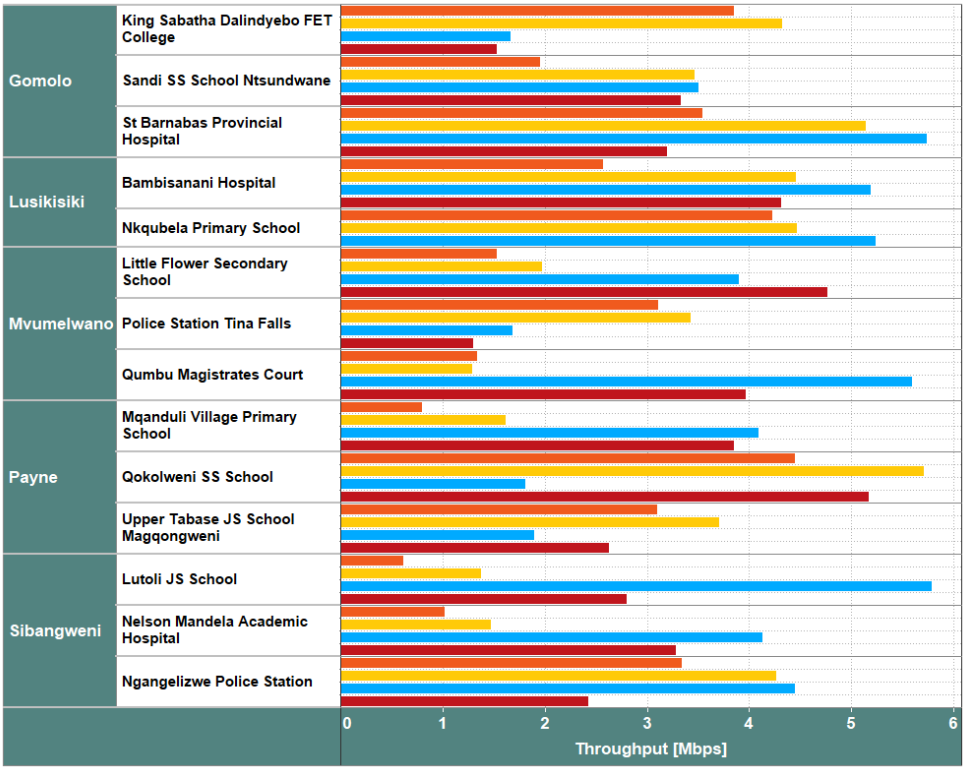


Figure 45. 3G Preferred – FTP average Download Throughput results per Stationary Points (Mbps)

4.2.1.4. 3G Preferred Stationary HTTP Upload

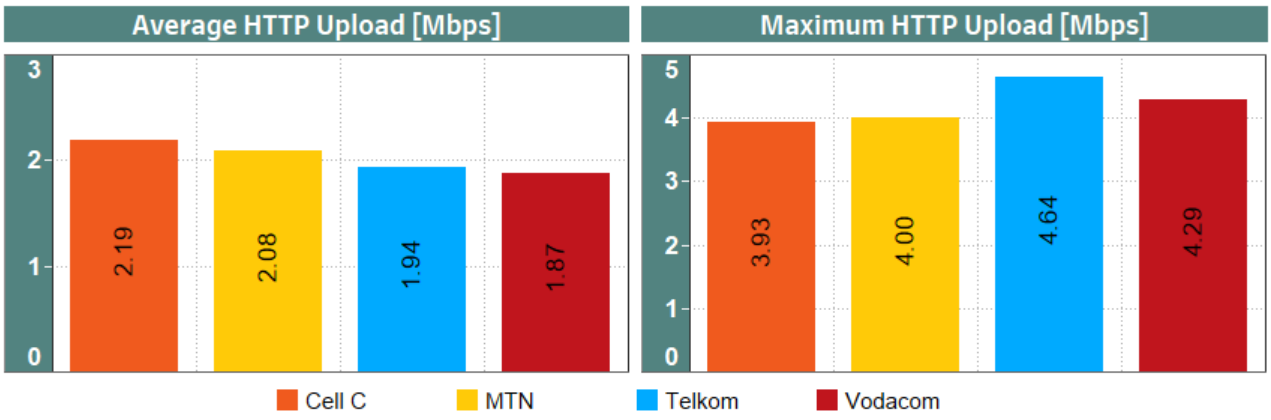


Figure 46. Stationary 3G Preferred - HTTP Upload Throughput results (Mbps)

Figure 46 shows that Cell C achieved the highest stationary average HTTP upload throughput, followed by MTN, Telkom and Vodacom in a descending order. Telkom achieved the highest stationary maximum HTTP upload throughput, followed by Vodacom, MTN and Cell C in a descending order.

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

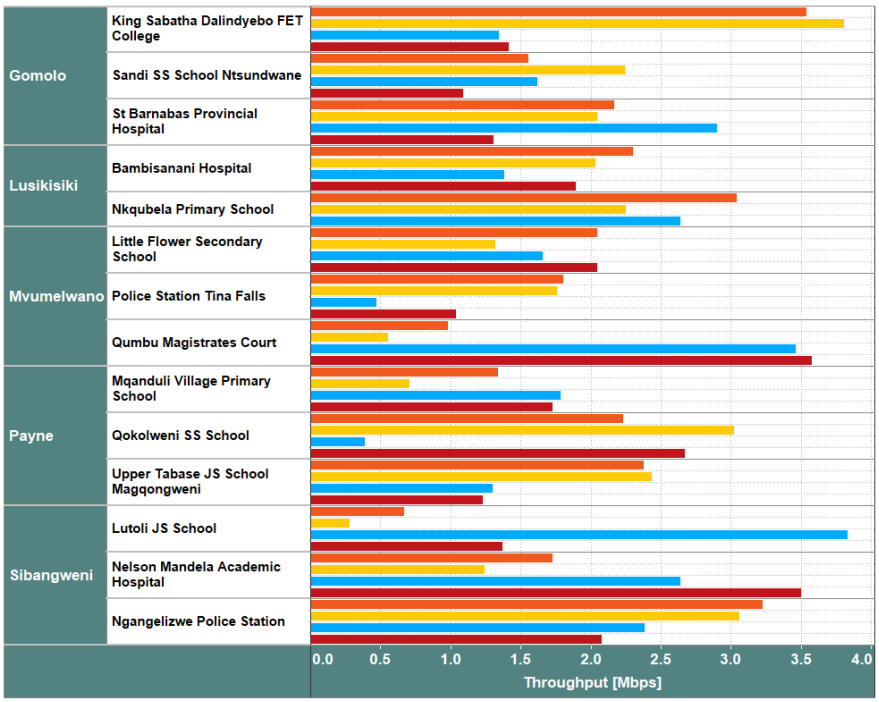


Figure 47. 3G Preferred – average HTTP Upload Throughput results per Stationary Points (Mbps)

4.2.1.5. 3G Preferred Stationary Capacity Upload

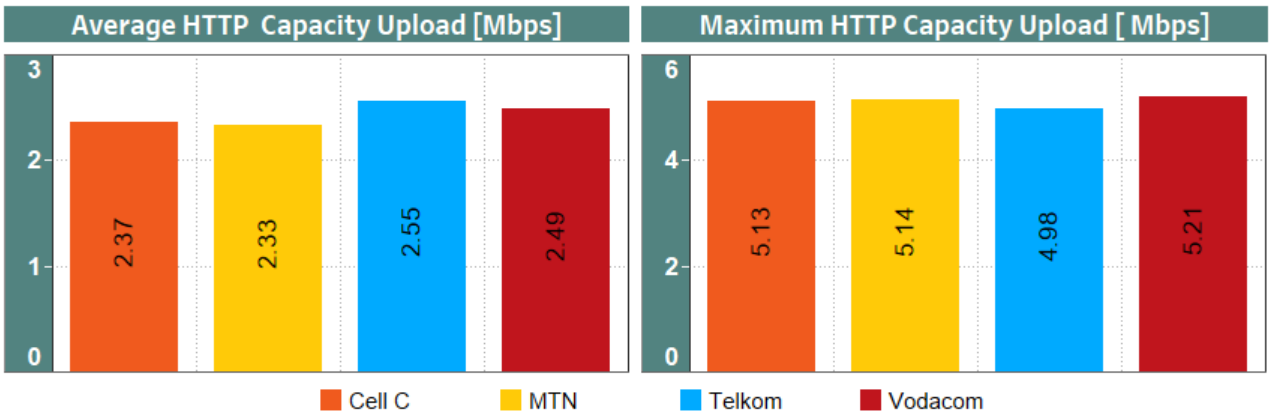


Figure 48. Stationary 3G Preferred – HTTP Capacity Upload Throughput Overall results (Mbps)

Figure 48 shows overall 3G Preferred HTTP capacity upload throughput results where Telkom achieved the highest stationary average HTTP capacity upload throughput, followed by Vodacom, Cell C and MTN in descending order. However, there was no significant difference among the results of the operators.

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

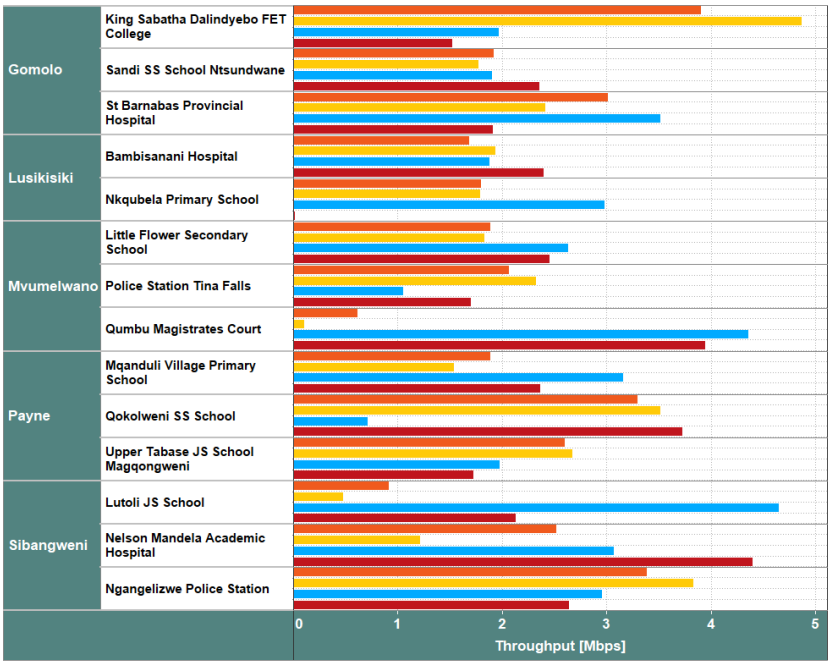


Figure 49. 3G Preferred – HTTP Capacity Upload Throughput results per Stationary Points (Mbps)

4.2.1.6. 3G Preferred Stationary FTP Upload

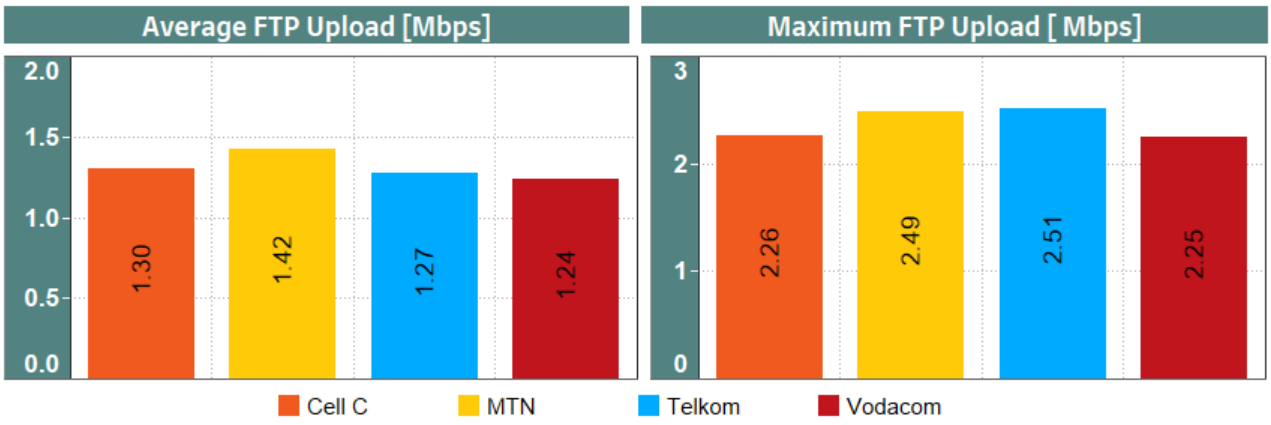


Figure 50. Stationary 3G Preferred – average FTP Upload Throughput Overall results (Mbps)

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

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

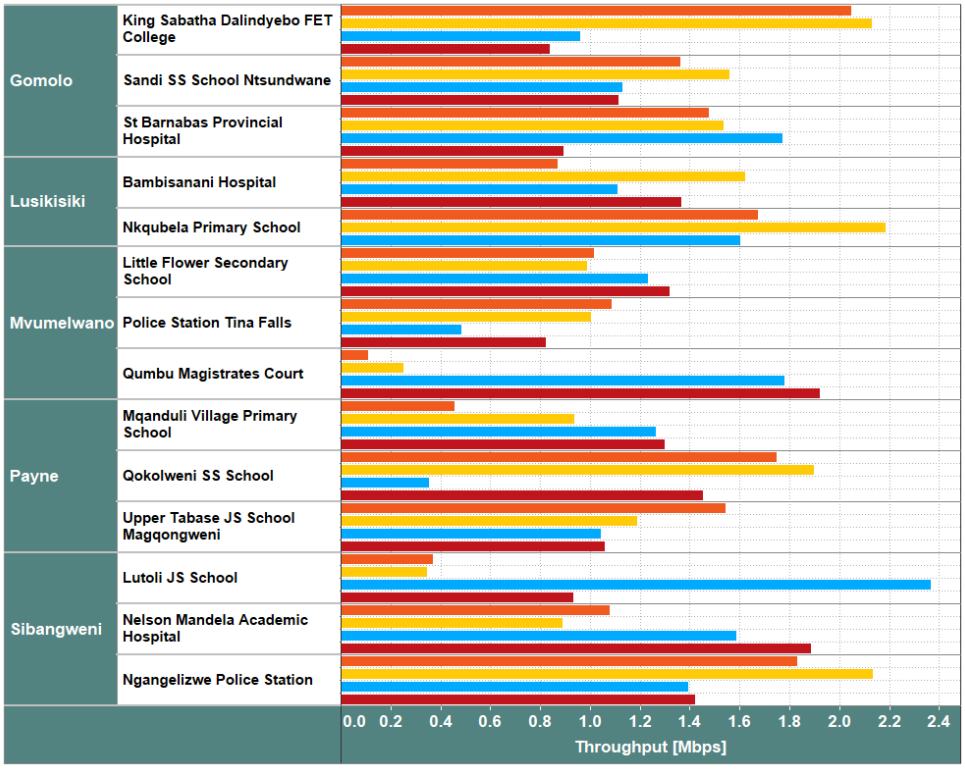


Figure 51. 3G Preferred – FTP Upload Throughput results per Stationary Point (Mbps)

4.2.1.7. 3G Preferred Stationary YouTube Results

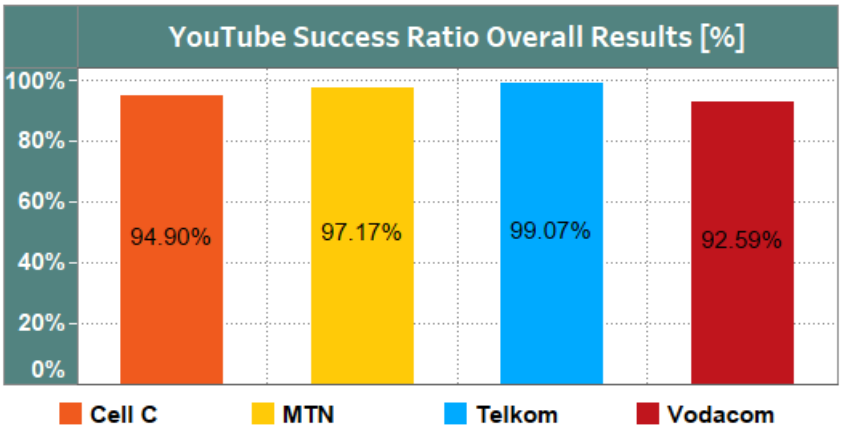


Figure 52. 3G Preferred – YouTube Success Ratio Overall results [%]

Figure 52 shows Telkom achieved the best 3G Preferred YouTube Overall Success ratio followed by MTN, Cell C and Vodacom in descending order.

Figure 53 shows 3G Preferred YouTube Success ratio per stationary point

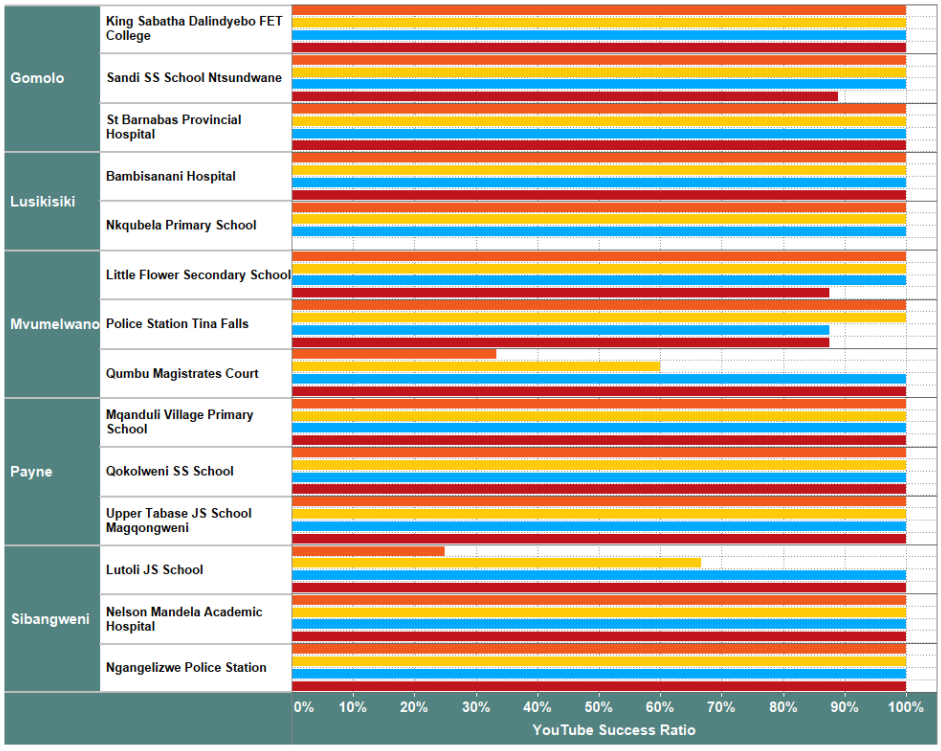


Figure 53. 3G Preferred – YouTube Success Ratio results per Stationary Point [%]

4.2.1.8. 3G Preferred Stationary Web Browsing Page Download Time

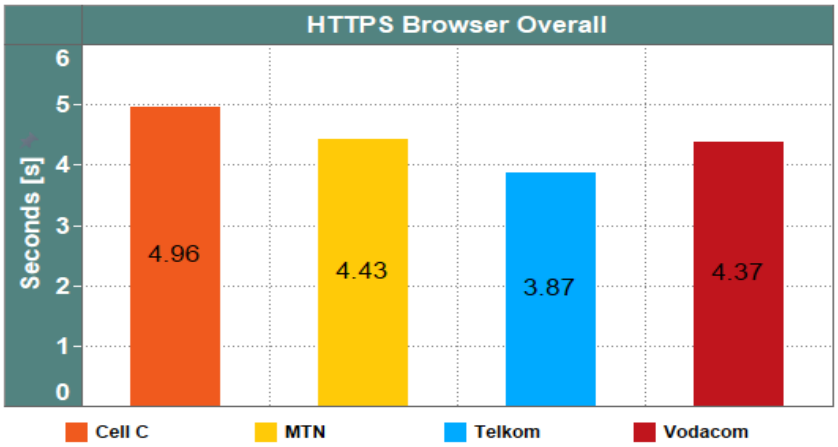


Figure 54. 3G Preferred – HTTPS Web Browsing Overall Results(s)

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

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

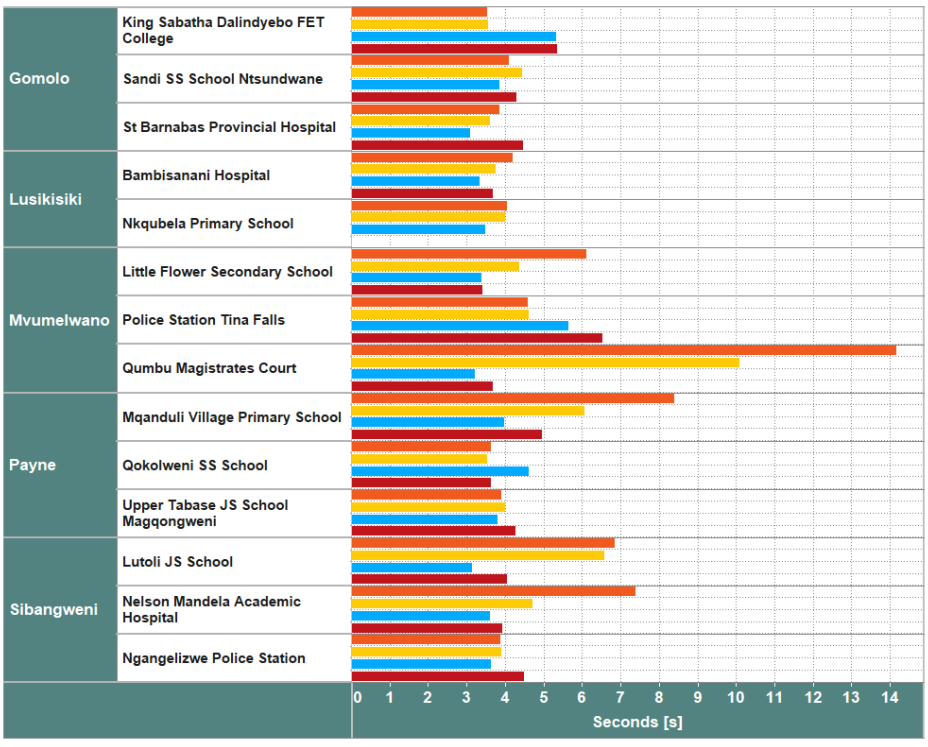


Figure 55. 3G Preferred HTTPS Web Browsing Results per Stationary Point [s]

4.2.1.9. 3G Preferred Stationary Ping Results

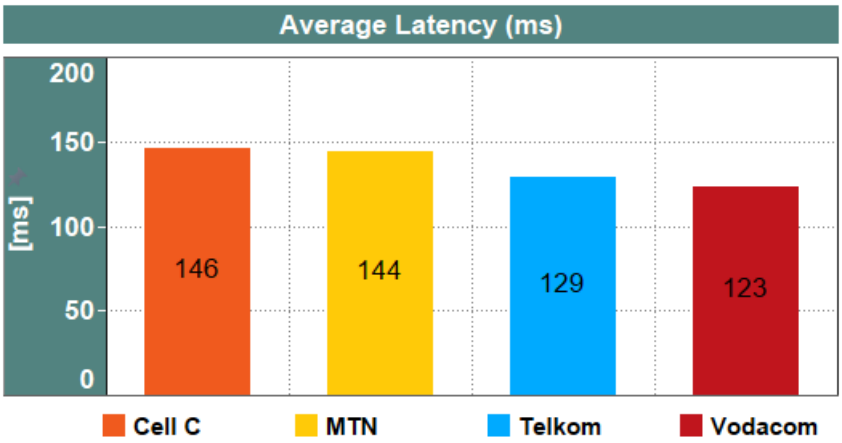


Figure 56. Stationary 3G Preferred Average Ping Overall Results (ms)

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

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

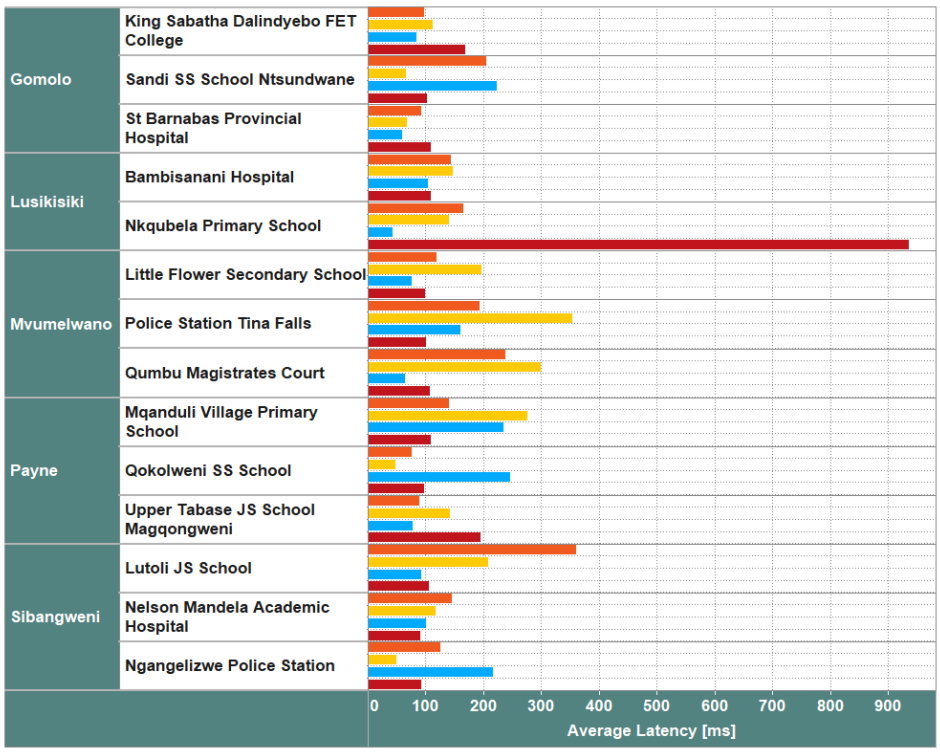


Figure 57. Stationary 3G Preferred Average Ping Results per Stationary Point (ms)

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]	2.14	36.22	12.49	21.94
	HTTP UL Throughput – Average [Mbps]	5.63	20.16	8.21	9.31
	Capacity DL Throughput – Average [Mbps]	2.32	59.44	32.82	30.27
	Capacity UL Throughput – Average [Mbps]	7.51	29.77	9.64	10.42
	FTP DL Throughput – Average [Mbps]	1.47	8.63	7.76	9.02
	FTP UL Throughput – Average [Mbps]	3.2	8.46	4.47	5.96
HTTPS Browser	Overall HTTPS Browsing Web Page Load Time [s]	5.76	3.24	3.14	3.21
	Kepler Page [s]	7.70	6.29	6.28	6.64
	Mobile Kepler Page [s]	2.32	0.90	0.83	1.14
	MSN [s]	7.15	2.40	2.02	2.02
	Google [s]	5.01	2.14	2.38	2.05
	News24 [s]	7.16	4.49	4.22	4.26
Data Latency	Overall Average Ping Latency [ms]	77	65	70	53
	Average Ping – Google Website [ms]	73	62	79	47
	Average Ping – Independent Server [ms]	80	69	61	59
YouTube	YouTube Successful Ratio [%]	95.00%	100.00%	97.70%	90.91%
	YouTube Number of Freezing	3	1	2	8
	YouTube Average Resolution [pixels]	757.10	1013.94	1019.11	1015.88
	YouTube Access Time [s]	12.8	4.53	5.01	4.48
	YouTube Quality MOS	3.91	4.18	4.20	4.20

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

4.2.2.1. 4G Preferred Stationary HTTP Download

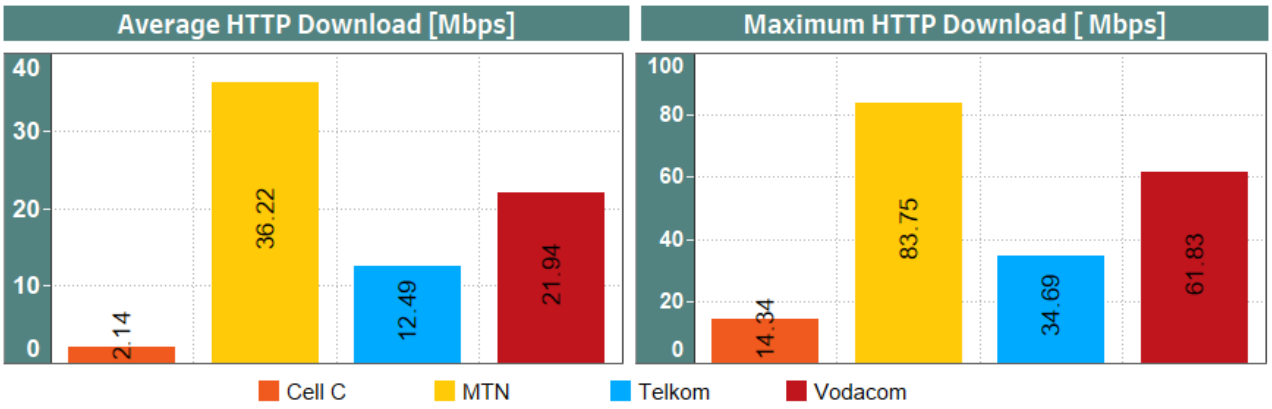


Figure 58. Stationary 4G Preferred – average HTTP Download Throughput Overall Results (Mbps)

Figure 58 shows that for overall results MTN achieved the highest stationary HTTP download throughput for both average and maximum HTTP download throughput, followed by Vodacom, Telkom, and Cell C in descending order.

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

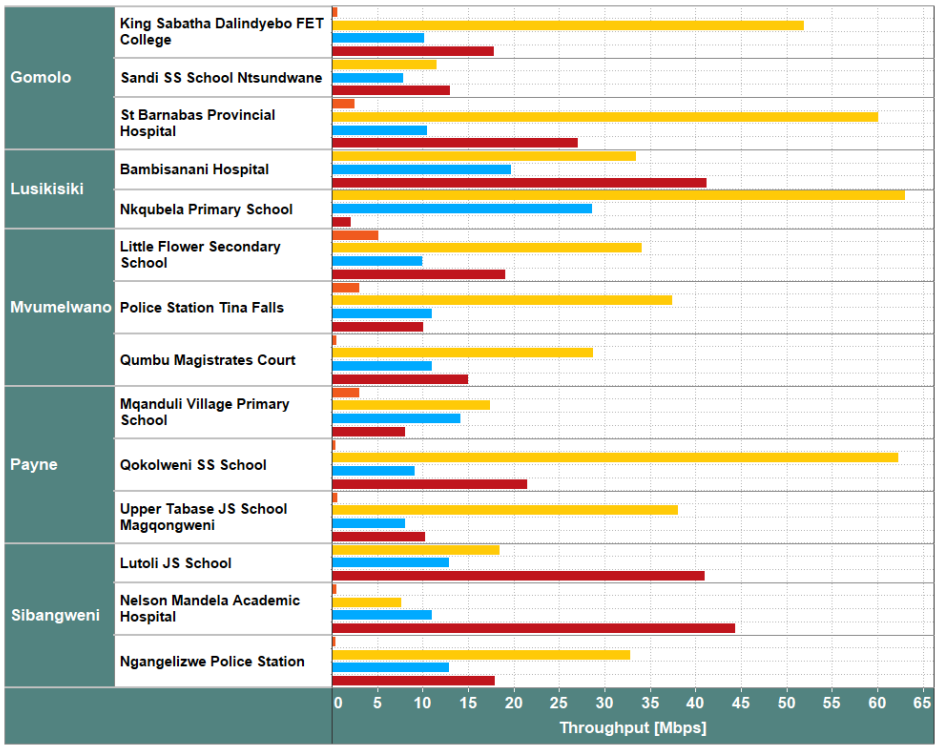


Figure 59. Stationary 4G Preferred – average HTTP Download Results per Static Point (Mbps)

4.2.2.2. 4G Preferred Stationary Capacity Download

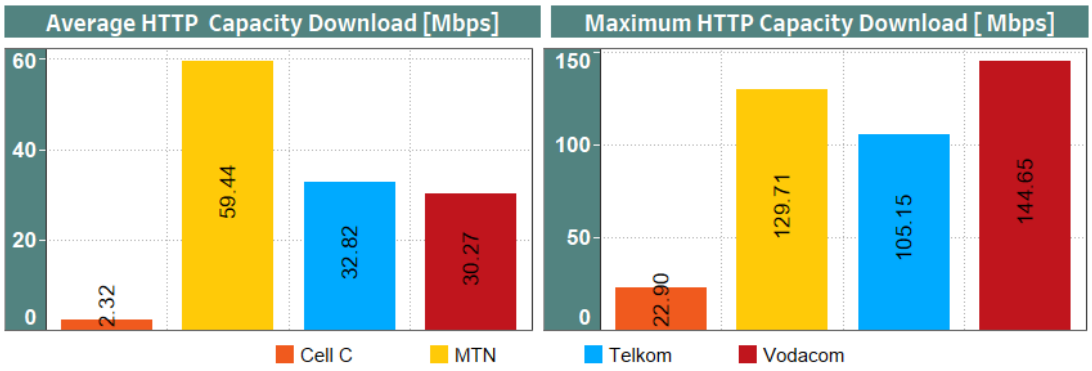


Figure 60. Stationary 4G Preferred – HTTP Capacity Download Throughput Overall Results (Mbps)

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

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

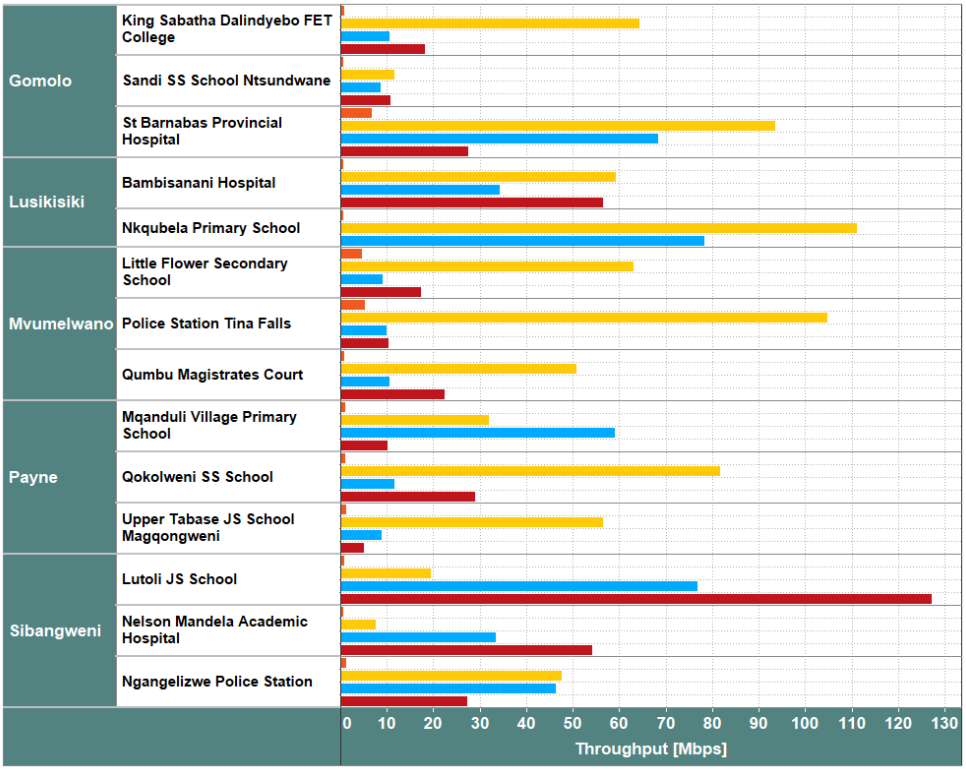


Figure 61. 4G Preferred – HTTP Capacity Download Throughput Results per Stationary Point (Mbps)

4.2.2.3. 4G Preferred Stationary FTP Download

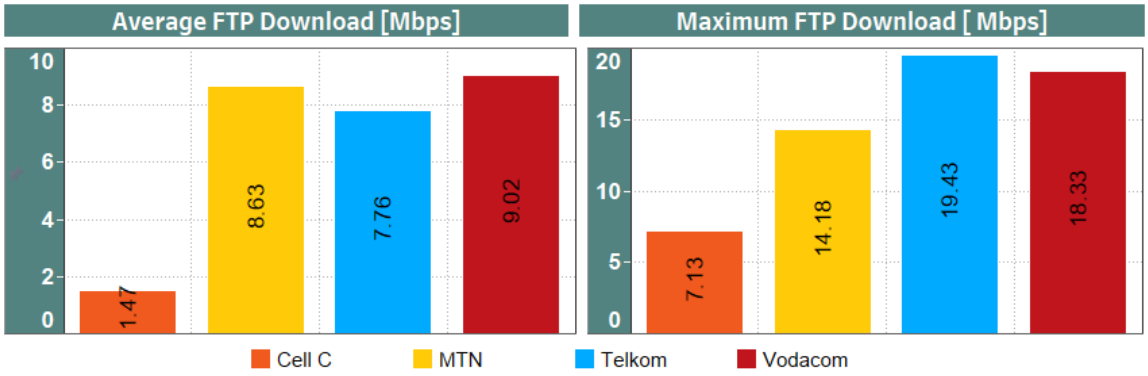


Figure 62. Stationary 4G Preferred – FTP Download Throughput Overall Results (Mbps)

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

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

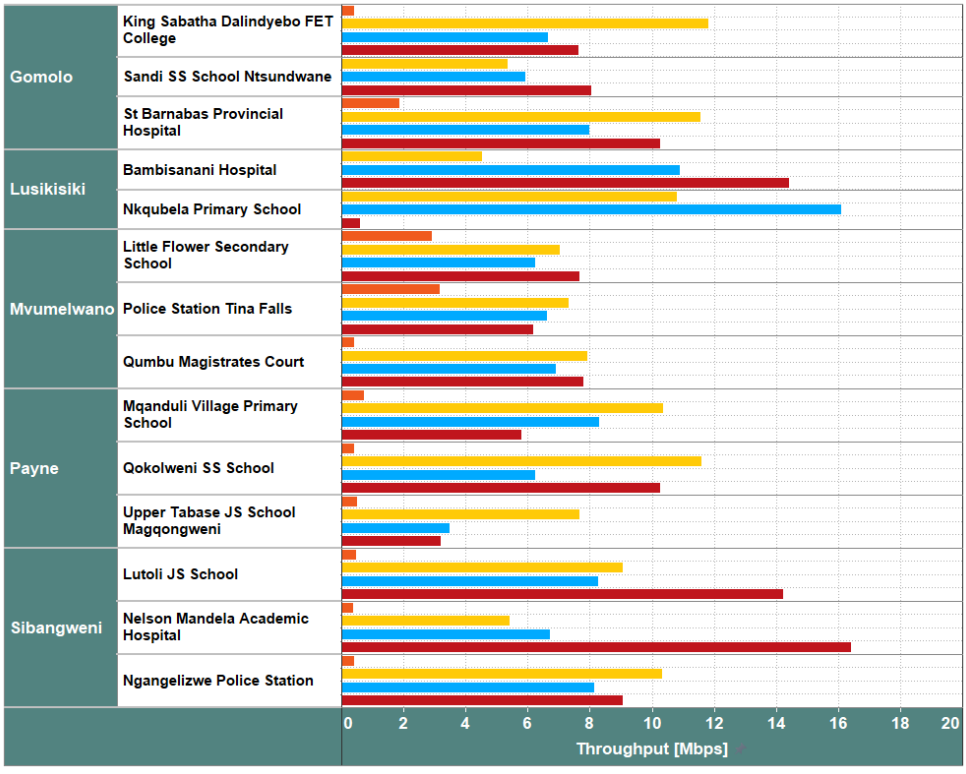


Figure 63. 4G preferred – average FTP Download Throughput Results per Static Point (Mbps)

4.2.2.4. 4G Preferred Stationary HTTP Upload

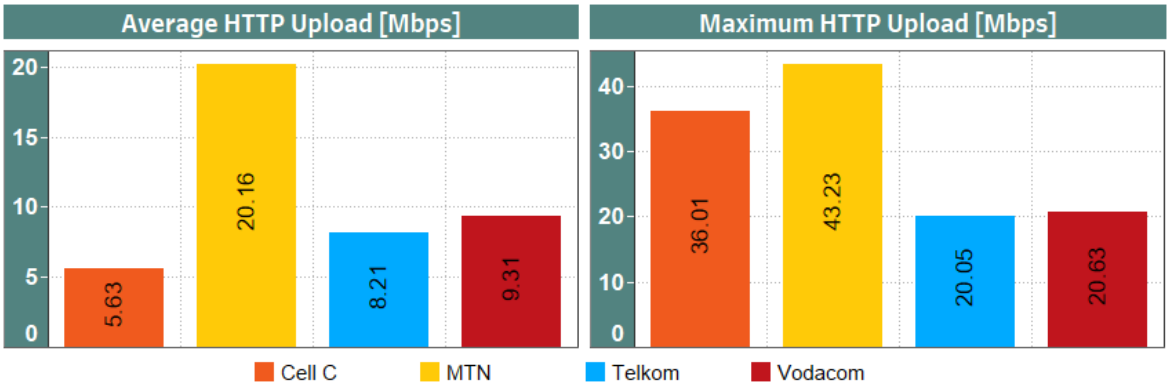


Figure 64. Stationary 4G Preferred – HTTP Upload Throughput Overall Results (Mbps)

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

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

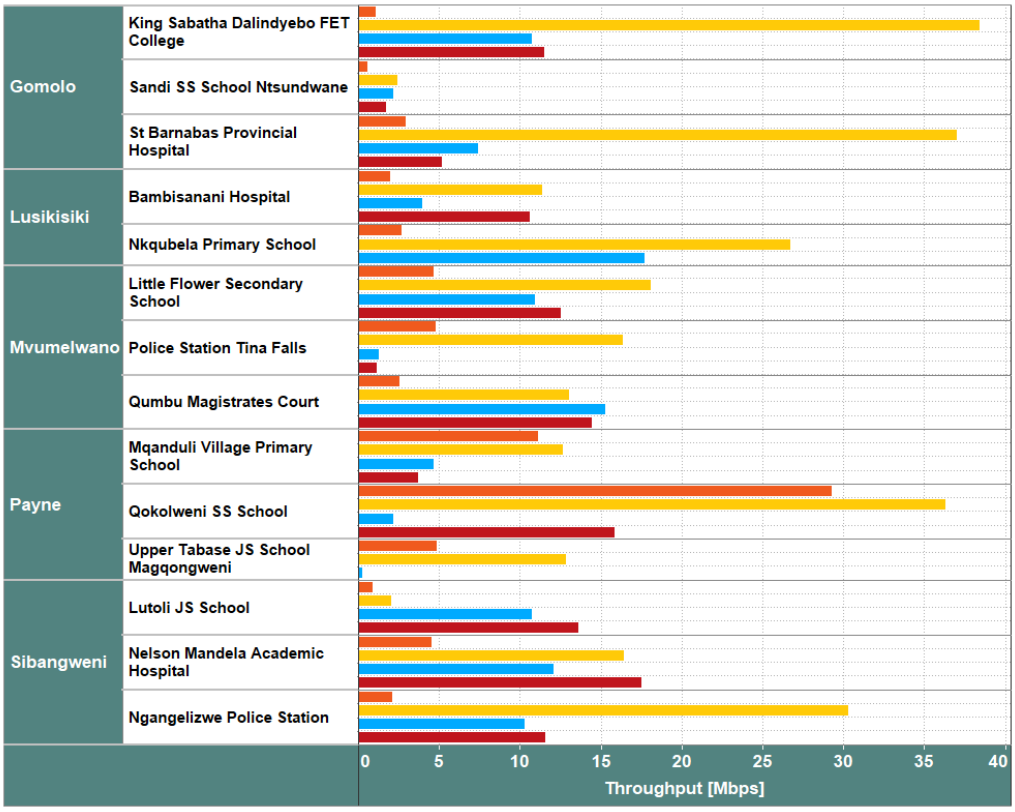


Figure 65. 4G Preferred – average HTTP Upload Overall Throughput Results per Static Point (Mbps)

4.2.2.5. 4G Preferred Stationary Capacity Upload

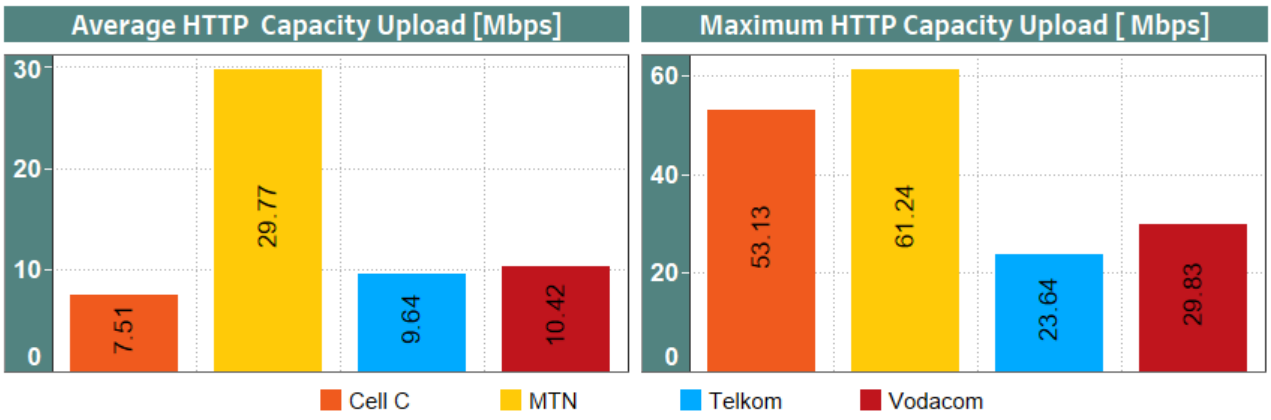


Figure 66. Stationary 4G Preferred – HTTP Capacity Upload Throughput Overall Results (Mbps)

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

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

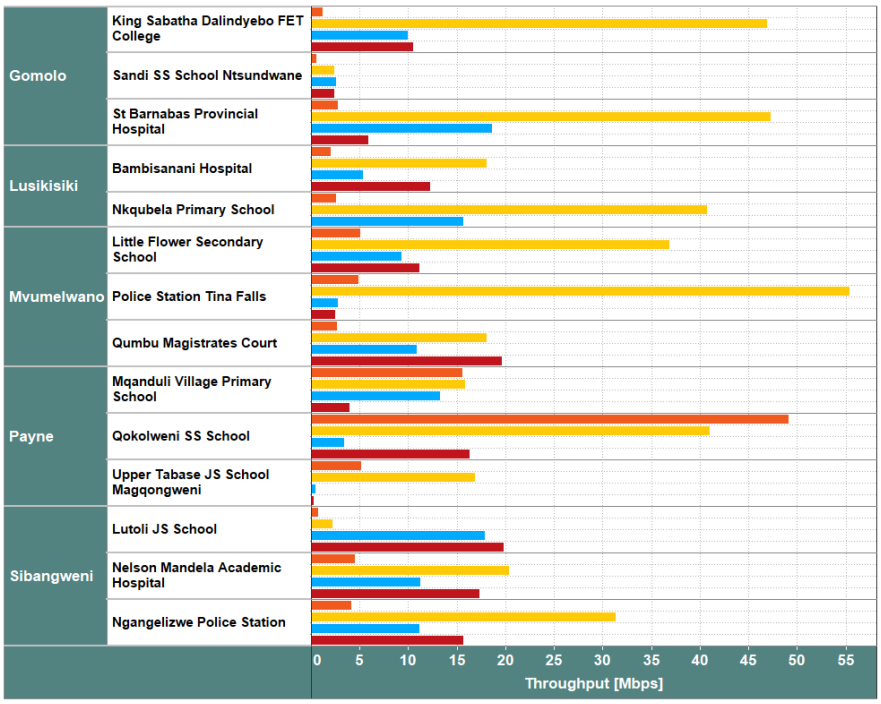


Figure 67. Stationary 4G Preferred – HTTP Capacity Upload Overall Results per Static Point (Mbps)

4.2.2.6. 4G Preferred Stationary FTP Upload

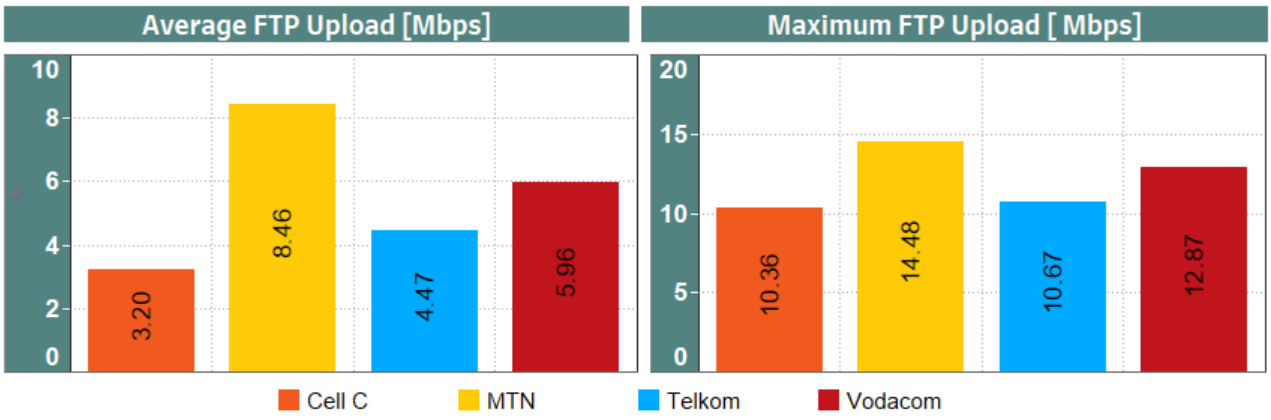


Figure 68. Stationary 4G Preferred – average FTP Upload Throughput Overall Results (Mbps)

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

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

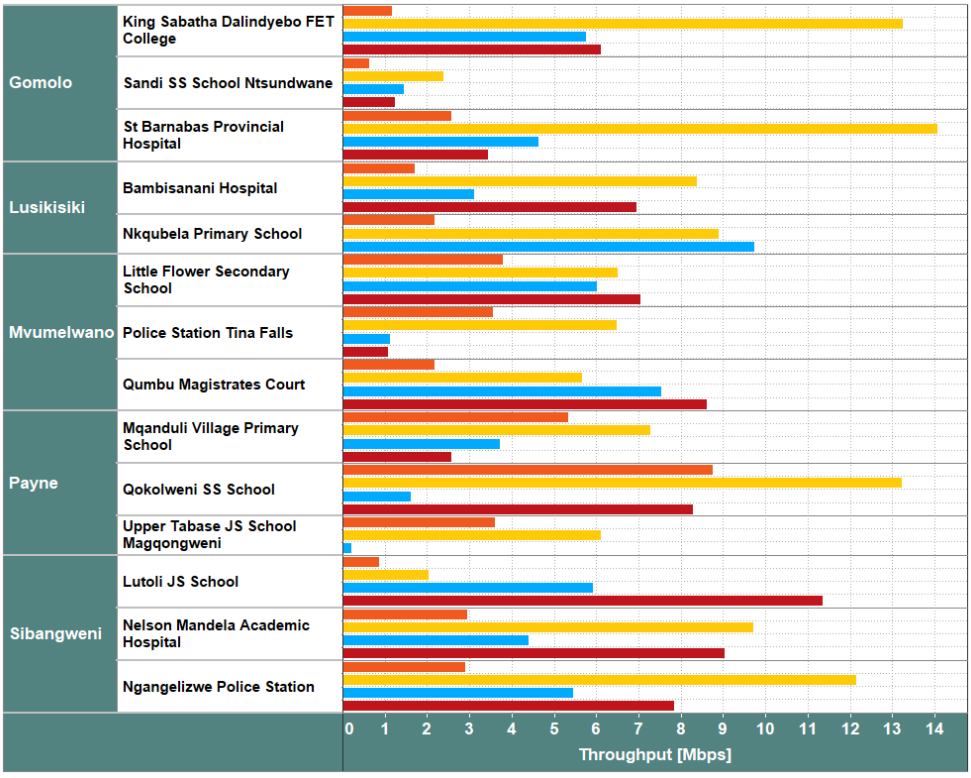


Figure 69. 3G Preferred – FTP Upload Throughput results per Stationary Points (Mbps)

4.2.2.7. 4G Preferred Stationary YouTube Results

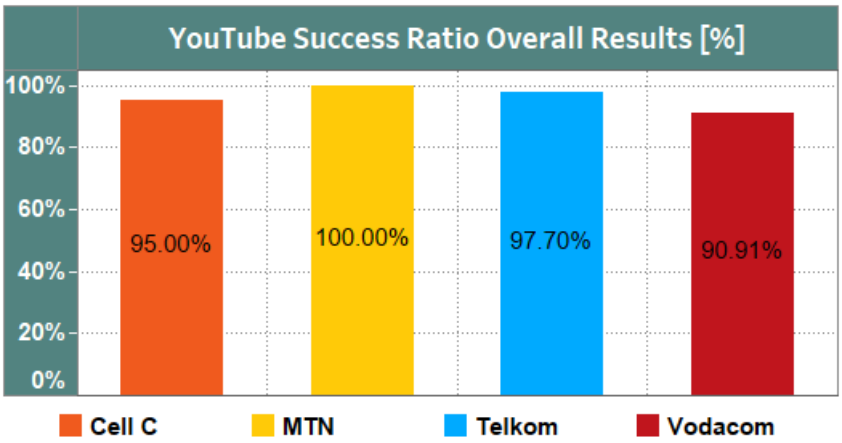


Figure 70. 4G Preferred – YouTube Success Ratio Overall results [%]

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

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

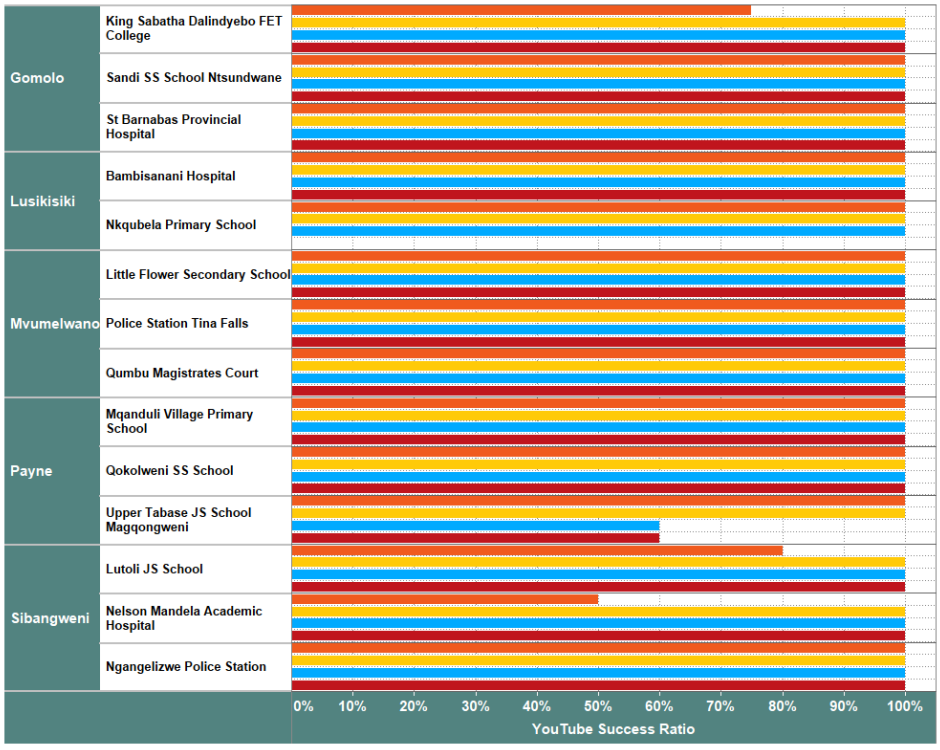


Figure 71. 4G Preferred – YouTube Success Ratio results per Stationary Point [%]

4.2.2.8. 4G Preferred Stationary Web Browsing Page Download Time

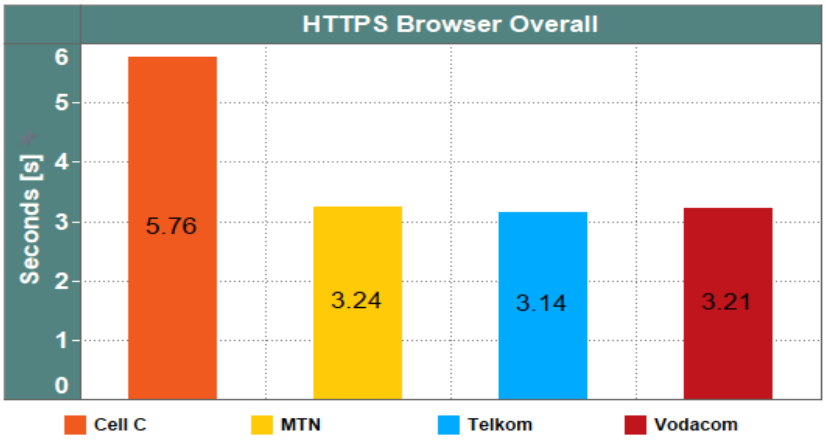


Figure 72. 4G Preferred – HTTPS Web Browsing Overall Results (s)

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

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

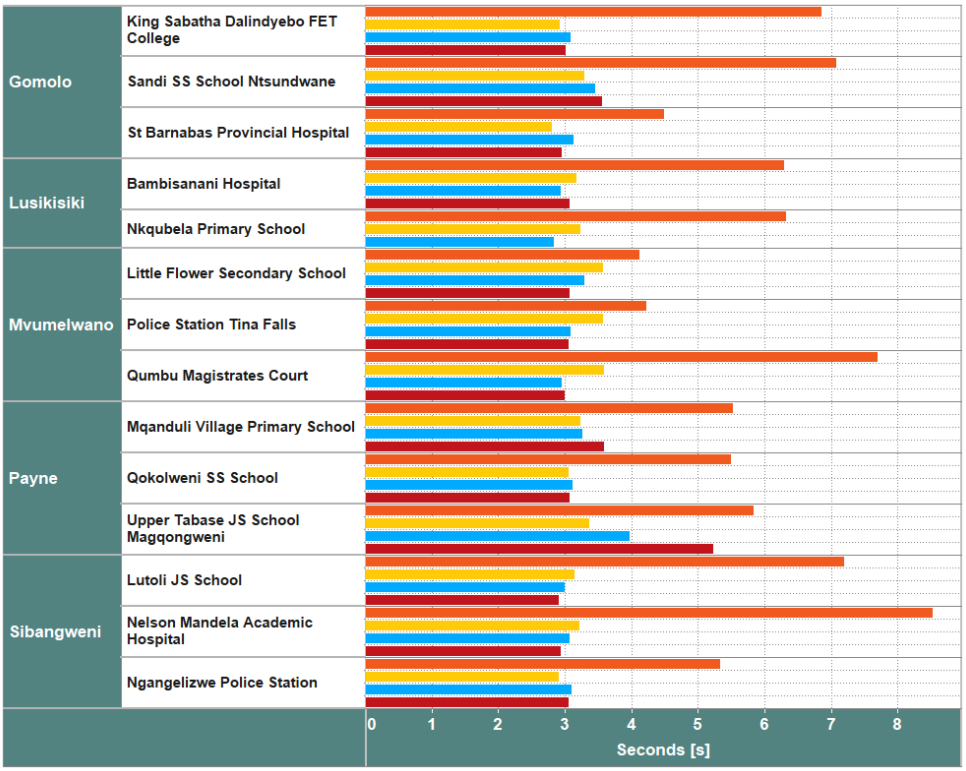


Figure 73. 4G Preferred – HTTPS Web Browsing Results per Stationary Point[s]

4.2.2.9. 4G Preferred Stationary Ping Results

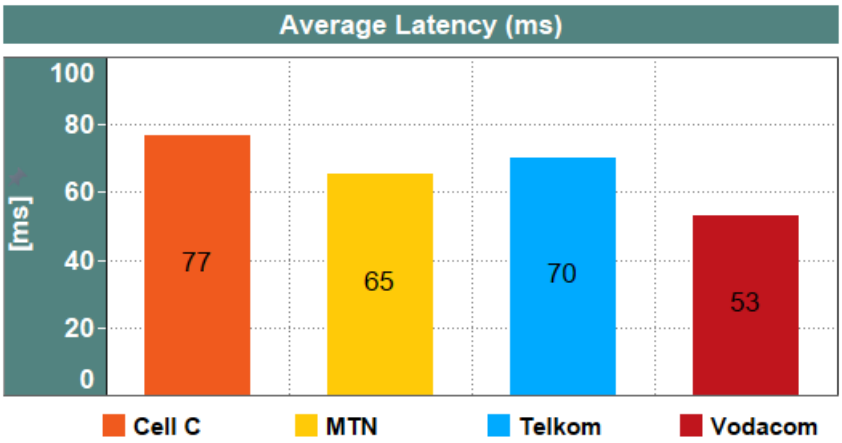


Figure 74. 4G Preferred Average Ping Overall Results (ms)

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

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

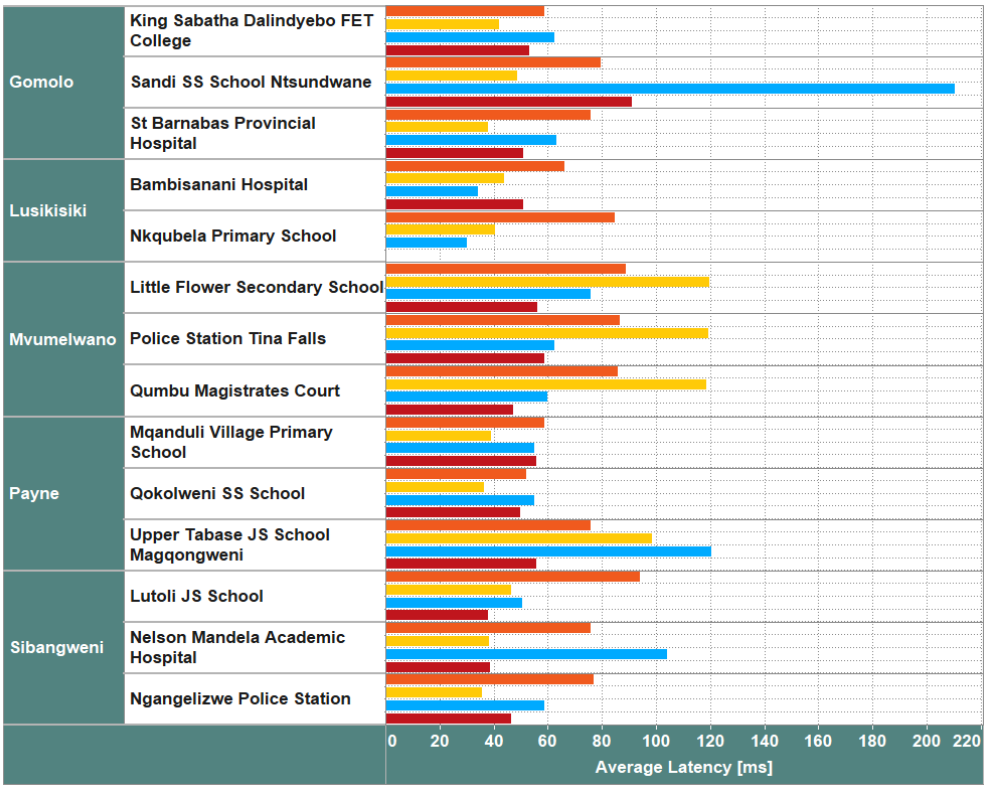


Figure 75. 4G Preferred – Average Ping Results per Stationary Point (ms)

4.3. Signal Strength

4.3.1. 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)

4.3.2. Overall RF Signal Levels

Table 11: Technology Coverage Footprints

3G Preferred Technology				
	Cell C	MTN	Telkom	Vodacom
UMTS	99.58%	99.23%	98.25%	98.47%
GSM	0.42%	0.77%	1.75%	1.53%

4G Preferred Technology				
	Cell C	MTN	Telkom	Vodacom
LTE	90.43%	89.58%	60.77%	75.55%
UMTS	9.49%	10.23%	39.04%	23.65%
GSM	0.07%	0.19%	0.19%	0.80%

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

Table 12: Signal Level and Quality Reference Information

LTE Coverage

RSRP [dBm]				
	Cell C	MTN	Telkom	Vodacom
Avg	-92.74	-94.84	-102.83	-93.12
Max	-55.80	-56.00	-63.60	-56.90
Min	-141.00	-141.00	-141.00	-141.00

SINR [dB]				
	Cell C	MTN	Telkom	Vodacom
Avg	8.21	8.45	8.47	3.06
Max	36.40	36.10	35.00	32.50
Min	-20.00	-18.50	-19.00	-18.50

3G Coverage

RSCP [dbm]				
	Cell C	MTN	Telkom	Vodacom
Ave	-88.47	-87.89	-89.28	-87.66
Max	-38.0	-37.9	-42.0	-32.5
Min	-125.0	-124.0	-124.0	-134.0

EcNo [db]				
	Cell C	MTN	Telkom	Vodacom
Ave	-11.61	-11.66	-10.13	-10.91
Max	-1.60	-1.50	-1.40	-2.00
Min	-24.00	-24.00	-24.00	-24.00

Table 12 shows that Vodacom had the best 3G coverage and Cell C had the best LTE coverage. The results are based on all available samples limited to the areas where the operators had coverage and none of the operators were penalised for no coverage.

5. Conclusion

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

5.1. 3G Preferred measurements:

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

After benchmarking the operators for 3G preferred, the results show that on per areas basis.

a) Telkom achieved the highest results for HTTP download average throughput in Lusikisiki, Payne and Sibangweni. MTN had the highest throughput in Gomolo and Mvumelwano.
b) For HTTP Upload, Telkom achieved the highest results for HTTP Upload average throughput in Lusikisiki. Cell C led in Gomolo and Mvumelwano and MTN had the highest in Payne and Sibangweni.
c) Vodacom achieved the lowest Latency time in Lusikisiki and Sibangweni and Telkom had the lowest latency in Gomolo, Mvumelwano and Payne.

5.2. 4G Preferred measurements

In terms of overall results for 4G preferred mobile mode test, MTN leads in all 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.

For Stationary Points, MTN had the highest throughput download speeds for HTTP DL test, Capacity Test and FTP DL Test. MTN had the highest throughput for Upload tests and Capacity Upload tests whereas Vodacom had the highest overall FTP upload throughput speed Vodacom had the lowest Latency time.

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

6.1. Vodacom

Vodacom has submitted in comments and analysis of this report. The remedial action and long-term solutions were provided as follows:

- Gomolo – Congestion was observed which resulted in poor coverage and quality due to sites being out of service and some of the sites serving the area did not have Back-up power after being vandalised. The solution to address these issues include site hardening and battery back-up installation, LTE900 layer upgrades, and U900 and U2100 rollout in the area.
- Mvumelwano - Inadequate downlink and uplink speeds for file transfer services. High congestion resulting in packet loss affecting latency and throughput performance. The solution to address these issues include Site hardening and battery back-up, LTE900 and LTE700 Layer upgrades to increase coverage area and add carrier aggregation capability to sites, U900 and U2100 rollout, and new site in the affected areas.
- Lusikisiki - Site outages causing High congestion and cell shrinkage affecting coverage. The result is poor Uplink and downlink throughputs. The solution to address poor performance include site hardening and battery back-up installation, LTE900 Layer upgrades to increase coverage area and carrier aggregation capability to sites, Network equipment modernization, and Further U900 and U2100 rollout in the affected area.
- Payne - Site outages causing high congestion and affecting coverage. The result is poor uplink and downlink throughputs. The solution to address poor performance include Site hardening and battery back-up installation, L2100 Rollout, and New Spectrum rollout to support advanced LTE.
- Sibangweni - Site outages causing High congestion and affecting coverage affecting throughput. The solution to address poor performance include site hardening and battery backup installation, L2100 rollout, new spectrum rollout to support advanced LTE, U2100 and U900 rollout, and RF cluster optimisation.

6.2. MTN

MTN has submitted in comments and analysis of this report. The remedial action and long-term solutions were provided as follows:

- Gomolo - five critical areas where there is poor coverage identified that resulted in lower throughputs experienced during the drive test. The cluster is surrounded by mountains and hills which affect network coverage. MTN's solutions to improve data coverage in the area include Sectorisation and deployment of L900, plan and build new coverage site from 2023 financial year and antenna optimisation.

- Lusikisiki - Poor coverage due to the mountainous terrain resulted in low data throughputs experienced during the drive tests. MTN's solutions to improve data coverage in the area include plans to build a new site from the 2023 financial year to improve the data coverage significantly in the area, implement antenna optimisation methods, and sectorization of some of the sites.
- Mvumelwano - Lower data throughputs experienced during the drive test are due to site availability issues (hardware and/ software faults on site) and poor coverage due to mountainous terrain. MTN will implement antenna optimisation methods to improve coverage. Two new sites have been planned and will be built from the 2023 financial year to improve data coverage.
- Payne - All throughput issues experienced during the drive test are due to poor coverage due to site availability issues (hardware and software faults) during the period when the Authority was conducting the drive test. Site with availability issues were rectified. Antenna Optimisation methods will also be implemented to improve data coverage in the affected area. MTN will also build a new site from in the 2023 financial year to improve the data coverage.
- Sibangweni - Low throughputs experienced during the drive tests were main due to mountainous terrain in the cluster. MTN will implement antenna optimisation methods to improve data network coverage and three new sites have been planned and will be built, from 2023, to address the data coverage issues

MTN further states that it should be noted that MTN has indicated its intention to switch off 3G by 2025 and to do this they are actively moving spectrum away from 3G towards 4G. This active re-farming of spectrum from 3G to 4G (which carries the bulk of our traffic), is necessary to ensure the sustainability of the 4G performance but at the cost of 3G performance degrading and hence any 3G targets set by ICASA will become harder to achieve, while MTN is actively reducing its reliance on this technology.

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

6.3. Cell C

Cell C has submitted in comments and analysis of this report. The remedial action and long-term solutions were provided as follows:

- Gomolo - Availability issues due to power affected several sites on days of drive test. 4 base stations were upgraded in Sept 2021 to address poor performance.

- Lusikisiki - Availability issues due to power affected several sites on days of drive test. 1 base station was upgraded in Sept 2021 to address poor performance.
- Mvumelwano - Availability issues due to power affected several sites on days of drive test. 3 base stations were upgraded in Sept 2021 to address poor performance.
- Payne - Availability issues due to power affected several sites on days of drive test. 3 base stations were upgraded in Sept 2021 to address poor performance.
- Sibangweni - Availability issues due to power affected several sites on days of drive test. 2 base stations were upgraded in Sept 2021 to address poor performance

6.4. Telkom

Telkom has submitted in comments and analysis of this report. The remedial action and long-term solutions were provided as follows:

- Site availability also impacted static points testing by degrading the signal strength. This will be resolved by installing batteries to stabilize power to these sites where practically possible.
- Telkom has seventeen (17) sites across all the tested areas, and eighteen (18) more sites planned. Seven (7) is in Lusikisiki and expected to go live in the FY22/23.
- Repairs are underway to address vandalized sites in the affected areas
- In areas where Telkom does not have network presence, we will continue to engage our roaming partner to improve customer experience in the affected areas. Furthermore, the recent on boarding 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

		Gomolo	Lusikisiki	Mvumelwano	Payne	Sibangweni	Grand Total
HTTP DL Throughput - Average [Mbps]	**Cell C**	3.98	3.98	4.27	3.48	3.44	3.84
	MTN	4.92	4.71	5.33	4.71	4.65	4.87
	Telkom	2.94	6.63	4.76	5.03	5.32	5.07
	Vodacom	3.70	4.44	4.40	4.45	4.30	4.30
HTTP UL Throughput - Average [Mbps]	**Cell C**	1.55	1.62	1.75	1.73	1.74	1.68
	MTN	1.52	1.74	1.59	1.90	2.04	1.76
	Telkom	1.23	1.90	1.72	1.61	1.72	1.66
	Vodacom	1.05	1.49	1.66	1.70	1.94	1.59
HTTP DL Capacity Throughput - Average [Mbps]	**Cell C**	4.07	4.17	4.23	4.06	3.44	4.01
	MTN	5.74	5.34	5.64	4.72	4.06	5.09
	Telkom	3.56	8.17	4.88	5.38	6.30	5.81
	Vodacom	3.62	4.31	5.13	4.72	4.99	4.61
HTTP UL Capacity Throughput - Average [Mbps]	**Cell C**	2.01	1.84	2.22	2.15	2.13	2.07
	MTN	2.04	1.78	1.98	2.23	2.10	2.01
	Telkom	1.14	2.24	2.10	2.19	2.24	2.03
	Vodacom	1.26	1.87	1.99	2.48	2.04	1.96
FTP DL Throughput - Average [Mbps]	**Cell C**	2.09	2.06	1.95	1.82	1.89	1.96
	MTN	2.13	2.61	2.73	2.68	2.57	2.56
	Telkom	1.86	3.43	2.62	2.96	3.01	2.82
	Vodacom	1.69	2.67	2.33	2.50	2.39	2.36
FTP UL Throughput - Average [Mbps]	**Cell C**	1.18	1.03	1.13	1.27	1.27	1.17
	MTN	0.97	1.03	1.14	1.34	1.31	1.16
	Telkom	0.72	1.19	1.16	1.16	1.18	1.10
	Vodacom	0.63	0.96	0.98	0.98	1.18	0.97

7.1.2. 3G Preferred Web Page Download Time

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

		Gomolo	Lusikisiki	Mvumelwano	Payne	Sibangweni	Grand Total
HTTPS Kepler [s]	Cell C	9.11	8.42	8.52	10.22	11.77	9.54
	MTN	7.70	8.02	7.82	8.48	9.54	8.30
	Telkom	10.88	6.86	8.07	8.54	8.65	8.47
	Vodacom	9.79	8.29	7.56	7.49	8.96	8.32
HTTPS Mobile Kepler [s]	Cell C	3.30	4.03	2.77	3.26	2.38	3.17
	MTN	2.63	2.78	2.80	1.70	2.63	2.51
	Telkom	3.51	1.67	1.53	2.12	3.70	2.44
	Vodacom	3.04	2.37	3.19	2.92	2.68	2.82
Google [s]	Cell C	4.54	5.03	4.71	5.17	4.85	4.87
	MTN	5.29	5.22	4.97	5.56	5.27	5.26
	Telkom	5.18	3.81	4.23	4.22	4.44	4.29
	Vodacom	5.66	4.52	5.07	4.88	5.26	5.01
MSN [s]	Cell C	4.72	4.32	3.89	4.42	3.87	4.24
	MTN	3.71	3.90	3.76	3.68	3.47	3.72
	Telkom	4.26	3.14	3.39	3.23	2.94	3.34
	Vodacom	4.34	3.36	3.07	3.91	3.37	3.54
News24 [s]	Cell C	7.18	6.97	7.26	6.74	6.58	6.96
	MTN	6.54	6.24	6.28	6.60	6.84	6.49
	Telkom	6.87	5.90	5.86	6.50	6.50	6.28
	Vodacom	8.31	6.86	6.62	6.84	6.22	6.84

7.1.3. 3G Preferred Ping/RTT Results

Table 15. 3G Preferred Latency (ms)

		Gomolo	Lusikisiki	Mvumelwano	Payne	Sibangweni	Grand Total
Google ICMP (32 bytes) Ping [ms]	Cell C	184	193	164	176	137	171
	MTN	160	134	134	131	137	138
	Telkom	145	216	136	169	213	177
	Vodacom	170	113	131	127	112	128
Independent Server ICMP (32 bytes) Ping [ms]	Cell C	249	209	210	209	130	201
	MTN	238	225	217	241	252	233
	Telkom	163	80	104	100	75	101
	Vodacom	179	135	150	147	127	146

7.1.4. 3G Preferred YouTube Results

Table 16. 3G Preferred YouTube Results

		Gomolo	Lusikisiki	Mvumelwano	Payne	Sibangweni	Grand Total
YouTube Success Ratio	Cell C	73.08%	81.82%	88.71%	83.05%	69.23%	79.73%
	MTN	78.85%	88.16%	95.71%	92.31%	83.61%	88.27%
	Telkom	75.00%	87.18%	94.20%	93.85%	79.37%	86.69%
	Vodacom	74.07%	84.62%	88.06%	93.85%	89.06%	86.28%

7.2. 4G Preferred Mobile Test Results

7.2.1. 4G Preferred Average Throughput

Table 17: 4G Preferred Average throughput per area

		Gomolo	Lusikisiki	Mvumelwano	Payne	Sibangweni	Grand Total
HTTP DL Throughput - Average [Mbps]	**Cell C**	4.31	2.71	4.93	0.73	3.70	3.62
	MTN	29.51	27.98	32.21	27.13	26.11	28.77
	Telkom	7.74	16.52	7.26	9.43	10.18	10.12
	Vodacom	13.05	11.72	13.18	17.81	14.52	13.93
HTTP UL Throughput - Average [Mbps]	**Cell C**	4.51	3.61	3.29	3.02	4.28	3.75
	MTN	14.39	13.98	14.98	15.28	22.66	16.45
	Telkom	4.81	5.53	5.72	5.08	5.01	5.27
	Vodacom	5.29	6.61	6.70	9.82	9.19	7.61
HTTP DL Capacity Throughput - Average [Mbps]	**Cell C**	4.09	4.01	6.18	1.03	3.46	3.89
	MTN	45.94	41.68	52.51	42.98	29.56	42.71
	Telkom	9.06	24.47	7.34	19.71	20.74	16.12
	Vodacom	16.47	10.12	16.04	20.01	25.86	17.84
HTTP UL Capacity Throughput - Average [Mbps]	**Cell C**	4.46	3.69	3.50	4.38	3.68	3.89
	MTN	20.32	16.44	23.53	22.74	21.23	20.95
	Telkom	3.88	7.68	4.58	6.34	7.97	6.16
	Vodacom	4.40	5.84	7.67	9.56	11.05	7.88
FTP DL Throughput - Average [Mbps]	**Cell C**	1.82	1.18	3.05	0.88	2.18	2.08
	MTN	7.70	7.97	7.41	8.68	8.01	7.90
	Telkom	5.13	9.14	5.00	6.03	5.80	6.18
	Vodacom	6.52	6.46	6.46	7.41	6.75	6.68
FTP UL Throughput - Average [Mbps]	**Cell C**	3.03	2.00	2.85	2.01	3.01	2.60
	MTN	6.66	6.60	6.80	7.13	8.91	7.26
	Telkom	3.08	4.02	3.51	3.17	3.63	3.52
	Vodacom	3.76	4.22	4.76	5.22	5.67	4.79

7.2.2. 4G Preferred Web Page Download Time

Table 18: 4G Preferred HTTPS Webpage download times per area

		Gomolo	Lusikisiki	Mvumelwano	Payne	Sibangweni	Grand Total
HTTPS Kepler [s]	Cell C	9.82	8.53	6.79	7.78	7.53	7.99
	MTN	6.65	6.72	6.79	6.35	6.49	6.62
	Telkom	8.60	7.09	7.42	6.51	6.45	7.05
	Vodacom	7.81	7.81	6.62	7.06	6.88	7.15
HTTPS Mobile Kepler [s]	Cell C	2.96	3.34	1.63	2.69	2.05	2.50
	MTN	1.73	1.39	1.16	0.86	0.85	1.18
	Telkom	2.55	1.73	1.38	1.12	1.63	1.57
	Vodacom	1.76	1.41	0.98	1.07	1.00	1.19
Google [s]	Cell C	4.74	5.19	3.57	4.69	4.64	4.52
	MTN	2.42	2.34	2.38	2.13	2.45	2.35
	Telkom	4.75	3.10	3.48	2.93	2.76	3.22
	Vodacom	3.04	3.36	2.61	2.43	2.68	2.80
MSN [s]	Cell C	7.37	6.41	4.00	9.69	5.03	6.05
	MTN	2.41	2.62	2.70	2.49	2.53	2.56
	Telkom	3.01	3.16	2.70	2.12	2.45	2.65
	Vodacom	4.45	2.60	2.14	2.25	2.19	2.58
News24 [s]	Cell C	6.86	7.26	5.54	7.18	5.68	6.41
	MTN	4.79	4.49	4.79	4.21	4.43	4.56
	Telkom	6.11	5.39	5.05	4.92	5.09	5.19
	Vodacom	7.07	5.50	4.58	4.28	4.46	4.99

7.2.3. 4G Preferred YouTube Results

Table 19: 4G Preferred YouTube Success Ratio results per area

		Gomolo	Lusikisiki	Mvumelwano	Payne	Sibangweni	Grand Total
YouTube Success Ratio [%]	Cell C	93.48%	82.76%	81.58%	95.56%	85.48%	86.76%
	MTN	100.00%	96.97%	98.78%	98.08%	95.83%	97.86%
	Telkom	37.74%	86.15%	87.80%	98.04%	94.44%	82.35%
	Vodacom	74.00%	90.77%	98.78%	96.08%	94.59%	91.93%

Table 20: 4G Preferred YouTube MOS quality results per area

		Gomolo	Lusikisiki	Mvumelwano	Payne	Sibangweni	Grand Total
YouTube Quality MOS	Cell C	3.69	3.85	4.12	3.81	3.98	3.91
	MTN	4.15	4.17	4.19	4.19	4.16	4.17
	Telkom	4.06	4.09	4.13	4.15	4.15	4.12
	Vodacom	4.03	4.03	4.14	4.19	4.14	4.11

Table 21: 4G Preferred YouTube Access time results per area

		Gomolo	Lusikisiki	Mvumelwano	Payne	Sibangweni	Grand Total
YouTube Access Time [s]	Cell C	12.64	14.11	7.89	12.02	12.03	11.54
	MTN	4.39	4.53	4.51	4.51	4.47	4.49
	Telkom	6.54	6.60	8.39	6.97	7.15	7.30
	Vodacom	9.36	8.65	6.30	6.19	6.48	7.19

Table 22: 4G Preferred YouTube video resolution results

		Gomolo	Lusikisiki	Mvumelwano	Payne	Sibangweni	Grand Total
YouTube Average Resolution [pixels]	Cell C	644.53	701.63	918.24	658.34	765.81	756.18
	MTN	1024.40	1006.30	1011.20	1019.40	1012.76	1014.13
	Telkom	940.61	951.92	960.28	983.94	974.63	965.47
	Vodacom	925.41	863.20	988.03	998.55	971.06	953.43

7.2.4. 4G Preferred Ping Results

Table 23: 4G Preferred Ping Latency per area

		Gomolo	Lusikisiki	Mvumelwano	Payne	Sibangweni	Grand Total
Google ICMP (32 bytes) Ping [ms]	Cell C	85	85	71	59	57	71
	MTN	79	97	88	44	67	77
	Telkom	168	65	99	118	86	103
	Vodacom	81	72	71	60	62	69
Independent Server ICMP (32 bytes) Ping [ms]	Cell C	78	76	89	67	67	75
	MTN	71	59	87	50	55	66
	Telkom	128	57	78	87	84	84
	Vodacom	105	78	73	60	71	76

7.3. 3G Stationary Test Results

7.3.1. 3G Preferred Throughput

Table 24. Table 26: 3G Preferred Throughput results per stationary point

		Gomolo			Lusikisiki		Mvumelwano			Payne			Sibangweni			Grand Total
		King Sabatha Dalindyebo FET College	Sandi SS School Ntsundwane	St Barnabas Provincial Hospital	Bambisanani Hospital	Nkqubela Primary School	Little Flower Secondary School	Police Station Tina Falls	Qumbu Magistrates Court	Mqanduli Village Primary School	Qokolweni SS School	Upper Tabase JS School Magqongweni	Lutoli JS School	Nelson Mandela Academic Hospital	Ngangelizwe Police Station	
HTTP DL Throughput - Average [Mbps]	Cell C	9.17	3.75	9.02	5.13	7.58	2.49	4.75	1.34	1.80	8.41	7.07	0.96	1.34	6.63	5.37
	MTN	7.92	4.13	10.40	7.48	8.52	4.64	7.23	2.18	2.11	12.16	7.18	0.95	1.84	7.31	6.29
	Telkom	2.06	5.18	9.40	7.18	7.68	5.88	2.67	9.31	6.67	2.51	3.81	9.72	7.19	8.00	6.14
	Vodacom	1.93	5.43	4.25	8.92		9.81	1.98	6.85	5.75	10.16	3.95	7.25	5.27	3.49	5.62
HTTP UL Throughput - Average [Mbps]	Cell C	3.54	1.56	2.17	2.31	3.04	2.05	1.81	0.99	1.34	2.23	2.38	0.67	1.73	3.23	2.19
	MTN	3.81	2.24	2.05	2.04	2.25	1.32	1.76	0.55	0.71	3.02	2.44	0.28	1.24	3.06	2.08
	Telkom	1.35	1.62	2.90	1.38	2.64	1.66	0.47	3.46	1.79	0.39	1.30	3.83	2.64	2.38	1.94
	Vodacom	1.41	1.09	1.31	1.90		2.04	1.04	3.58	1.73	2.68	1.23	1.37	3.51	2.08	1.87
HTTP DL Capacity Throughput - Average [Mbps]	Cell C	8.42	3.60	11.95	4.69	7.79	3.07	6.32	1.01	1.00	10.63	8.74	1.32	0.84	8.70	6.16
	MTN	8.11	4.10	15.43	7.49	13.31	4.17	11.16	1.42	4.03	20.09	9.41	1.73	2.54	9.11	8.38
	Telkom	2.58	8.33	21.49	8.87	9.20	7.55	2.39	12.60	8.68	2.43	4.08	25.74	9.06	11.10	9.52
	Vodacom	1.88	6.97	3.87	9.16		10.72	1.99	10.97	6.22	15.23	5.01	5.04	4.14	2.82	6.32
HTTP UL Capacity Throughput - Average [Mbps]	Cell C	3.90	1.92	3.02	1.68	1.80	1.89	2.07	0.62	1.89	3.29	2.60	0.92	2.52	3.38	2.37
	MTN	4.87	1.78	2.41	1.93	1.79	1.83	2.32	0.11	1.54	3.52	2.67	0.48	1.22	3.83	2.33
	Telkom	1.96	1.90	3.51	1.88	2.98	2.63	1.06	4.36	3.16	0.71	1.98	4.65	3.07	2.96	2.55
	Vodacom	1.52	2.36	1.91	2.40	0.02	2.46	1.70	3.95	2.37	3.72	1.73	2.13	4.40	2.64	2.49
FTP DL Throughput - Average [Mbps]	Cell C	3.85	1.96	3.54	2.57	4.22	1.53	3.11	1.34	0.80	4.45	3.10	0.62	1.02	3.34	2.67
	MTN	4.32	3.47	5.14	4.46	4.46	1.98	3.43	1.29	1.62	5.71	3.71	1.38	1.48	4.26	3.53
	Telkom	1.66	3.50	5.74	5.19	5.24	3.90	1.68	5.59	4.09	1.81	1.90	5.79	4.13	4.45	3.83
	Vodacom	1.53	3.33	3.20	4.32		4.77	1.30	3.97	3.85	5.17	2.62	2.80	3.29	2.42	3.24
FTP UL Throughput - Average [Mbps]	Cell C	2.05	1.36	1.48	0.87	1.68	1.01	1.09	0.11	0.46	1.75	1.54	0.37	1.08	1.83	1.30
	MTN	2.13	1.56	1.54	1.62	2.19	0.99	1.01	0.25	0.94	1.90	1.19	0.35	0.89	2.13	1.42
	Telkom	0.96	1.13	1.77	1.11	1.60	1.23	0.48	1.78	1.26	0.35	1.04	2.37	1.59	1.39	1.27
	Vodacom	0.84	1.11	0.89	1.37		1.32	0.82	1.92	1.30	1.45	1.06	0.93	1.89	1.42	1.24

7.3.2. 3G Preferred Web Page Time

Table 25: 3G Preferred HTTPS web page time results

		Gomolo			Lusikisiki		Mvumelwano			Payne			Sibangweni			Grand Total
		King Sabatha Dalindyebo FET College	Sandi SS School Ntsundwane	St Barnabas Provincial Hospital	Bambisanani Hospital	Nkqubela Primary School	Little Flower Secondary School	Police Station Tina Falls	Qumbu Magistrates Court	Mqanduli Village Primary School	Qokolweni SS School	Upper Tabase JS School Magqongweni	Lutoli JS School	Nelson Mandela Academic Hospital	Ngangelizwe Police Station	
HTTPS Kepler [s]	**Cell C**	6.29	6.58	6.41	6.42	6.53	9.22	6.81	24.90	11.11	6.47	6.43	9.21	11.39	6.54	8.16
	MTN	6.31	7.53	6.30	6.21	6.15	6.95	6.68	13.98	11.36	6.10	6.57	7.40	6.56	6.26	7.11
	Telkom	7.42	6.47	6.08	6.25	6.26	6.26	7.57	6.22	6.67	6.92	6.60	6.19	6.36	7.39	6.64
	Vodacom	7.39	7.04	7.35	6.61		6.59	8.88	6.67	6.88	6.48	6.58	6.64	6.53	6.70	6.96
HTTPS Mobile Kepler [s]	**Cell C**	0.97	1.72	1.26	1.27	1.23	2.74	1.53	10.62	3.11	1.08	1.28	2.72	6.80	1.47	2.43
	MTN	1.13	1.99	1.20	1.24	1.19	1.82	1.80	11.18	3.10	1.09	1.55	4.28	2.11	1.54	2.13
	Telkom	1.35	1.41	0.92	0.95	0.90	1.00	2.26	0.82	1.19	1.24	1.19	0.86	1.08	0.94	1.16
	Vodacom	1.81	1.49	1.91	1.41		1.28	2.26	1.31	1.65	1.27	1.41	1.92	1.11	1.33	1.55
Google [s]	**Cell C**	2.72	3.66	2.95	4.82	3.16	8.23	5.36	8.91	7.56	2.62	3.10	9.38	5.00	3.30	4.25
	MTN	3.17	4.50	3.17	3.24	3.06	4.08	4.65	7.35	4.66	3.15	3.58	9.50	5.15	4.05	4.29
	Telkom	7.05	3.43	2.21	2.62	2.55	2.67	6.81	2.64	3.81	4.61	3.43	2.43	3.18	2.86	3.61
	Vodacom	7.55	4.77	4.53	3.06		2.94	8.23	3.06	3.98	2.82	4.76	3.64	3.73	5.75	4.57
MSN [s]	**Cell C**	2.50	3.20	3.02	2.94	3.46	4.19	3.06	7.95	9.77	2.92	3.34	7.37	6.77	2.74	4.00
	MTN	2.38	3.07	2.55	2.79	2.69	3.49	3.26	4.28	5.07	2.46	3.00	5.09	3.50	2.86	3.17
	Telkom	2.94	2.55	2.02	2.28	2.22	1.96	3.89	2.02	3.11	3.27	2.74	2.05	2.43	2.13	2.52
	Vodacom	3.16	2.39	2.88	2.25		2.16	5.50	2.07	5.58	2.06	2.86	3.54	2.87	2.96	3.04
News24 [s]	**Cell C**	5.21	5.32	5.66	5.54	5.81	6.70	6.42	12.92	11.27	5.05	5.51	8.40	6.30	5.36	6.02
	MTN	4.79	4.96	4.87	5.35	6.41	5.37	6.65		5.92	4.91	5.30	6.71	6.19	4.76	5.43
	Telkom	7.83	5.44	4.24	4.57	5.47	5.09	7.69	4.41	5.02	7.09	5.30	4.19	4.97	4.89	5.45
	Vodacom	6.86	5.74	5.97	5.28		4.42	8.24	5.27	6.70	5.55	5.81	4.92	5.36	5.77	5.85

7.3.3. 3G Preferred YouTube Results

Table 26: 3G Preferred YouTube Success ratio results

		Gomolo			Lusikisiki		Mvumelwano			Payne			Sibangweni			Grand Total
		King Sabatha Dalindyebo FET College	Sandi SS School Ntsundwane	St Barnabas Provincial Hospital	Bambisanani Hospital	Nkqubela Primary School	Little Flower Secondary School	Police Station Tina Falls	Qumbu Magistrates Court	Mqanduli Village Primary School	Qokolweni SS School	Upper Tabase JS School Magqongweni	Lutoli JS School	Nelson Mandela Academic Hospital	Ngangelizwe Police Station	
YouTube Success Ratio [%]	Cell C	100.00	100.00	100.00	100.00	100.00	100.00	100.00	33.33	100.00	100.00	100.00	25.00	100.00	100.00	94.90
	MTN	100.00	100.00	100.00	100.00	100.00	100.00	100.00	60.00	100.00	100.00	100.00	66.67	100.00	100.00	97.17
	Telkom	100.00	100.00	100.00	100.00	100.00	100.00	87.50	100.00	100.00	100.00	100.00	100.00	100.00	100.00	99.07
	Vodacom	100.00	88.89	100.00	100.00		87.50	87.50	100.00	100.00	100.00	100.00	100.00	100.00	100.00	92.59

Table 27: 3G Preferred YouTube MOS quality results

		Gomolo			Lusikisiki		Mvumelwano			Payne			Sibangweni			Grand Total
		King Sabatha Dalindyebo FET College	Sandi SS School Ntsundwane	St Barnabas Provincial Hospital	Bambisanani Hospital	Nkqubela Primary School	Little Flower Secondary School	Police Station Tina Falls	Qumbu Magistrates Court	Mqanduli Village Primary School	Qokolweni SS School	Upper Tabase JS School Magqongweni	Lutoli JS School	Nelson Mandela Academic Hospital	Ngangelizwe Police Station	
YouTube Quality MOS	Cell C	4.20	3.70	4.13	4.17	4.18	4.06	3.70	2.00	3.00	4.16	3.87	3.00	3.83	4.19	3.94
	MTN	4.20	3.94	4.20	4.10	4.08	4.04	4.20	3.62	3.87	4.19	4.19	3.70	3.81	4.14	4.06
	Telkom	3.70	4.13	4.20	4.20	4.20	4.19	4.04	4.20	4.20	3.97	3.99	4.20	4.20	4.20	4.11
	Vodacom	3.78	4.14	4.10	4.18		4.20	3.75	4.20	4.17	4.20	4.06	4.20	4.15	3.98	4.07

Table 28: 3G Preferred YouTube access time results

		Gomolo			Lusikisiki		Mvumelwano			Payne			Sibangweni			Grand Total
		King Sabatha Dalindyebo FET College	Sandi SS School Ntsundwane	St Barnabas Provincial Hospital	Bambisanani Hospital	Nkqubela Primary School	Little Flower Secondary School	Police Station Tina Falls	Qumbu Magistrates Court	Mqanduli Village Primary School	Qokolweni SS School	Upper Tabase JS School Magqongweni	Lutoli JS School	Nelson Mandela Academic Hospital	Ngangelizwe Police Station	
YouTube Access Time [s]	Cell C	6.78	16.12	8.87	9.20	7.10	12.87	13.48	25.55	20.73	8.86	12.87	28.74	14.28	9.09	11.69
	MTN	6.14	10.06	4.65	6.91	7.60	10.41	6.91	18.10	11.33	4.89	6.36	13.37	16.50	6.42	8.52
	Telkom	16.80	8.31	4.62	6.34	5.75	7.35	13.40	4.93	7.45	11.16	14.16	4.27	6.91	6.33	8.51
	Vodacom	17.78	7.76	10.50	6.05		5.79	20.38	5.23	7.65	4.67	10.26	10.15	8.59	12.81	9.99

Table 29: 3G Preferred YouTube Video resolution results

		Gomolo			Lusikisiki		Mvumelwano			Payne			Sibangweni			Grand Total
		King Sabatha Dalindyebo FET College	Sandi SS School Ntsundwane	St Barnabas Provincial Hospital	Bambisanani Hospital	Nkqubela Primary School	Little Flower Secondary School	Police Station Tina Falls	Qumbu Magistrates Court	Mqanduli Village Primary School	Qokolweni SS School	Upper Tabase JS School Magqongweni	Lutoli JS School	Nelson Mandela Academic Hospital	Ngangelizwe Police Station	
YouTube Average Resolution [pixels]	Cell C	1002.00	659.00	920.00	962.00	981.00	753.00	580.00		534.00	976.00	646.00	480.00	595.00	968.00	826.00
	MTN	1026.00	636.00	1026.00	696.00	688.00	799.00	1022.00	588.00	704.00	1013.00	1002.00	490.00	579.00	943.00	844.00
	Telkom	541.00	900.00	1022.00	1012.00	998.00	983.00	710.00	1026.00	999.00	646.00	726.00	1026.00	994.00	1020.00	905.00
	Vodacom	571.00	929.00	768.00	943.00		996.00	532.00	1007.00	951.00	1026.00	684.00	1007.00	912.00	686.00	845.00

7.3.4. 3G Preferred Ping/RTT Results

Table 30: 3G Preferred Ping Latency results

		Gomolo			Lusikisiki		Mvumelwano			Payne			Sibangweni			Grand Total
		King Sabatha Dalindyebo FET College	Sandi SS School Ntsundwane	St Barnabas Provincial Hospital	Bambisanani Hospital	Nkqubela Primary School	Little Flower Secondary School	Police Station Tina Falls	Qumbu Magistrates Court	Mqanduli Village Primary School	Qokolweni SS School	Upper Tabase JS School Magqongweni	Lutoli JS School	Nelson Mandela Academic Hospital	Ngangelizwe Police Station	
Google ICMP (32 bytes) Ping [ms]	**Cell C**	68	261	85	83	100	111	181	292	126	75	84	473	108	84	140
	MTN	128	63	66	47	207	142	304	205	382	47	163	100	145	47	135
	Telkom	84	360	59	154	42	78	202	64	405	387	76	126	133	351	184
	Vodacom	97	95	103	103	1230	92	92	90	99	91	297	118	90	92	125
Independent Server ICMP (32 bytes) Ping [ms]	**Cell C**	128	149	100	206	232	126	208	102	161	79	94	219	182	172	151
	MTN	95	68	71	249	77	251	412	423	118	50	122	614	86	52	155
	Telkom	83	86	59	54	45	75	118	63	65	83	80	57	70	72	73
	Vodacom	249	112	114	114	641	108	110	124	120	106	94	93	91	93	122

7.4. 4G Stationary Test Results

7.4.1. 4G Preferred Throughput

Table 31: 4G Preferred Throughput per stationary point

		Gomolo			Lusikisiki		Mvumelwano			Payne			Sibangweni			Grand Total
		King Sabatha Dalindyebo FET College	Sandi SS School Ntsundwane	St Barnabas Provincial Hospital	Bambisanani Hospital	Nkqubela Primary School	Little Flower Secondary School	Police Station Tina Falls	Qumbu Magistrates Court	Mqanduli Village Primary School	Qokolweni SS School	Upper Tabase JS School Magqongweni	Lutoli JS School	Nelson Mandela Academic Hospital	Ngangelizwe Police Station	
HTTP DL Throughput - Average [Mbps]	Cell C	0.63		2.54			5.13	3.00	0.55	2.99	0.37	0.59		0.51	0.44	2.14
	MTN	51.91	11.57	60.07	33.44	63.02	34.07	37.46	28.78	17.44	62.30	38.04	18.48	7.69	32.87	36.22
	Telkom	10.21	7.82	10.49	19.75	28.68	9.99	10.96	10.99	14.14	9.14	8.10	12.86	11.00	12.88	12.49
	Vodacom	17.79	12.96	27.09	41.19	2.10	19.04	10.05	14.96	8.02	21.45	10.32	41.03	44.32	17.98	21.94
HTTP UL Throughput - Average [Mbps]	Cell C	1.11	0.59	2.97	1.96	2.67	4.68	4.82	2.58	11.14	29.31	4.85	0.87	4.52	2.08	5.63
	MTN	38.43	2.42	37.00	11.40	26.76	18.11	16.39	13.02	12.63	36.30	12.84	2.05	16.40	30.29	20.16
	Telkom	10.72	2.17	7.43	3.98	17.70	10.95	1.30	15.31	4.69	2.20	0.25	10.73	12.08	10.32	8.21
	Vodacom	11.53	1.74	5.21	10.59		12.53	1.16	14.46	3.70	15.86		13.65	17.55	11.59	9.31
HTTP DL Capacity Throughput - Average [Mbps]	Cell C	0.90	0.62	6.68	0.65	0.65	4.60	5.37	0.80	1.09	1.11	1.32	0.79	0.65	1.19	2.32
	MTN	64.38	11.68	93.59	59.32	111.06	63.00	104.89	50.75	31.88	81.77	56.50	19.42	7.63	47.59	59.44
	Telkom	10.51	8.74	68.31	34.23	78.26	9.09	10.00	10.56	59.16	11.67	8.91	76.93	33.38	46.40	32.82
	Vodacom	18.19	10.90	27.51	56.44		17.45	10.33	22.46	10.12	29.04	5.13	127.24	54.21	27.23	30.27
HTTP UL Capacity Throughput - Average [Mbps]	Cell C	1.17	0.56	2.77	2.05	2.59	5.11	4.93	2.71	15.61	49.12	5.18	0.78	4.48	4.17	7.51
	MTN	46.92	2.36	47.28	18.08	40.73	36.85	55.39	18.05	15.88	41.02	16.86	2.20	20.41	31.32	29.77
	Telkom	9.94	2.63	18.58	5.32	15.69	9.32	2.79	10.85	13.24	3.45	0.42	17.92	11.26	11.20	9.64
	Vodacom	10.52	2.41	5.91	12.25		11.19	2.45	19.62	3.97	16.34	0.31	19.79	17.35	15.64	10.42
FTP DL Throughput - Average [Mbps]	Cell C	0.42		1.88			2.91	3.17	0.41	0.74	0.42	0.52	0.46	0.37	0.40	1.47
	MTN	11.83	5.36	11.57	4.53	10.79	7.05	7.33	7.94	10.37	11.60	7.67	9.08	5.44	10.34	8.63
	Telkom	6.64	5.93	7.99	10.92	16.09	6.24	6.61	6.92	8.32	6.24	3.48	8.26	6.72	8.13	7.76
	Vodacom	7.65	8.04	10.27	14.43	0.61	7.66	6.19	7.81	5.81	10.27	3.21	14.23	16.42	9.05	9.02
FTP UL Throughput - Average [Mbps]	Cell C	1.16	0.63	2.58	1.71	2.18	3.78	3.57	2.19	5.34	8.76	3.60	0.88	2.95	2.89	3.20
	MTN	13.24	2.38	14.07	8.38	8.89	6.52	6.47	5.66	7.29	13.24	6.10	2.04	9.71	12.16	8.46
	Telkom	5.77	1.46	4.63	3.11	9.74	6.02	1.13	7.55	3.72	1.60	0.22	5.91	4.40	5.45	4.47
	Vodacom	6.10	1.23	3.45	6.95		7.06	1.08	8.62	2.58	8.29		11.35	9.04	7.84	5.96

7.4.2. 4G Preferred Web Page Download Time

Table 32: 4G Preferred HTTPS Web page download time results

		Gomolo			Lusikisiki		Mvumelwano			Payne			Sibangweni			Grand Total
		King Sabatha Dalindyebo FET College	Sandi SS School Ntsundwane	St Barnabas Provincial Hospital	Bambisanani Hospital	Nkqubela Primary School	Little Flower Secondary School	Police Station Tina Falls	Qumbu Magistrates Court	Mqanduli Village Primary School	Qokolweni SS School	Upper Tabase JS School Magqongweni	Lutoli JS School	Nelson Mandela Academic Hospital	Ngangelizwe Police Station	
HTTPS Kepler [s]	**Cell C**	7.40	7.79	7.15	8.64	8.94	6.67	6.54	8.74	7.33	7.35	7.64	9.29	9.59	6.88	7.70
	MTN	6.17	6.10	6.10	6.61	6.15	6.55	6.60	6.61	6.06	6.14	6.20	6.36	5.97	6.18	6.29
	Telkom	6.03	6.51	6.07	6.29	6.35	6.20	6.17	6.37	6.34	6.28	6.70	6.47	6.11	6.48	6.28
	Vodacom	6.52	6.77	6.57	6.85		6.57	6.37	6.76	6.59	6.61	7.39	6.60	6.48	6.66	6.64
HTTPS Mobile Kepler [s]	**Cell C**	2.72	3.22	1.24	3.11	3.02	1.40	1.36	2.24	2.94	1.85	1.98	3.85	3.32	2.38	2.32
	MTN	0.64	0.82	0.64	0.66	0.86	1.28	1.43	1.29	0.62	0.70	1.10	0.71	0.78	0.73	0.90
	Telkom	0.73	0.91	0.82	0.66	0.69	0.87	0.77	0.71	0.83	0.80	2.17	0.75	0.79	0.75	0.83
	Vodacom	0.71	1.31	0.74	0.69		0.80	0.81	0.72	0.82	0.68	6.89	0.62	0.59	0.69	1.14
Google [s]	**Cell C**	9.74	9.01	3.01	4.53	4.25	3.45	2.81	8.15	3.18	3.10	3.41	6.44	9.30	4.96	5.01
	MTN	1.80	2.40	1.75	2.04	1.95	2.35	2.51	2.68	2.11	1.82	2.14	2.34	2.25	1.84	2.14
	Telkom	2.28	2.58	2.42	1.87	1.85	2.61	2.41	2.13	2.43	2.41	3.29	2.45	2.45	2.40	2.38
	Vodacom	2.04	2.26	1.81	1.74		2.27	2.21	1.87	2.43	1.88	2.58	1.84	1.80	2.04	2.05
MSN [s]	**Cell C**	6.79	9.99	5.36	6.54	8.55	3.63	5.22	10.05	11.02	11.56	10.25	7.10	11.56	5.46	7.15
	MTN	2.23	2.43	2.10	2.31	2.15	2.66	2.44	2.36	3.16	2.03	2.45	2.19	2.92	2.02	2.40
	Telkom	2.14	2.31	2.12	2.03	1.73	2.06	2.02	1.77	2.61	1.92	2.01	1.79	1.98	1.83	2.02
	Vodacom	1.81	2.09	1.84	1.84		1.90	1.74	1.86	2.74	1.84	2.80	1.79	2.19	2.09	2.02
News24 [s]	**Cell C**	7.61	8.10	6.01	8.83	9.50	5.48	5.21	9.76	5.51	7.66	6.65	9.66	10.90	7.00	7.16
	MTN	3.78	4.74	3.85	4.30	5.05	5.07	4.94	5.02	4.25	4.63	4.92	4.18	4.20	3.82	4.49
	Telkom	4.28	5.63	4.22	3.86	3.57	4.70	4.08	3.81	4.00	4.17	5.70	3.55	4.05	4.08	4.22
	Vodacom	4.03	5.09	3.79	4.28		3.86	4.19	3.77	5.42	4.36	6.68	3.68	3.63	3.83	4.26

7.4.3. 4G Preferred YouTube Results

Table 33: 4G Preferred YouTube Success Ratio Results

		Gomolo			Lusikisiki		Mvumelwano			Payne			Sibangweni			Grand Total
		King Sabatha Dalindyebo FET College	Sandi SS School Ntsundwane	St Barnabas Provincial Hospital	Bambisanani Hospital	Nkqubela Primary School	Little Flower Secondary School	Police Station Tina Falls	Qumbu Magistrates Court	Mqanduli Village Primary School	Qokolweni SS School	Upper Tabase JS School Magqongweni	Lutoli JS School	Nelson Mandela Academic Hospital	Ngangelizwe Police Station	
YouTube Success Ratio [%]	Cell C	75.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	80.00	50.00	100.00	95.00
	MTN	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	Telkom	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	60.00	100.00	100.00	100.00	97.70
	Vodacom	100.00	100.00	100.00	100.00		100.00	100.00	100.00	100.00	100.00	60.00	100.00	100.00	100.00	90.91

Table 34: 4G Preferred YouTube MOS quality results

		Gomolo			Lusikisiki		Mvumelwano			Payne			Sibangweni			Grand Total
		King Sabatha Dalindyebo FET College	Sandi SS School Ntsundwane	St Barnabas Provincial Hospital	Bambisanani Hospital	Nkqubela Primary School	Little Flower Secondary School	Police Station Tina Falls	Qumbu Magistrates Court	Mqanduli Village Primary School	Qokolweni SS School	Upper Tabase JS School Magqongweni	Lutoli JS School	Nelson Mandela Academic Hospital	Ngangelizwe Police Station	
YouTube Quality MOS	Cell C	3.45	3.38	4.20	3.82	3.48	4.11	4.15	3.82	4.08	4.07	4.20	3.50	3.60	3.97	3.91
	MTN	4.20	4.20	3.99	4.20	4.18	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.15	4.20	4.18
	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	4.20	4.20	4.20
	Vodacom	4.20	4.20	4.20	4.20		4.20	4.20	4.20	4.20	4.20	4.17	4.20	4.20	4.20	4.20

Table 35: 4G Preferred YouTube Access time results

	Gomolo	Lusikisiki	Mvumelwano	Payne	Sibangweni	

		King Sabatha Dalindyebo FET College	Sandi SS School Ntsundwane	St Barnabas Provincial Hospital	Bambisanani Hospital	Nkqubela Primary School	Little Flower Secondary School	Police Station Tina Falls	Qumbu Magistrates Court	Mqanduli Village Primary School	Qokolweni SS School	Upper Tabase JS School Magqongweni	Lutoli JS School	Nelson Mandela Academic Hospital	Ngangelizwe Police Station	Grand Total
YouTube Access Time [s]	Cell C	28.74	21.96	7.02	10.05	9.42	9.21	5.34	24.25	10.64	7.08	7.14	24.98	26.49	10.80	12.80
	MTN	3.18	5.97	3.74	4.90	4.17	4.53	4.87	5.18	3.81	3.47	4.31	4.50	7.46	3.73	4.53
	Telkom	4.43	6.70	5.47	3.87	3.59	5.92	5.18	4.14	4.19	5.65	7.62	4.86	4.61	4.62	5.01
	Vodacom	4.69	6.45	4.02	3.53		4.28	5.26	4.08	5.90	4.03	6.71	3.25	3.44	3.90	4.48

Table 36: 4G Preferred YouTube video resolution results

		Gomolo			Lusikisiki		Mvumelwano			Payne			Sibangweni			Grand Total
		King Sabatha Dalindyebo FET College	Sandi SS School Ntsundwane	St Barnabas Provincial Hospital	Bambisanani Hospital	Nkqubela Primary School	Little Flower Secondary School	Police Station Tina Falls	Qumbu Magistrates Court	Mqanduli Village Primary School	Qokolweni SS School	Upper Tabase JS School Magqongweni	Lutoli JS School	Nelson Mandela Academic Hospital	Ngangelizwe Police Station	
YouTube Average Resolution [pixels]	Cell C	428.00	420.00	994.00	560.00	459.00	927.00	962.00	585.00	905.00	795.00	991.00	504.00	529.00	632.00	757.00
	MTN	1026.00	1015.00	1026.00	1017.00	1005.00	1026.00	1026.00	1008.00	1026.00	1017.00	1026.00	1026.00	913.00	1026.00	1014.00
	Telkom	1026.00	1000.00	1026.00	1008.00	1026.00	1008.00	1022.00	1026.00	1026.00	1026.00	994.00	1026.00	1026.00	1015.00	1019.00
	Vodacom	1021.00	996.00	1026.00	1026.00		1019.00	1022.00	1021.00	994.00	1008.00	958.00	1026.00	1026.00	1026.00	1016.00

7.4.4. 4G Preferred Ping/RTT Results

Table 37: 4G Preferred Ping Latency results per area

		Gomolo			Lusikisiki		Mvumelwano			Payne			Sibangweni			Grand Total
		King Sabatha Dalindyebo FET College	Sandi SS School Ntsundwane	St Barnabas Provincial Hospital	Bambisanani Hospital	Nkqubela Primary School	Little Flower Secondary School	Police Station Tina Falls	Qumbu Magistrates Court	Mqanduli Village Primary School	Qokolweni SS School	Upper Tabase JS School Magqongweni	Lutoli JS School	Nelson Mandela Academic Hospital	Ngangelizwe Police Station	
Google ICMP (32 bytes) Ping [ms]	**Cell C**	54	69	75	64	81	84	85	83	57	49	71	92	73	75	73
	MTN	36	48	34	42	37	115	117	115	33	33	95	42	35	32	62
	Telkom	61	293	71	34	30	75	62	60	60	57	165	52	101	58	79
	Vodacom	47	93	42	39		47	49	37	48	42	59	37	38	46	47
Independent Server ICMP (32 bytes) Ping [ms]	**Cell C**	64	90	77	69	89	94	89	89	60	55	81	97	79	79	80
	MTN	48	50	42	47	44	125	122	123	45	41	102	51	42	40	69
	Telkom	64	73	56	34	31	76	63	59	50	54	76	49	107	60	61
	Vodacom	60	89	60	63		66	69	57	64	58	50	39	39	47	59

8. Appendix 2 – RF Measurements

8.1.1. 3G Preferred Map Plots

8.1.1.1. Data Technology

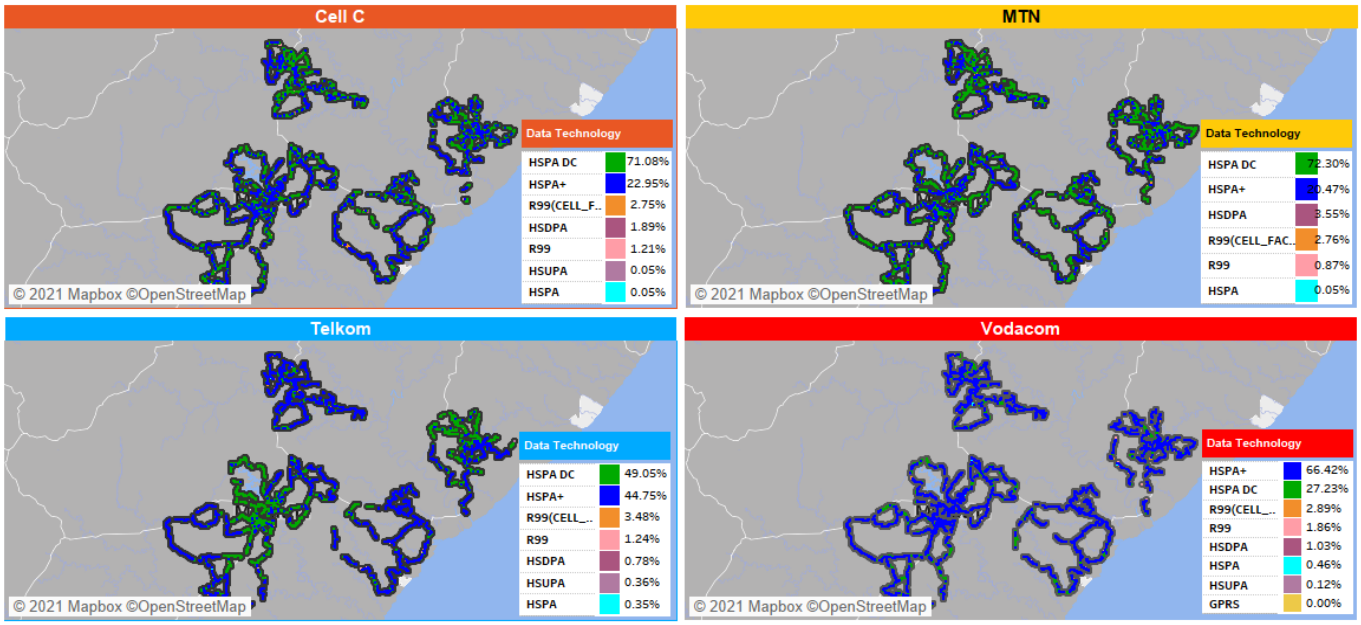


Figure 76. 3G Preferred Data Technology Map

8.1.1.2. RSCP

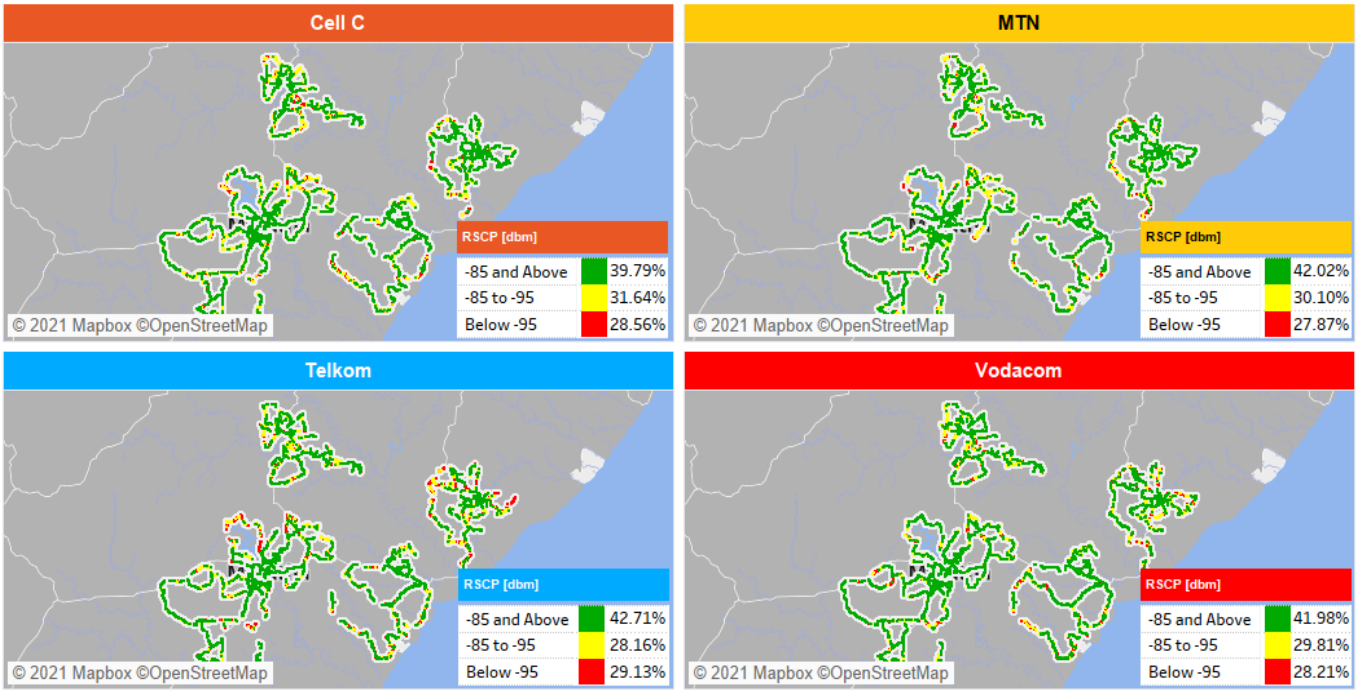


Figure 77. 3G Preferred RSCP

8.1.1.3. Eclo

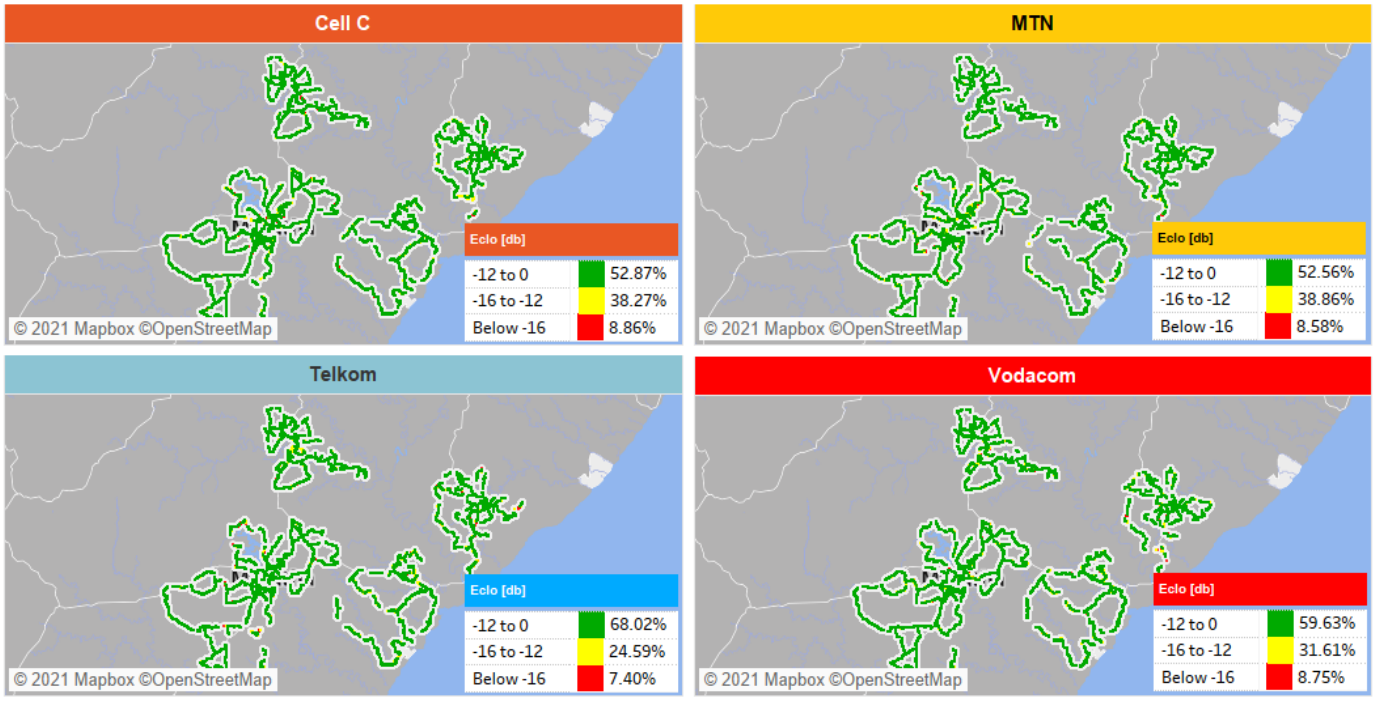


Figure 78. 3G Preferred Eclo

8.1.2. 4G Preferred Map Plots

8.1.2.1. Data Technology

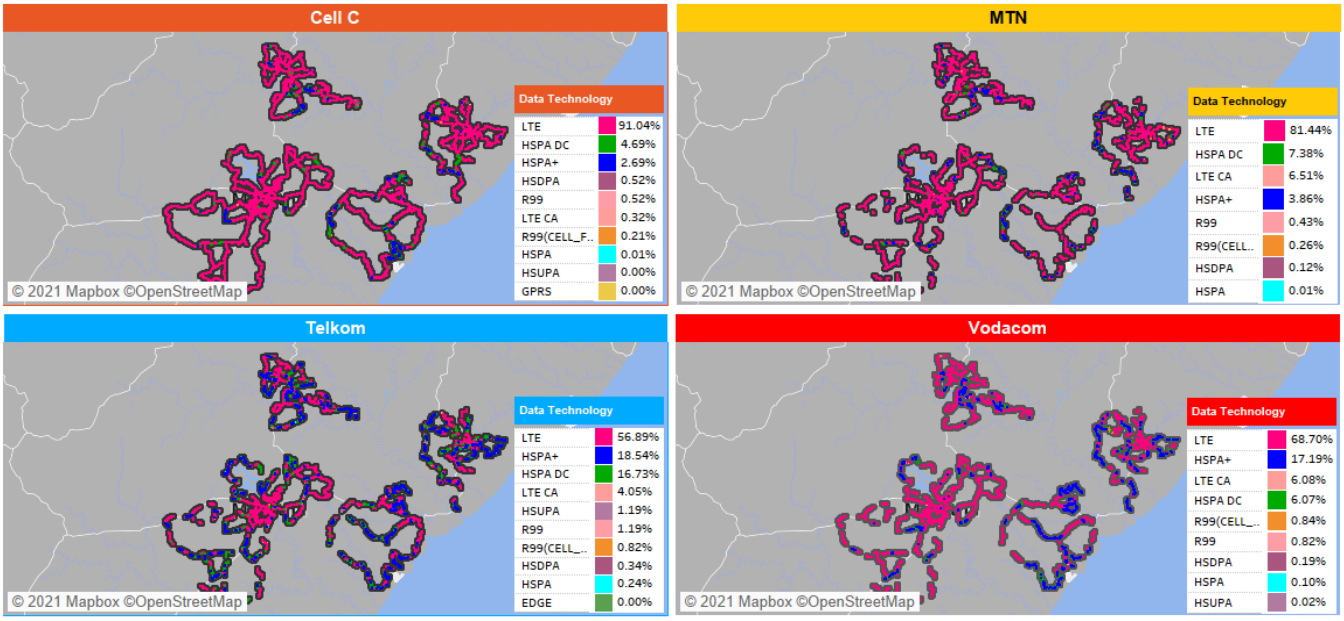


Figure 79. 4G Preferred Data Technology

8.1.2.2. RSRP

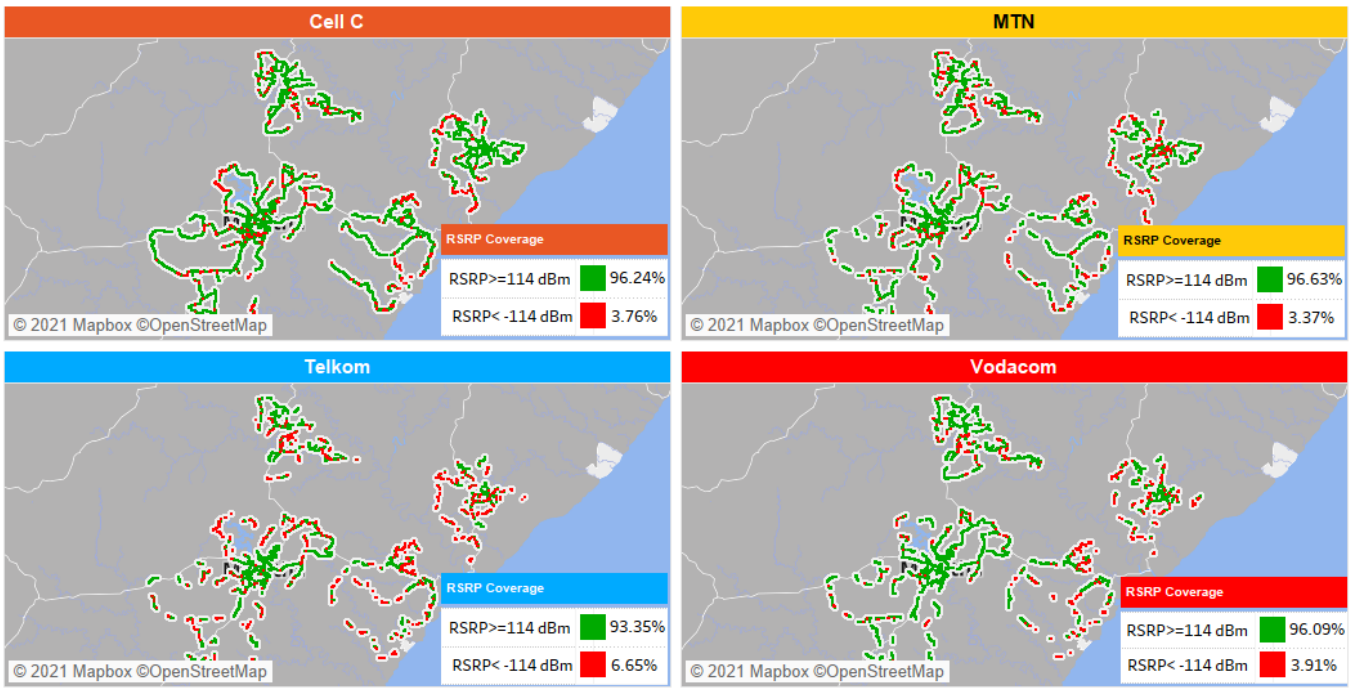


Figure 80. 4G Preferred LTE RSRP

8.1.2.3. SINR

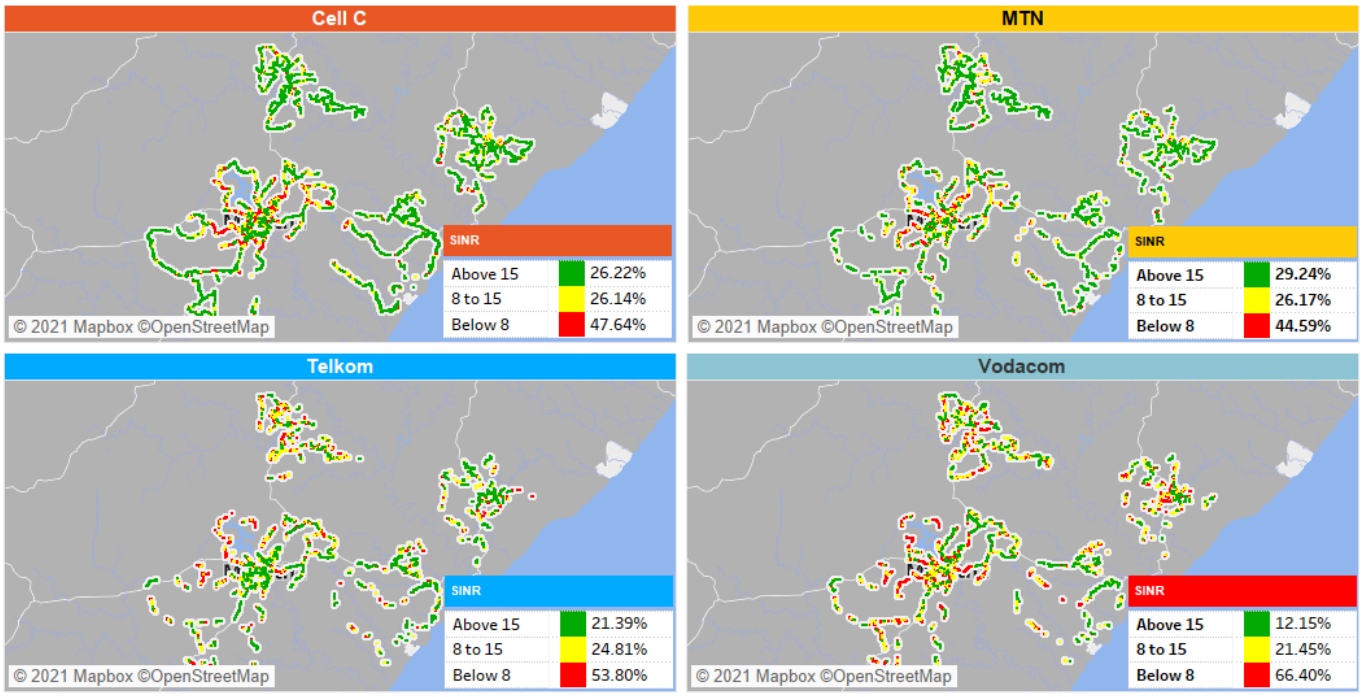


Figure 81. 4G Preferred LTE SINR

9. Appendix 3 – Statistical Counts

8.1 3G Preferred Mobile Data Drive Test Samples Count

		Cell C	MTN	Telkom	Vodacom
File Transfer	HTTP Download	315	327	324	308
	HTTP Upload	321	329	323	325
	HTTP Capacity Download	311	321	321	311
	HTTP Capacity Upload	321	324	324	332
	FTP Download	282	305	313	312
	FTP Upload	316	325	331	317
HTTPS Browser	Google	241	292	272	271
	HTTPs Kepler	308	324	314	309
	HTTPs Mobile Kepler	326	332	328	331
	MSN	277	307	299	295
	News24	232	289	275	261
Latency	Google ICMP Ping	1,612	1,675	1,622	1,637
	Independent Server ICMP Ping	1,418	1,389	1,531	1,585
YT	YouTube	291	324	323	328

Figure 82. Statistical Count - 3G Preferred Mobile Data Test

8.2. 4G Preferred Mobile Data Drive Test Samples Count

		Cell C	MTN	Telkom	Vodacom
File Transfer	HTTP Download	211	328	300	315
	HTTP Upload	288	323	307	274
	HTTP Capacity Download	214	327	308	311
	HTTP Capacity Upload	293	325	302	314
	FTP Download	284	324	296	307
	FTP Upload	286	321	298	308
HTTPS Browser	Google	254	321	257	303
	HTTPs Kepler	284	325	276	304
	HTTPs Mobile Kepler	288	329	283	312
	MSN	236	327	273	311
	News24	249	324	262	300
Latency	Google ICMP Ping	1,376	1,643	1,512	1,559
	Independent Server ICMP Ping	1,265	1,526	1,487	1,518
YT	YouTube	287	327	323	322

Figure 83. Statistical Count - 4G Preferred Mobile Data