هيئة تنظيم الاتصالات
Telecommunications Regulatory Authority
Kingdom of Bahrain – مملكة البحرين

SOFRECOM

WiMAX network Coverage and QoS audit

Telecommunications Regulatory Authority

Kingdom of Bahrain

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The Know-How Network

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This report is published in accordance with Articles 3 (b) (1), 3 (c) (2), 3 (c) (4) and article 54 of the Telecommunications Law.

The purpose of the audit is to evaluate that WiMAX operators, Menatelecom and Zain, meet their respective License coverage obligations and report observed quality levels offered by the two WiMAX operators in the Kingdom of Bahrain. The independent audit was conducted by SOFRECOM.

Contents

1. EXECUTIVE SUMMARY

1.1. Introduction

WiMAX operators are under a coverage obligation as a condition of their service license, and it is the responsibility of the Authority to check and confirm that each operator is meeting its obligation.

The license obligation requires operators to, using their own WiMAX network, offer licensed services on or before a defined target date with coverage of at least 95% of the population in the Kingdom of Bahrain.

The respective deadlines for operators to meet their coverage obligation were as follows:

- Menatelecom: 8 January 2009
- Zain : 8 January 2009

This audit was conducted from 28th February 2013 to 1st April 2013 inclusive. All service tests and coverage evaluation were performed between 8:00 am and 07:00 pm, every day except weekends (Fridays & Saturdays).

The authority has selected SOFRECOM, an international consulting company (France Telecom-Orange Group subsidiary), to conduct the assessment using a test method designed to gather a faithful qualitative record from an end users' point of view, avoiding assessing quality through a pure technical angle as this can be performed by WiMAX Operators themselves.

Measurements were done in two phases:

- Coverage evaluation:
  - Measurement of signal levels
- QoS measurements for Data and voice:
  - Latency
  - FTP Download and Upload
  - Web browsing
  - Voice

The QoS tests are not intended to benchmark operators; rather they intend to provide valuable insight on the operator's performance during the period under test.

Finally, without WiMAX Operators' cooperation during measurements review and validation, this report would not have been possible.

1.2. Coverage evaluation

The objective of coverage evaluation was to confirm if the license coverage obligations were met for both WiMAX operators, Menatelecom and Zain.

License coverage requirements are to provide WiMAX coverage of at least 95% of the population in the licensed area.

The table below provides a summary of the population coverage results for each operator:

	Zain	Menatelecom
Population coverage	96.8%	99.5%

Table 1 : Menatelecom and Zain population coverage

Both WiMAX operators, Menatelecom and Zain, meet their license coverage obligation

Detailed coverage results for each operator are available in section 3 of this report.

1.3. Quality of Service evaluation

Quality of service (QoS) evaluation was performed on static points chosen randomly by the test team following a pre-defined route (defined as 'Random' in the report) and a set of locations provided by each operator (defined as 'Hotspots' in the report).

This section provides combined QoS results of Menatelecom and Zain.

Detailed QoS results for each operator are available in section 4 of this report.

1.3.1. Latency results

Network latency (Ping test) was measured by sending an Internet Control Message Protocol (ICMP) echo request to the specified test server. The measurements consist in measuring the average Round Trip Time (RTT) of 32 Kbytes IP packets - during 10 seconds to a server located on each operator's network.

	Random	Hotspots	Global
Number of test samples	901	98	999
Average Latency in milliseconds	75.0	67.6	74.3
Rate of successful PING within 100ms	95.1%	100.0%	95.6%

Table 2: Combined latency results

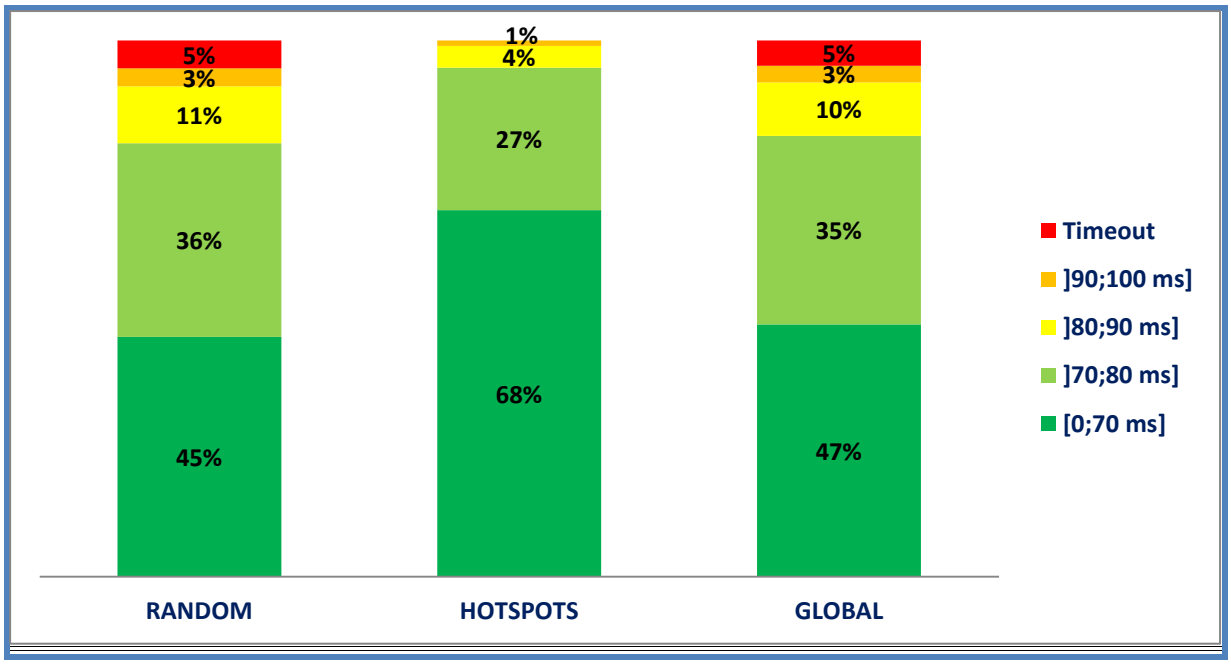


Figure 1: Combined latency results

Both operators provide good latency performance for the technology in most parts of the Kingdom.

1.3.2. FTP Download and Upload results

File Transfer Protocol (FTP) is a protocol used for downloading and uploading files over the Internet.

For this audit, a FTP server located on each operator's network was used.

		Random	Hotspots	Global
Number of test samples		1104	119	1223
FTP transfer time in seconds	Downlink	20.7	22.5	20.9
	Uplink	14.1	12.9	14.0
Average throughput (Mbps)	Downlink	5.8	5.7	5.8
	Uplink	0.7	0.7	0.7

Table 3: Combined FTP Download and Upload results

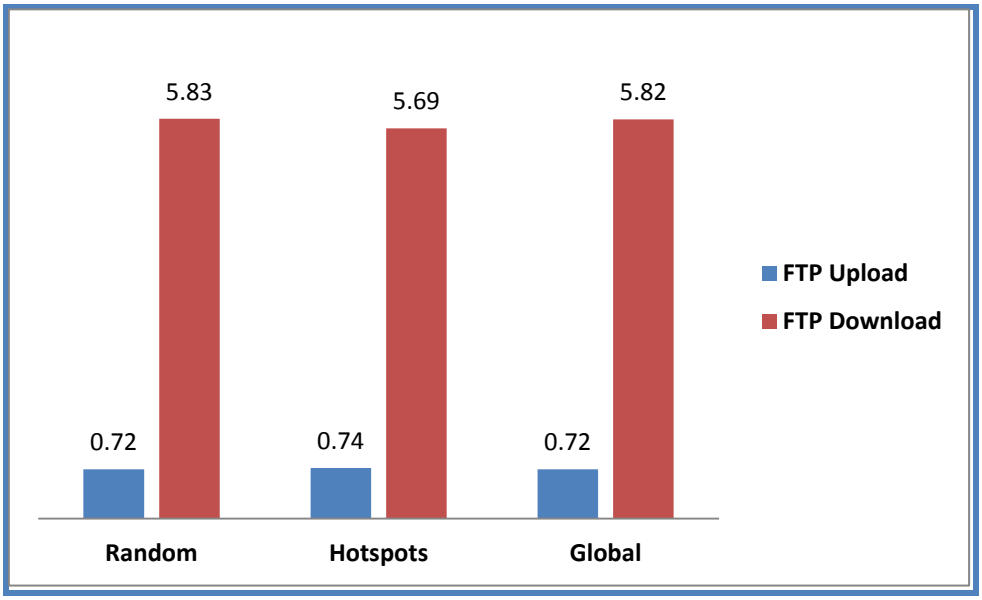


Figure 2: FTP Download and Upload combined results

Both operators achieved a fair performance for Download and poor performance for Upload.

1.3.3. Web browsing results

In this audit, the capability of both operators to connect to the Internet from any location in the Kingdom was assessed, while evaluating download time of web pages.

	Random	Hotspots	Global
Number of test samples	5138	592	5730
Web page Download time (s)	5.3	4.3	5.2

Table 4: Combined web browsing results

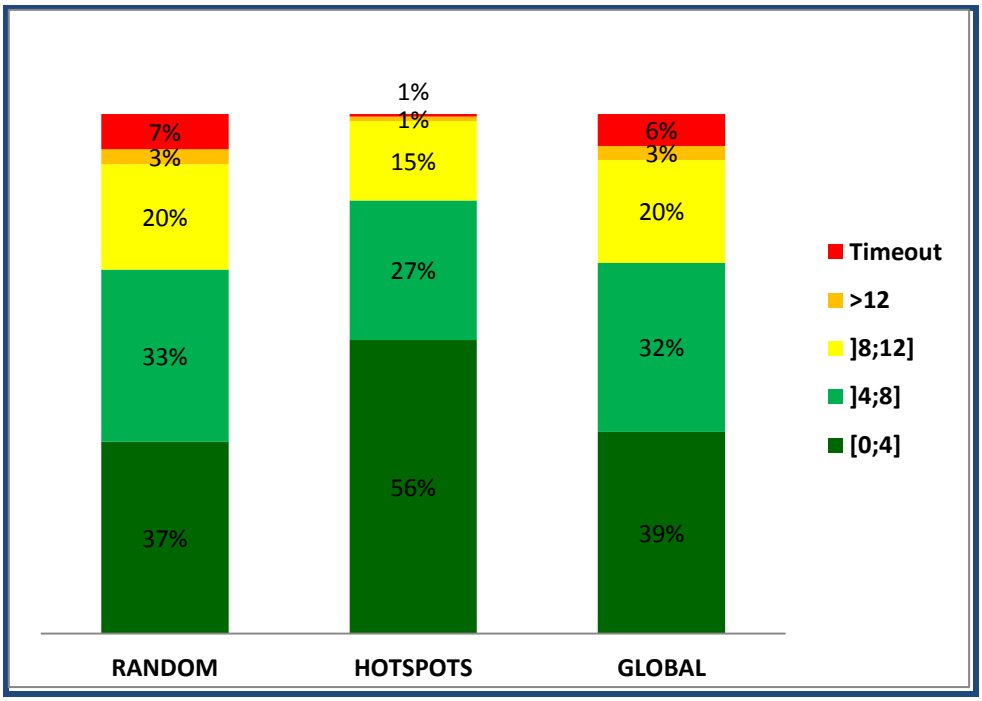


Figure 3: Combined Web browsing time download distribution

1.3.4. Voice results

In this audit, voice quality was evaluated from any location in the Kingdom.

	Random	Hotspots	Global
Number of test samples	1020	112	1132
Rate of calls with perfect voice quality	78.4%	71.4%	77.7%
Rate of calls with perfect or Fair voice quality	95.5%	97.3%	95.7%

Table 5: Combined voice test results

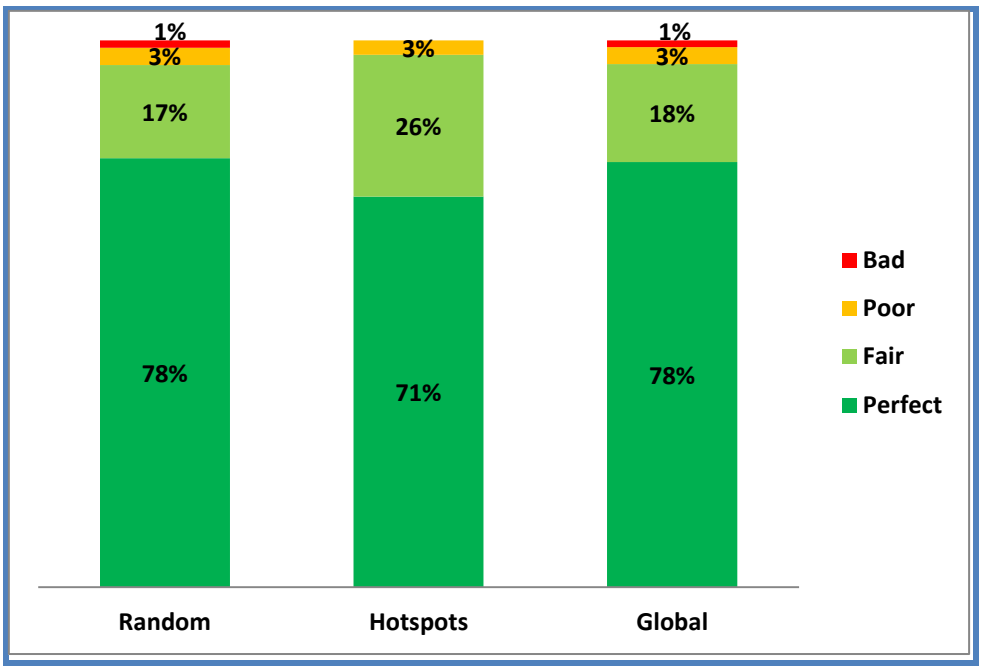


Figure 4: Combined Voice performance distribution

Detailed results for each operator are available in section 4 of this report.

2. MEASUREMENTS SPECIFICATION

2.1. Reader's advice

For a proper understanding of this report, readers are advised to take into account the following key elements:

- The Telecommunications Regulatory Authority (TRA) has authority to audit the Quality of Service (QoS) provided by the two WiMAX operators in the Kingdom of Bahrain with a view to protect the best interests of the consumers of WiMAX services.

- The audit was conducted on random locations, to assess the quality of the WiMAX services as experienced by an end user. It should be noted that there are several variables that affect the results obtained, and these results do not attempt to provide an overall view of the network. The objective of these tests was to check the level of signal and evaluating QoS experienced by a user using internet on the selected route at a random date and time.

- **Since mobility is not supported by both networks, QoS tests have been performed in static mode. Due to Customer Premise Equipment (CPE) interworking characteristics with WiMAX networks, the methodology used could not guaranty that the CPE was connected to the best serving cell during a measurement[1]. As a consequence QoS has been assessed in an equivalent but least favorable manner for both WiMAX operators.**

- WiMAX Operators are continuously performing modifications and upgrades. Performance at the time of reading the report may be different.

- The results have been rounded up or down to the nearest tenth of a unit. It is reminded that:
  - Sum of two rounded results can be different from the rounding of their sum.
  - Multiplying one rounded result by another is different than rounding the result of their multiplication.

Other mathematical formulas used in the report are:

- **Maximum** show the best results (such as delay, throughput) obtained during successful measurements.
- **Average** is always the arithmetic mean value of the referred samples.

[1] This could potentially lead to degraded radio frequency conditions for the service with a potential impact on the measured quality compared with an optimum radio link at the same location.

2.2. Measuring equipments

This section presents the equipment used by SOFRECOM to perform coverage evaluation and QoS measurements for data and voice.

2.2.1. WiMAX scanner

WiMAX scanner DRT 4301A was used. It provides the telecommunications industry with miniature receiver measurement capability to test and monitor wireless signals.

Figure 5: WiMAX scanner

Manufacturer	NEMO technologies
Model	DRT4301A+412033-00
Description	WiMAX scanner DRT 4301A+ 2300/2500/3500
Band coverage	2300 - 2400 MHz 2496 - 2690 MHz 3300 - 3800 MHz 5150 - 5825 MHz
Amplitude accuracy	100 dBm to -25 dBm ± 1dB* 110 dBm to -100 dBm ± 2dB* * Measurement Bandwidth = 250 kHz
Antenna gain	3 dBi
Cable losses	3 dB

Table 6: Scanner technical specifications

The scanner was used to continuously record downlink signal received, measured in terms of Received Signal Strength Indication (RSSI).

2.2.2. Antenna

A magnetic ultra-wideband cellular antenna GA110 was used, delivering stable high omni-directional gain.

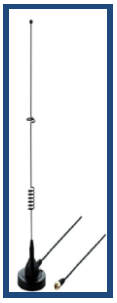


Figure 6: Antenna

Model	GA.110.101111
Description	2G/3G/4G High Gain Magnetic Mount Ultra-wideband Antenna 2300/2500/3500
Feature	Band: 700 MHz to 3,5 GHz RG174 Cable, SMA(M) Connector Typical 40% Efficiency and 3dBi Peak Gain Robust High Strength Super Magnet Mount
Cable length	1,5m

Table 7: Antenna technical specifications

2.2.3. Test packages

To ensure a fair test environment, both WiMAX operators were asked to provide two Customer Premise Equipments supporting their best commercial offer.

WiMAX compliance	IEEE 802.16e mobile WiMAX
Maximum nominal Transmission Power	Maximum nominal Tx power at the antenna connector: 26dBm
Transmitter Power Control	Transmit power control by step of 1dB, relative accuracy of +/-0,5 dB
Cumulated Noise Figure and Implementation Loss of the Receiver	Lower than 6,4 dB

Table 8: CPE technical specifications

The table below details the test packages provided by Menatelecom and Zain.

Operators	Test packages
Menatelecom	MenaHome Boost 18 Mb/s BD 70 offer unlimited download up to 18 Mb/s
Zain	Value 4 plan BD 35 offer unlimited download up to 4 Mb/s

Table 9: WiMAX test packages

2.2.4. NEMO OUTDOOR

NEMO outdoor is a drive test tool for measuring and monitoring wireless networks. Nemo Outdoor was used to collect continuously Received Signal Strength Indication (RSSI) levels. The setup includes a GPS receiver which records the exact location of each test. Results can be viewed in table, graph and map format with NEMO analyser.

Figure 7: NEMO outdoor laptop

2.3. Coverage evaluation methodology

Coverage evaluation measured downlink RSSI levels based on a threshold defined taking into account each operator's network architecture and CPE specifications.

Population coverage is then calculated by weighting these results with the population percentage in each governorate, using available Central Informatics Organisation (CIO) census statistics for the Kingdom. (See section 2.3.2 and 2.3.3 for more details).

Both operators were audited at the same time in dynamic mode over the most representative populated areas. For South Governorate, only main populated areas were evaluated (because of limited number of built areas). For other governorates, measurements were performed over all main streets and secondary roads.

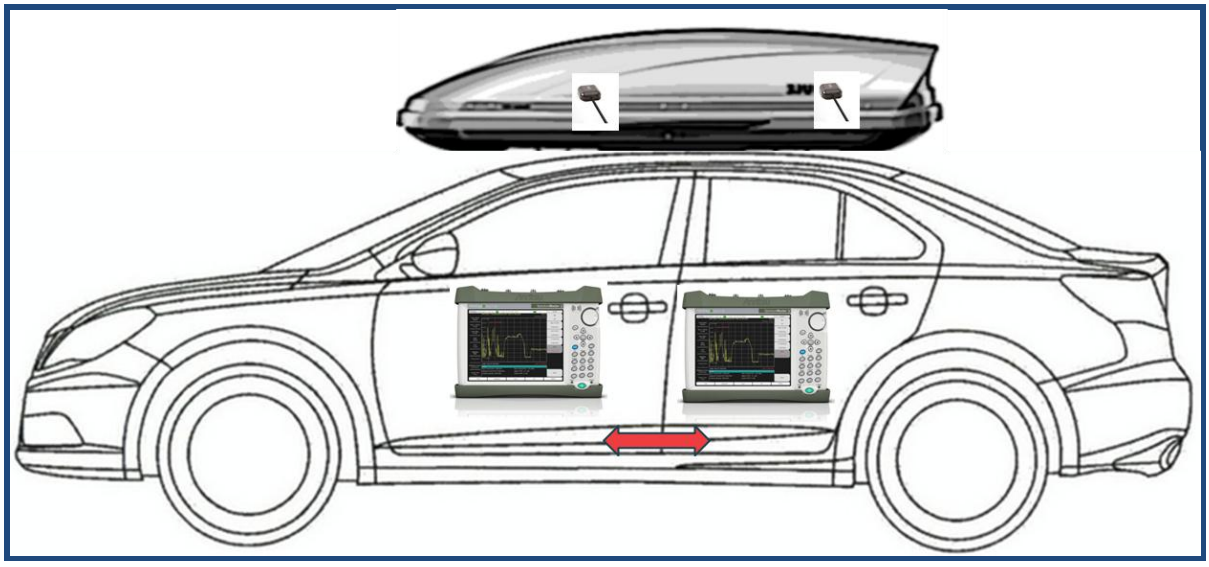


Figure 8: Rooftop box and laptops installed in the car

The vehicle was equipped with a WiMAX scanner, magnetic antenna, GPS receiver and NEMO outdoor tool to record log files.

2.3.1. Downlink RSSI threshold

Menatelecom coverage evaluation was based on Downlink RSSI level equal to -85 dBm.

Zain provides an outdoor CPE for areas with lower signal[2], therefore coverage evaluation, was based on Downlink RSSI threshold equal to -92 dBm.

Operators	Downlink RSSI threshold
Menatelecom	-85 dBm
Zain	-92 dBm

Table 10: Downlink RSSI thresholds

2.3.2. Geographical coverage formula

Percentage coverage per governorate is the geographical coverage rate. It is the percentage of samples where Downlink RSSI is higher than Downlink RSSI threshold.

$$Governorate\_CoverageRate = \frac{Samples\_(DL\_RSSI_{RSSI \geq RSSI\_Threshold})}{Total\_Valid\_Samples\_DL\_RSSI}$$

2.3.3. Population coverage formula

Population coverage is calculated by weighting these results with the population percentage in each governorate, using latest available Central Informatics Organisation (CIO) census statistics for the Kingdom.

$$Global\_CoverageRate = \sum_{Governorate} \frac{Population_{Governorate}}{Total\_Population} \times \frac{Samples\_(DL\_RSSI_{RSSI \geq RSSI\_Threshold})}{Total\_Valid\_Samples\_DL\_RSSI}$$

[2] The threshold for Zain was set taking into account the estimated 7 dB gain resulting of the use of an outdoor CPE combined with an external antenna.

2.4. QoS evaluation methodology

The objective was to assess the level of quality delivered by Menatelecom and Zain for a defined set of services.

All measurements were performed in static mode following two configurations:

- 608 points chosen randomly by the test team. These points are named 'Random' in the report.
- 12 locations provided by the each WiMAX operator. These points are named 'Hotspots' in the report.

Quality of the following services was audited:

- Latency: Round Trip Time of 32KB packets during 10 seconds
- File Transfer Protocol Download (FTP Downlink): 10MB file
- File Transfer Protocol Upload (FTP Uplink) : 1MB file
- Voice: manual call during 60 seconds
- Web browsing: 5 webpage download
    - www.yahoo.fr
    - www.linkedin.com
    - www.mediafire.com
    - www.conduit.com
    - www.bh.zain.com (for Zain) and www.menatelecom.com (for Menatelecom)

Data and voice QoS sequence in each static measurement point:

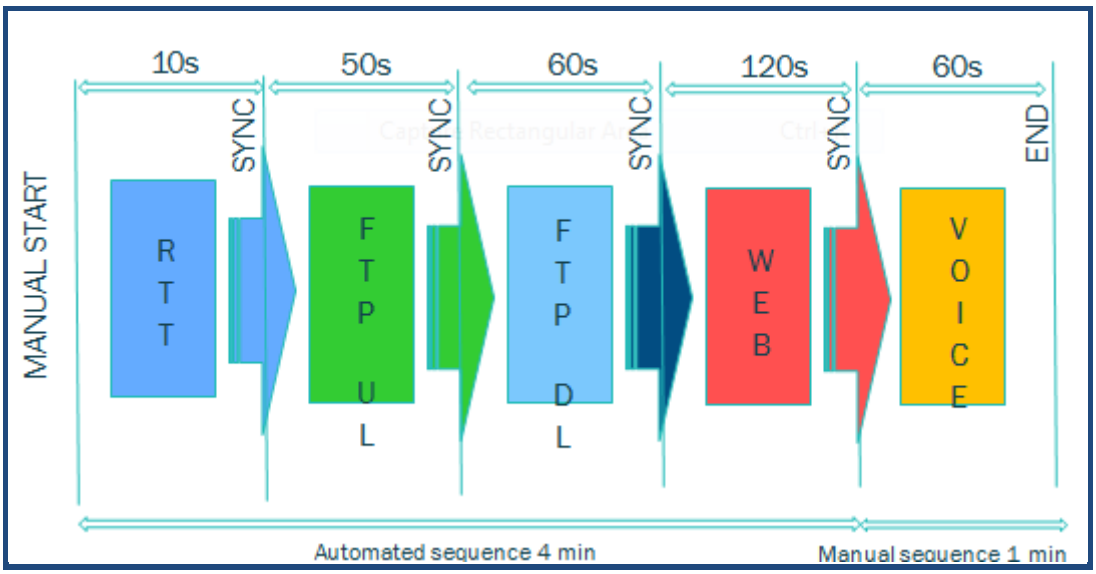


Figure 9: Data and voice testing sequence

Voice tests have been performed manually; data tests have been performed automatically by scrip running on a laptop.

For each service a time out was defined as shown in the following table.

Services	Timeout
Latency	1s
FTP Downlink	60s
FTP Uplink	50s
Web browsing	20s for each page
Voice	60s

Table 11: Test service Timeout

2.4.1. Data QoS measurements

Test vehicle was equipped with 2 PC connected to 2 CPE, one for each operator. Measurement log files have been locally saved.

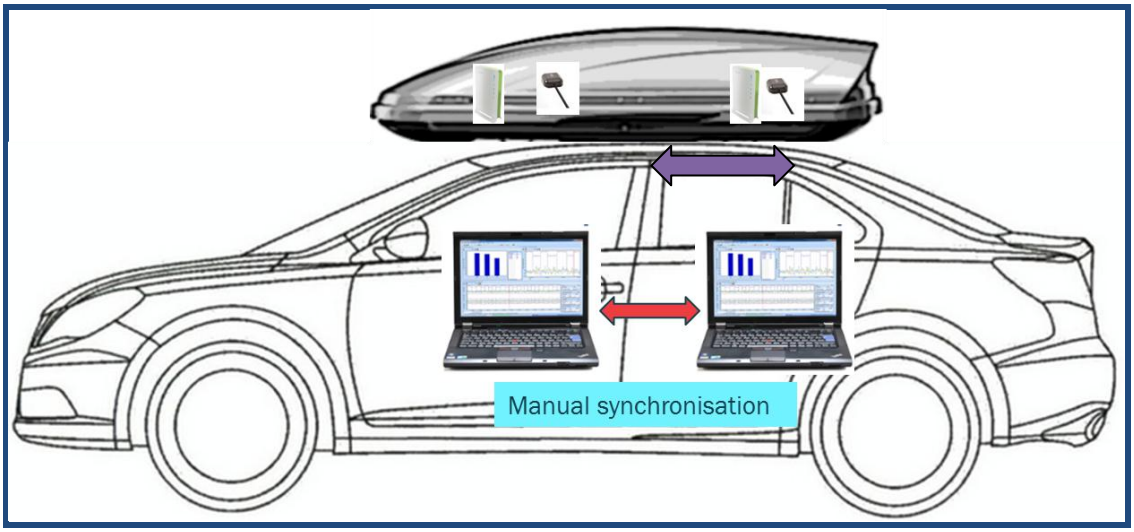


Figure 10: Rooftop box and laptops installed in the car

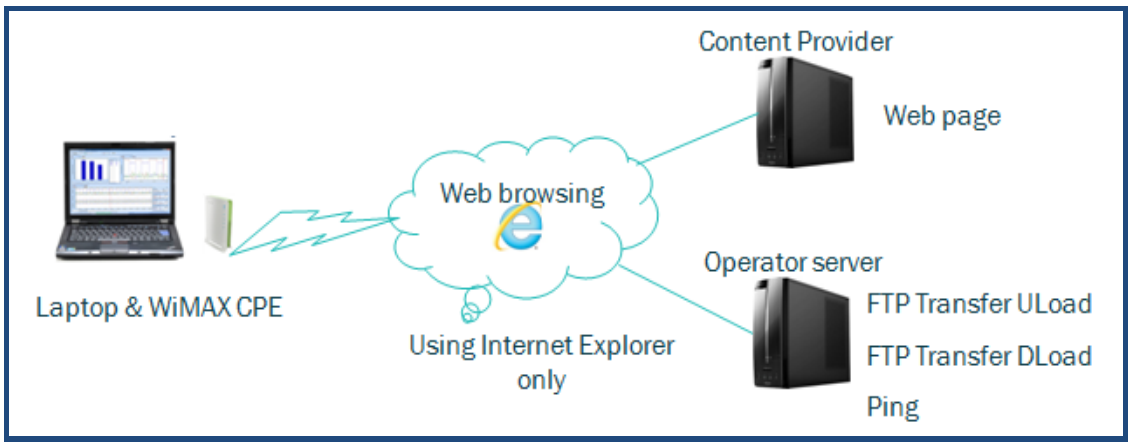


Figure 11: Data tests schematic overview

2.4.2. Voice QoS measurements

For voice service measurements, an analogic phone and an answering machine were used. The phone was plugged into RJ11 port of the CPE and the call was made on the answering machine for 60 seconds.

Figure 12 gives a schematic overview of the end-to-end measurement chain for voice.

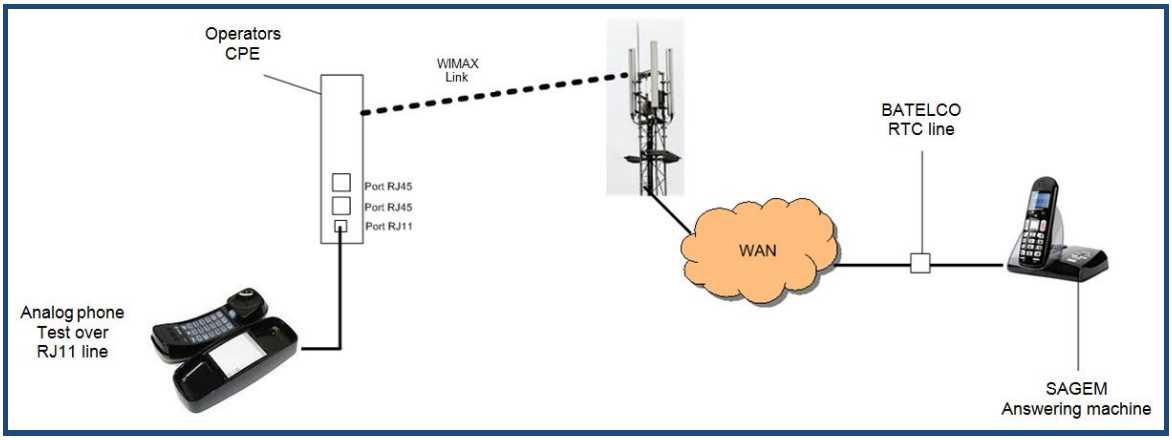


Figure 12: Schematic view of end-to-end voice tests

Once a call was established, quality of voice was evaluated according to the following criteria:

Perfect	No defect
Fair	One defect occurs while the conversation goes on uninterrupted
Poor	The natural flow of the conversation is altered
Bad	The defect is so strong that conversation cannot proceed.

Table 12: Voice test criteria

2.4.3. Key Performance Indicators (KPI)

The table below provides KPI details for each audited service.

Service	KPI	Definition
Latency	Average RTT (ms)	Average round trip delay, applied only to successful samples
FTP Downlink & Uplink	FTP transfer time (s)	Average transfer time, applied only to successful samples
	Average Throughput(Mbps)	Average throughput computed from successful samples
	Max Throughput (Mbps)	Best throughput from all successful samples
Web browsing	Home Page Download time (s)	Average delay recorded for each web page
Voice	% of calls with perfect quality	Number of calls marked as perfect quality / total number of calls
	% of calls with fair quality	Number of calls marked as fair quality / total number of calls
	% of calls with poor quality	Number of calls marked as poor quality / total number of calls
	% of calls with bad quality	Number of calls marked as bad quality / total number of calls

Table 13: KPIs table

2.5. Locations

2.5.1. Administrative divisions

The map below shows Kingdom of Bahrain's administrative divisions

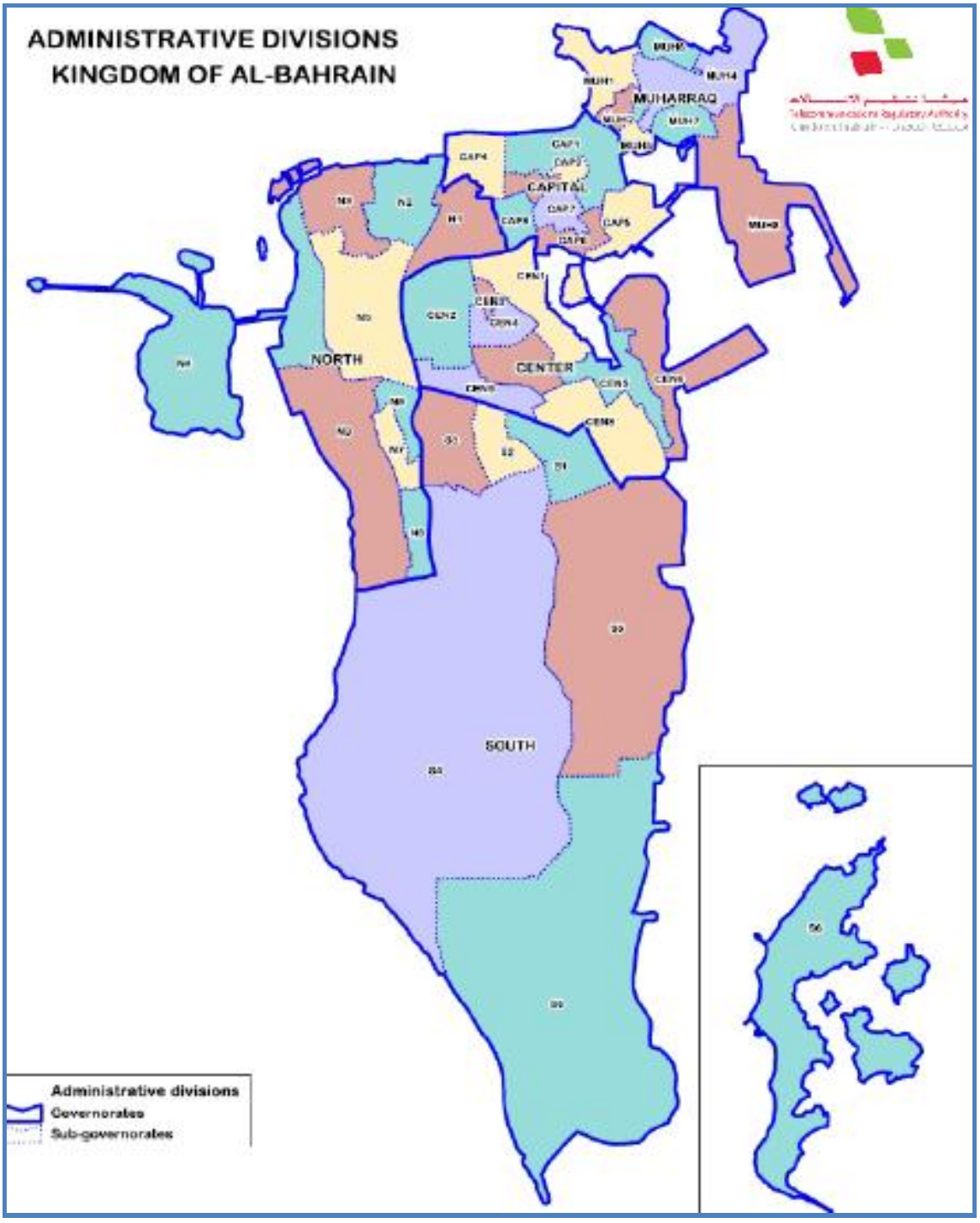


Figure 13: Administrative divisions

2.5.2. Drive test

Map of the routes followed by the test vehicle evaluating coverage:

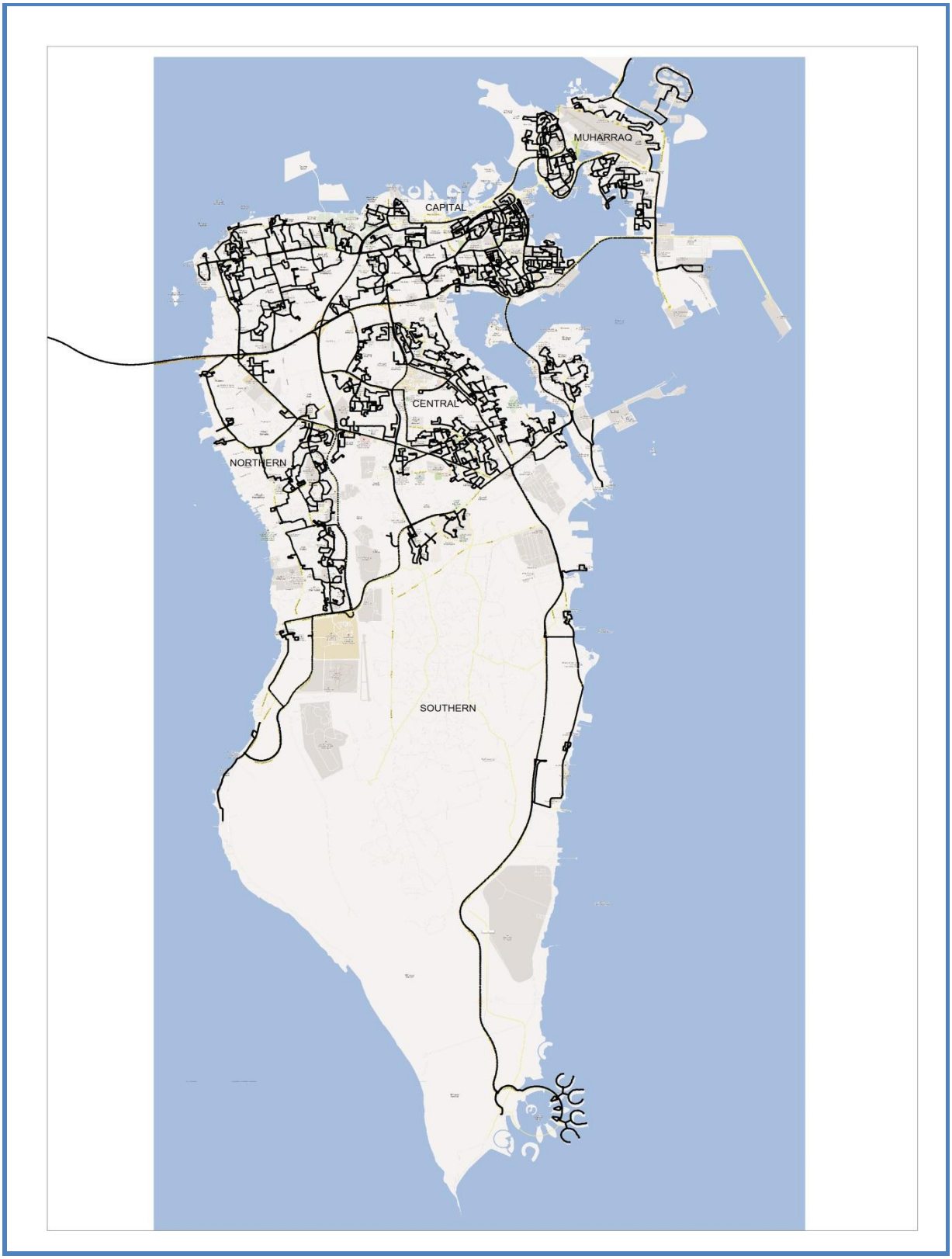


Figure 14: Drive tests overview

2.5.3. Random locations

Map showing random test locations for both operators.

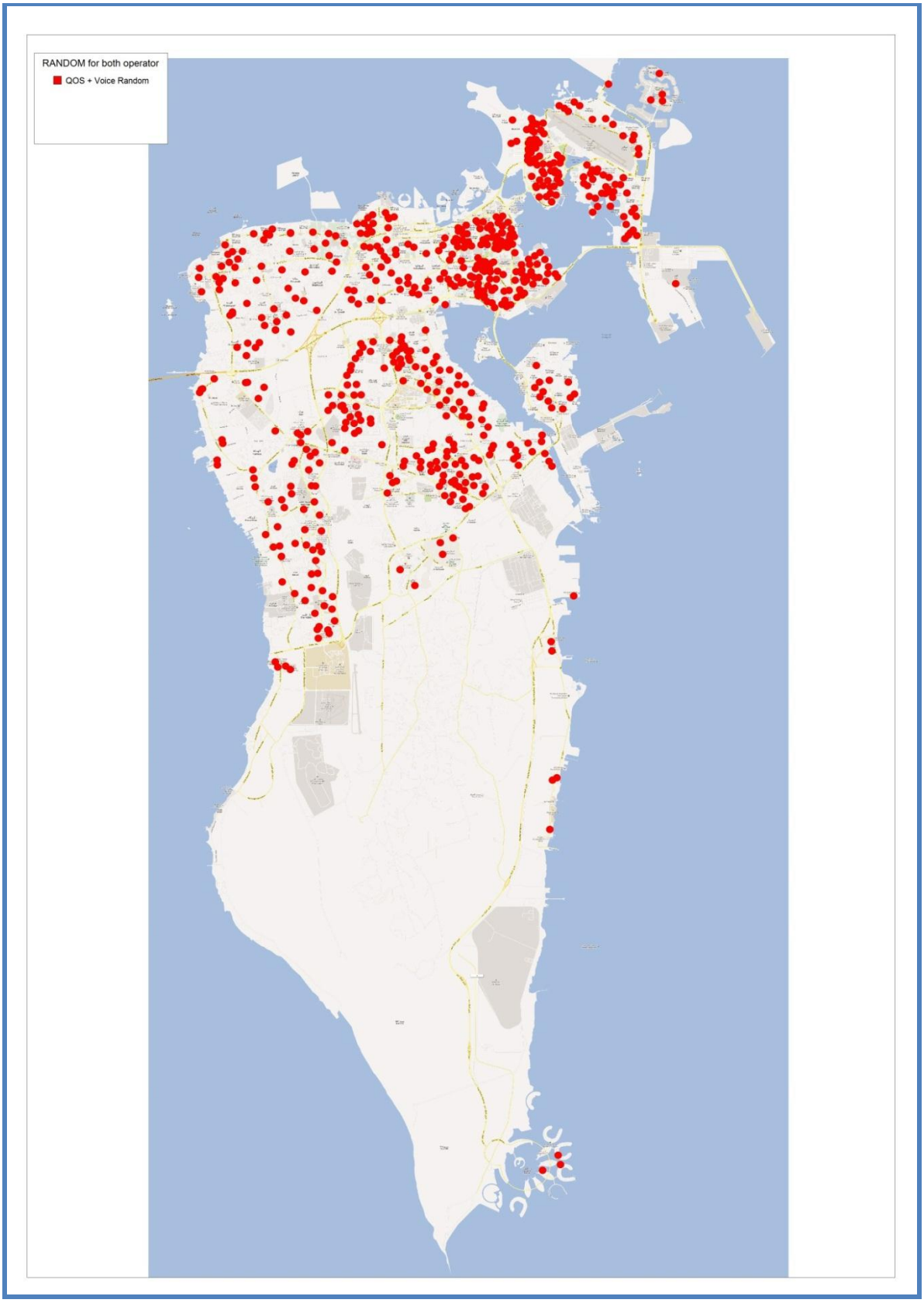


Figure 15: Random locations for QoS measurements

2.5.4. Hotspot locations

Hotspots have been provided by each operator, the map provides locations for Menatelecom and Zain.

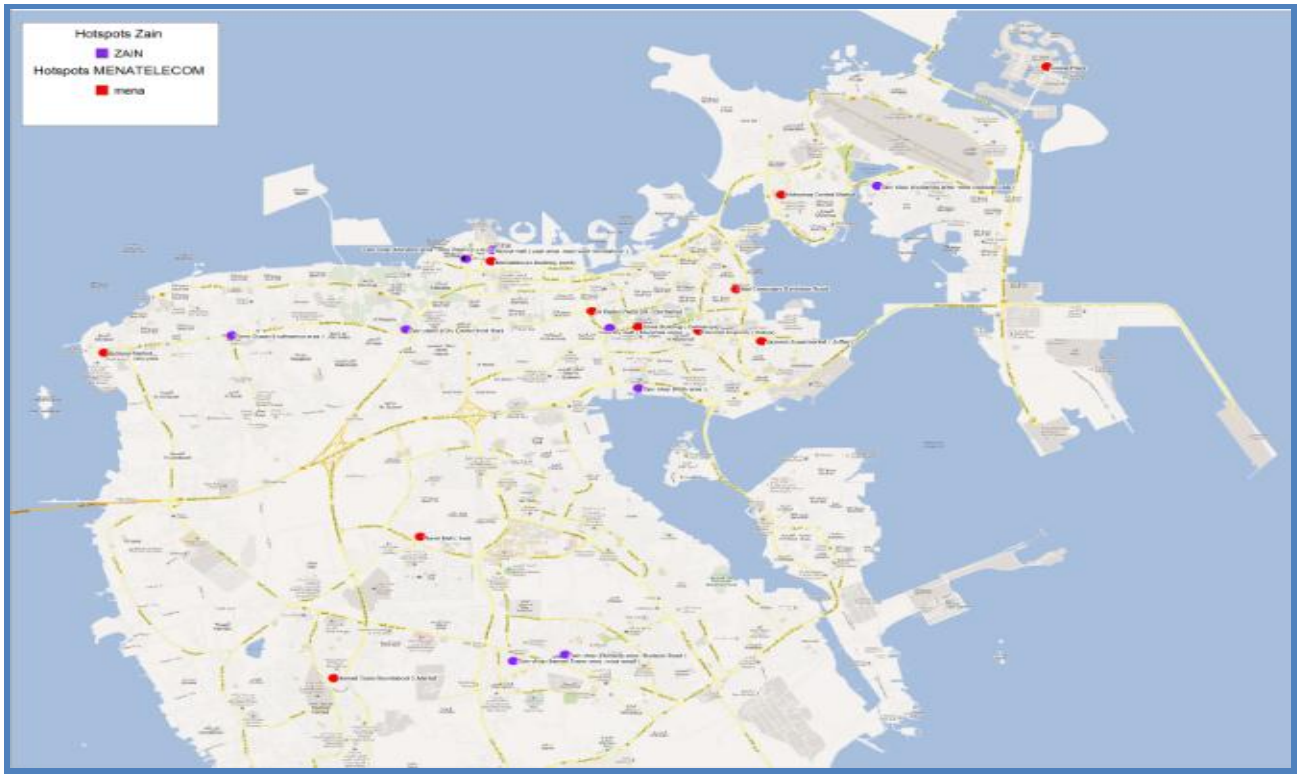


Figure 16: Hotspots locations for QoS measurements

Location	Menatelecom hotspots
1	Muharraq Central Market
2	Amwaj Plaza
3	Hilal Computers Exhibition Road
4	Jazeera Supermarket (Juffair)
5	Chinese Express (Adliya)
6	Menatelecom Building (seef)
7	Al Bader Plaza DR (Burhama)
8	Budaiya Market
9	Ramli Mall (Aali)
10	Sana Building (Salmaniya)
11	Najeeby Center (Barbar)
12	Hamad Town Roundabout 5 Market

Location	Zain hotspots
1	Zain shop (Muharraq area -near Muharraq club)
2	Zain shop (Exhibition Read)
3	Zain shop (Manama area -near Regency car park)
4	Dairy Queen (Salmaniya area)
5	Zain stand (City Center third flow)
6	Country mall (Muqshaa area)
7	Zain shop (Budayiq area -Budayie Read)
8	Alosra mall (Saar area -near saar roundabout)
9	Zain shop (Riffa area)
10	Zain shop (Hamad Tower area -Souq waqif)
11	Ataeeb restaurant
12	Oasis mall

Table 14: Menatelecom and Zain hotspots

3. COVERAGE AUDIT RESULTS

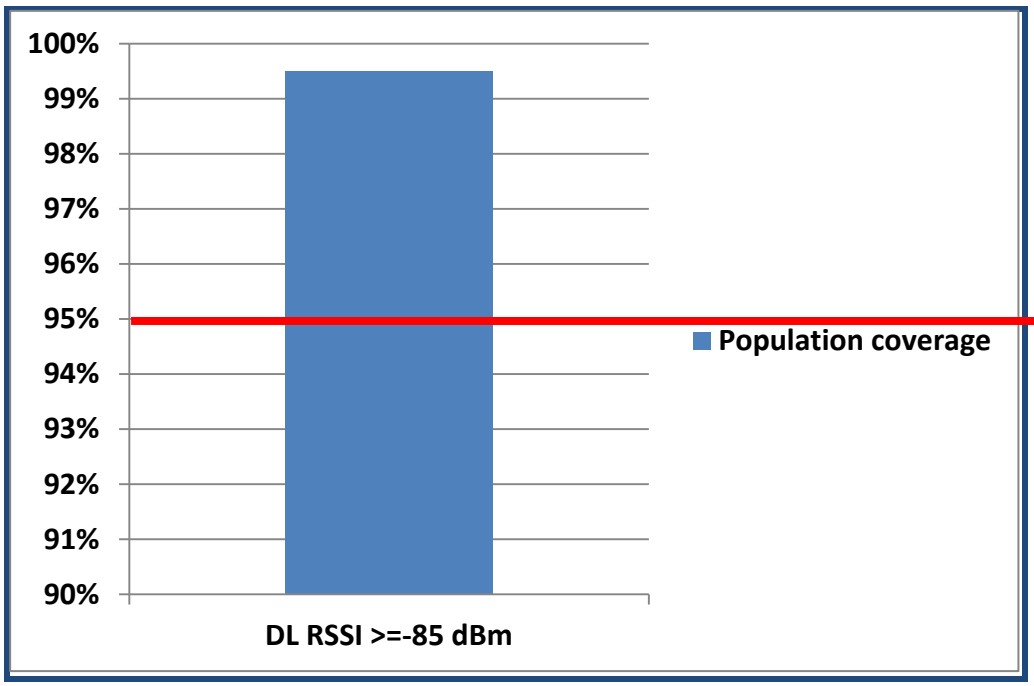
3.1. Menatelecom coverage

3.1.1. Population coverage results

The population covered is defined as the weighted average Downlink RSSI samples higher than target Downlink RSSI threshold (- 85 dBm). For Menatelecom, percentage of population covered is equal to 99.5%.

Population coverage	Downlink RSSI >= -85 dBm
	99.5%

Table 15: Population covered by Menatelecom



(coverage obligation)

Figure 17: Menatelecom population coverage

Menatelecom meet its license coverage obligation.

3.1.2. Geographical coverage per governorate

Table 16 and Figure 18 provide coverage results for each governorate. Coverage is computed from the percentage of Downlink RSSI samples higher than - 85 dBm.

Governorate	Downlink RSSI >= -85 dBm
Muharraq	99.8 %
Capital	100.0 %
Northern	97.9 %
Central	99.9 %
Southern	98.7 %

Table 16: Menatelecom geographical coverage per governorate

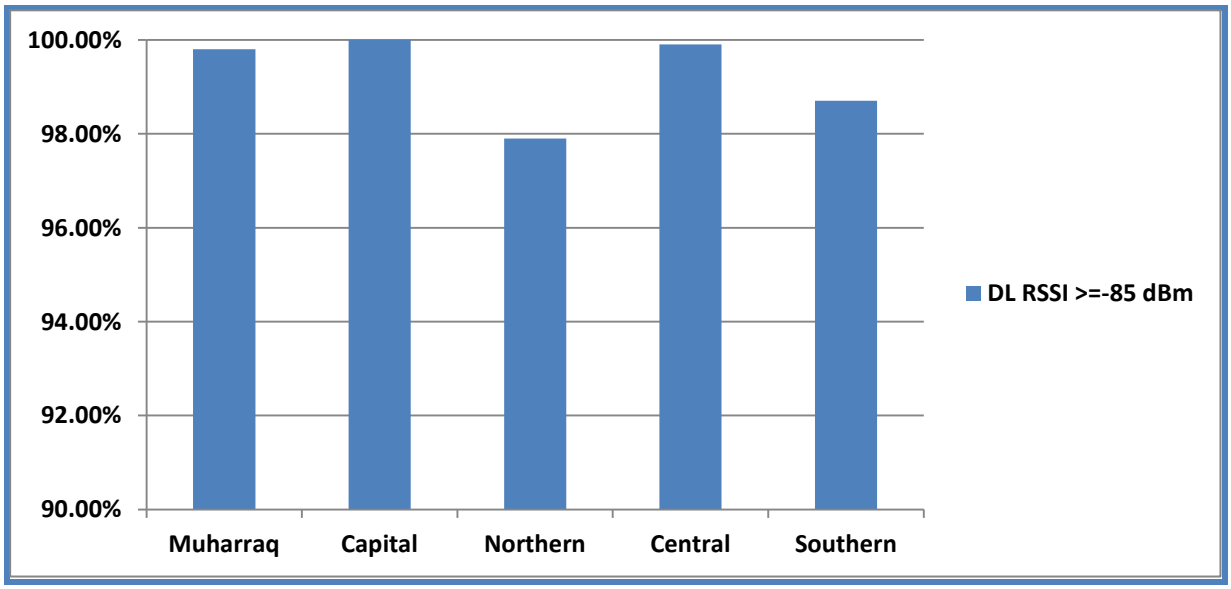


Figure 18: Menatelecom geographical coverage per governorate

Coverage for Menatelecom is very close to 100% for all governorates along the audited route.

WiMAX geographical coverage for Menatelecom is very good in all governorates.

3.1.3. Geographical coverage map

Figure 19 represents Downlink RSSI level samples for Menatelecom. Samples in green correspond to well cover location.

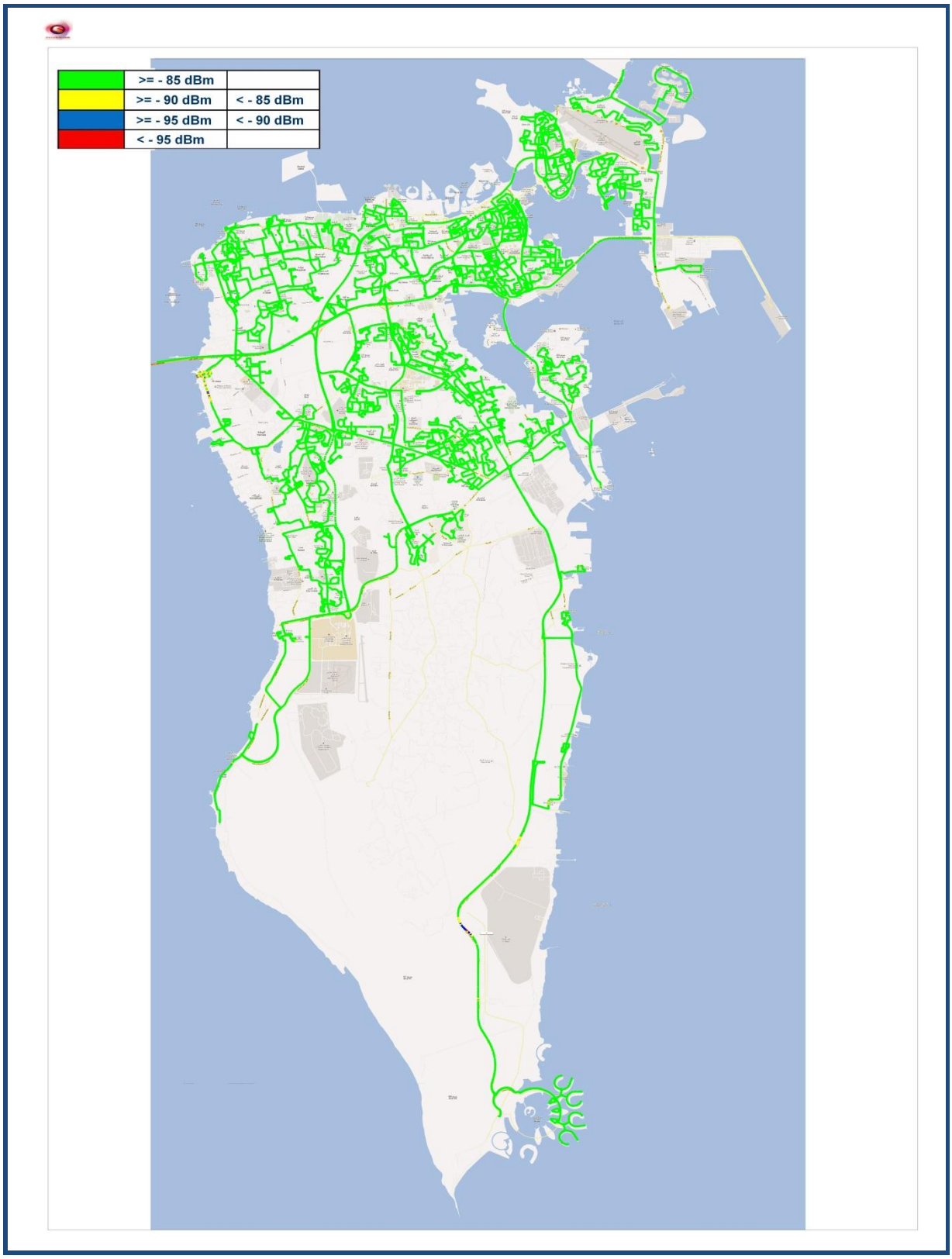


Figure 19: Menatelecom geographical coverage map

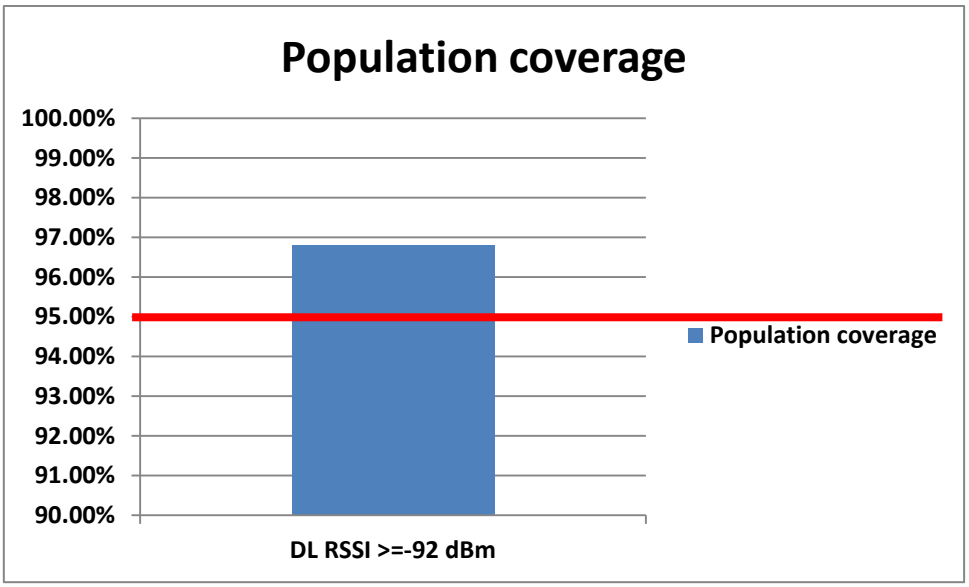
3.2. Zain coverage

3.2.1. Population coverage results

The population covered is defined as the weighted average Downlink RSSI samples higher than target Downlink RSSI threshold - 92 dBm. For Zain, percentage of population covered is equal to 96.8%.

Population coverage	Downlink RSSI >= -92 dBm
	96.8%

Table 17: Population covered by Zain



(coverage obligation)

Figure 20: Zain population coverage

Zain meet its license obligation.

3.2.2. Geographical coverage per governorate

Table 18 and Figure 21 provide coverage results for each governorate. Coverage is computed from the percentage of Downlink RSSI samples higher than - 92 dBm.

Governorate	Downlink RSSI >= -92 dBm
Muharraq	99.3 %
Capital	99.4 %
Northern	90.4 %
Central	98.7 %
Southern	57.2 %

Table 18: Zain geographical coverage per governorate

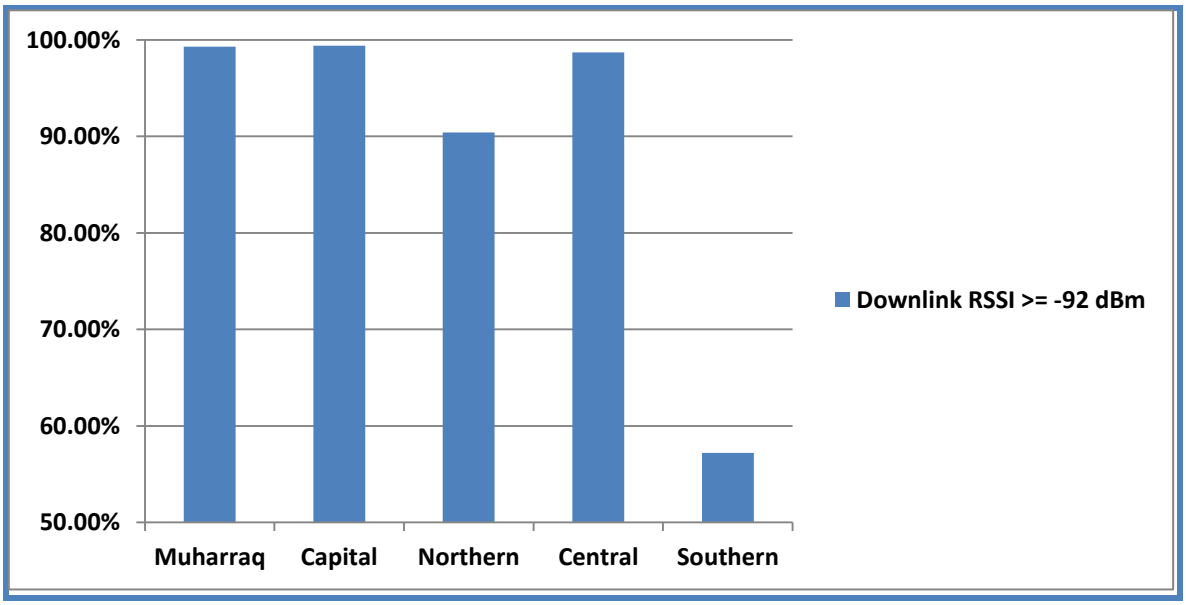


Figure 21: Zain geographical coverage per governorate

Zain coverage is limited in Northern and poor in Southern governorates

3.2.3. Geographical coverage map

Figure 22 represents Downlink RSSI level samples for Zain. Samples in green correspond to well covered locations.

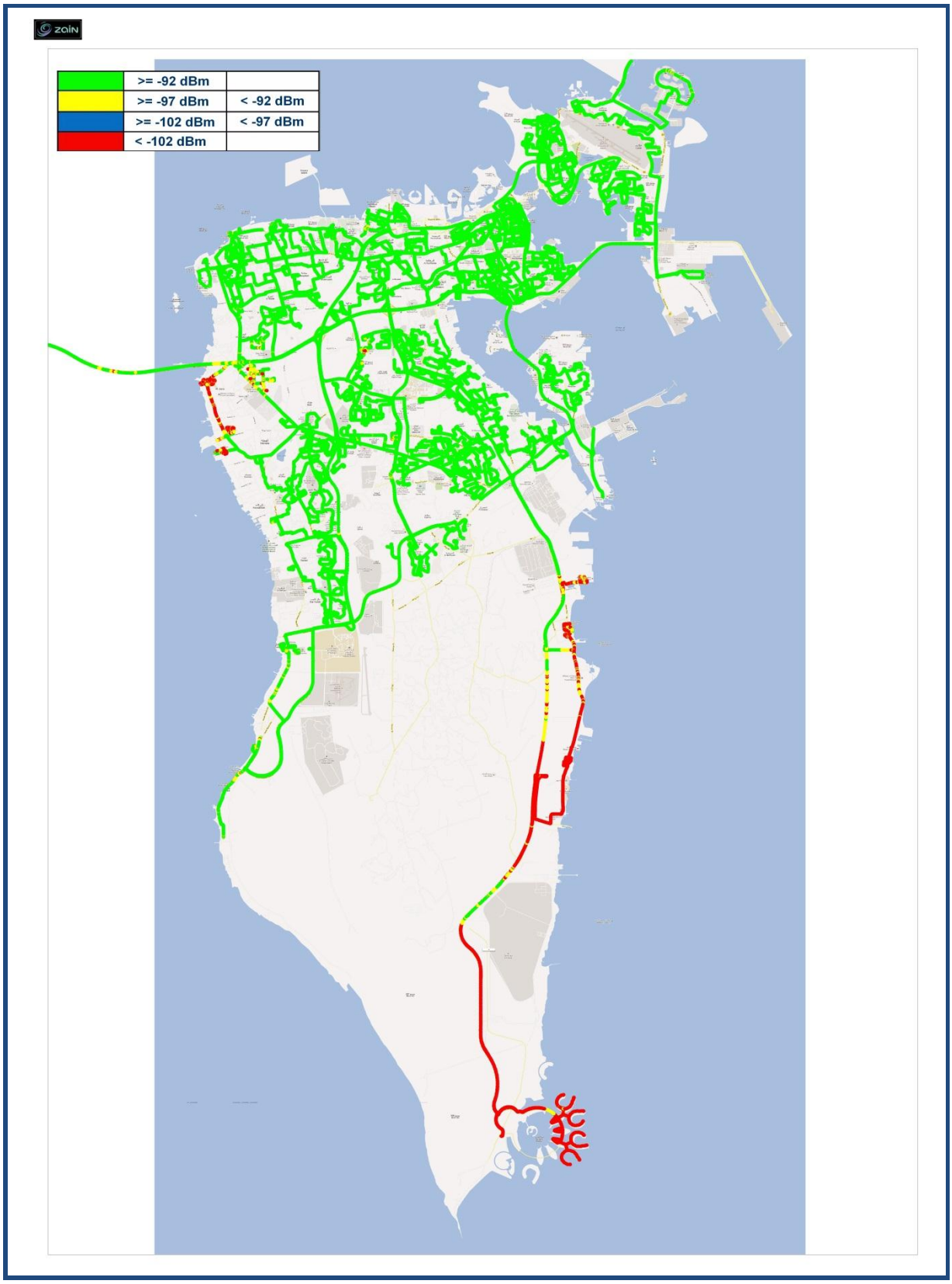


Figure 22: Zain coverage map

4. DATA AND VOICE QoS RESULTS

4.1. Menatelecom QoS

4.1.1. Latency

Latency results	Average latency (ms)
Random	75.6
Hotspots	68.3
Global	75.0

Table 19: Menatelecom - Average latency

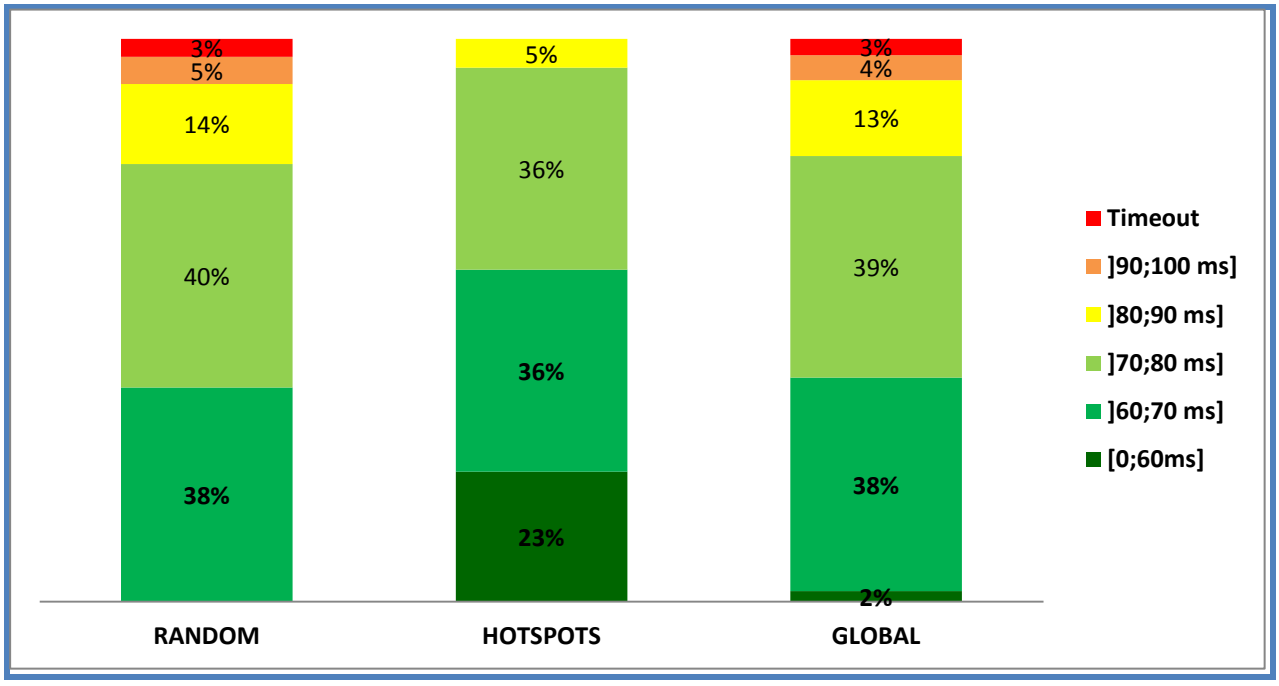


Figure 23: Menatelecom – Latency distribution

- Average latency offered by Menatelecom is good in all governorates.
- As expected better performance has been observed on hotspot locations compared to random points in the Kingdom.

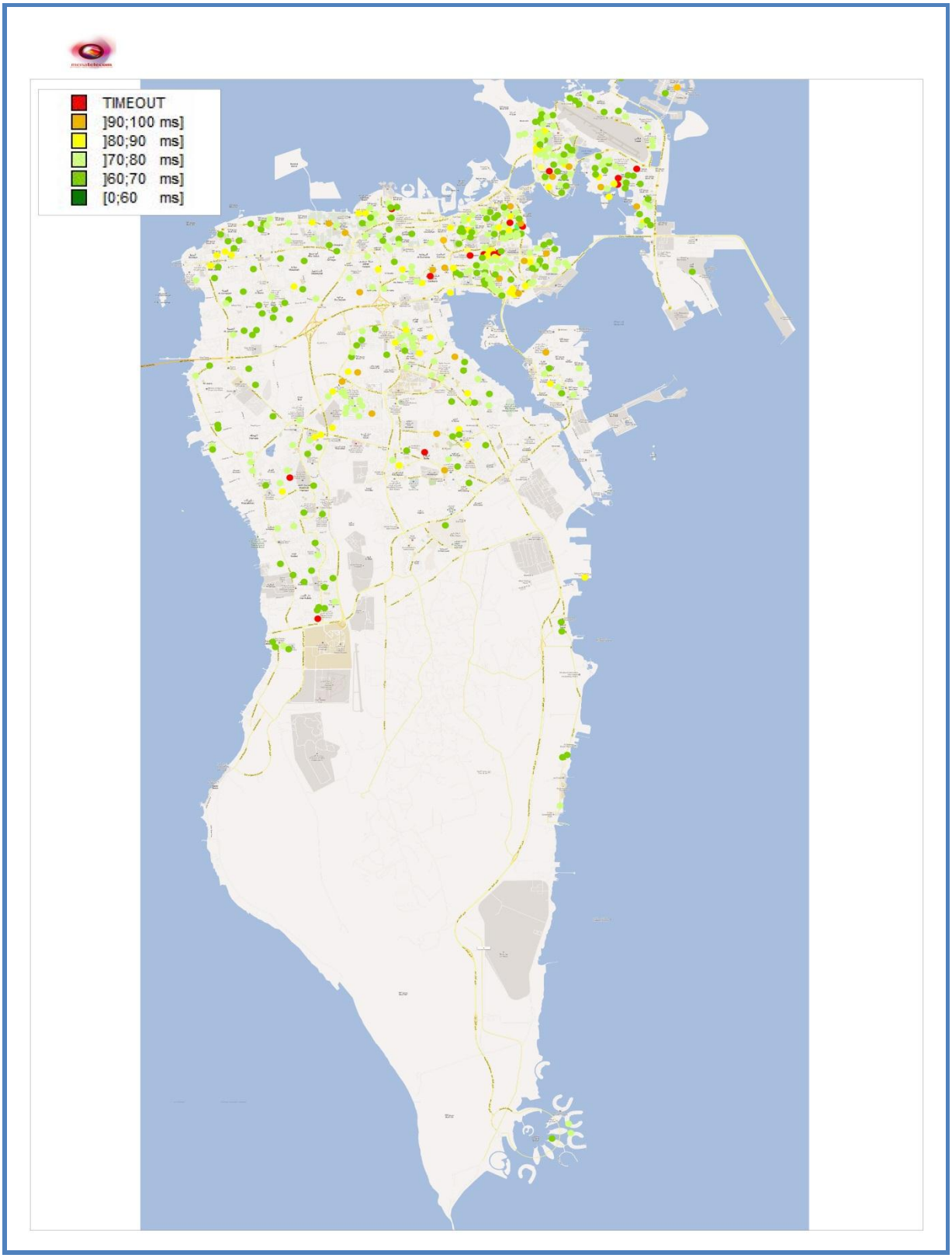


Figure 24: Menatelecom – Latency map

4.1.2. Download FTP

Download FTP	FTP Transfer Time (s)	Average Throughput (Mbps)	Maximum Throughput (Mbps)
Random	13.8	8.1	24.3
Hotspots	13.9	8.3	17.6
Global	13.8	8.1	24.3

Table 20: Menatelecom – Download FTP results

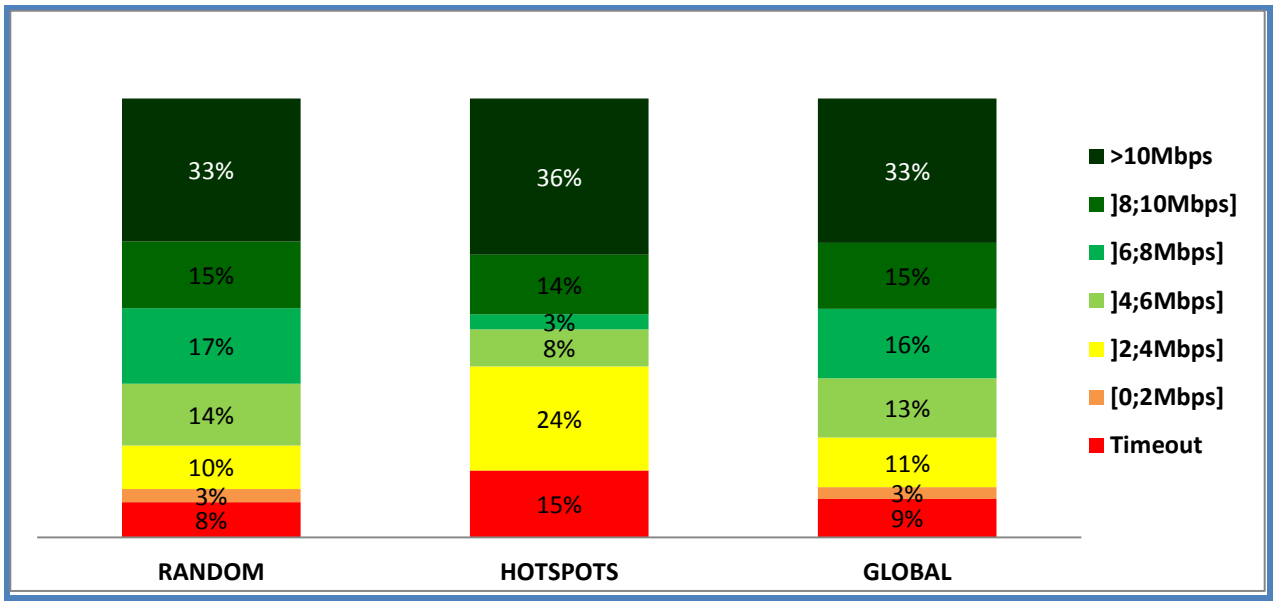


Figure 25: Menatelecom – Distribution of Downlink FTP throughput

- Average throughput observed for Menatelecom was 8.1 Mbps (tested offer up to 18 Mbps).
- We obtained a large number of timed out sessions in Central governorate compared to the other governorates.

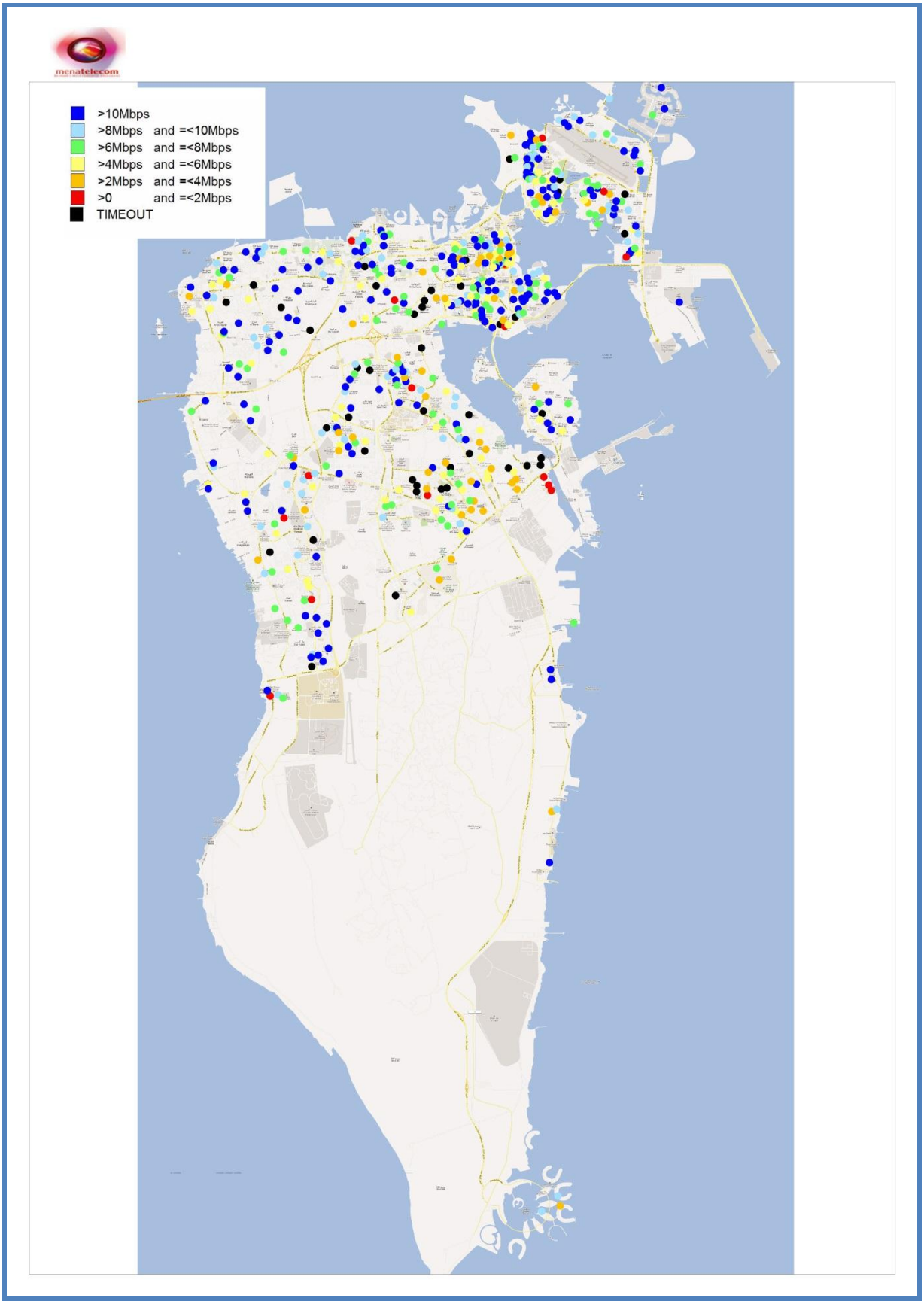


Figure 26: Menatelecom – Downlink FTP throughput

4.1.3. Upload FTP

Upload FTP	FTP Transfer Time (s)	Average Throughput (Mbps)	Maximum Throughput (Mbps)
Random	13.5	0.7	1.7
Hotspots	10.2	0.8	1.6
Global	13.2	0.8	1.7

Table 21: Menatelecom – Upload FTP results

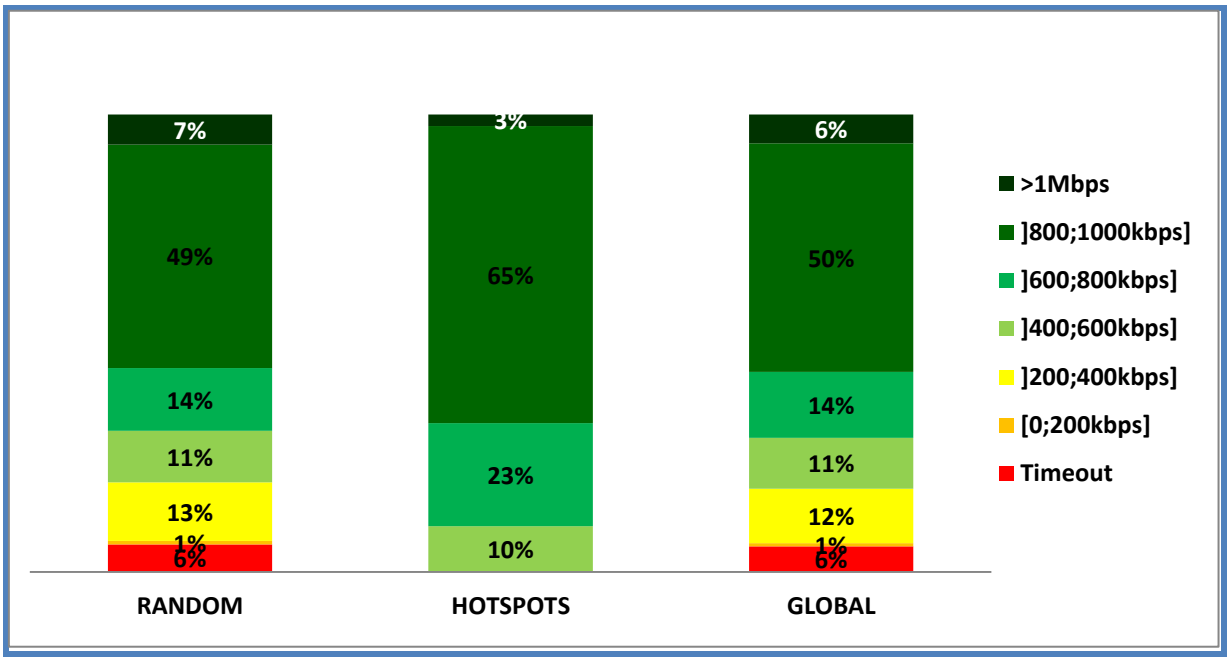


Figure 27: Menatelecom – Distribution of Uplink FTP throughput

- The average upload throughput 0.8 Mbps is limited – similar results observed in all governorates.

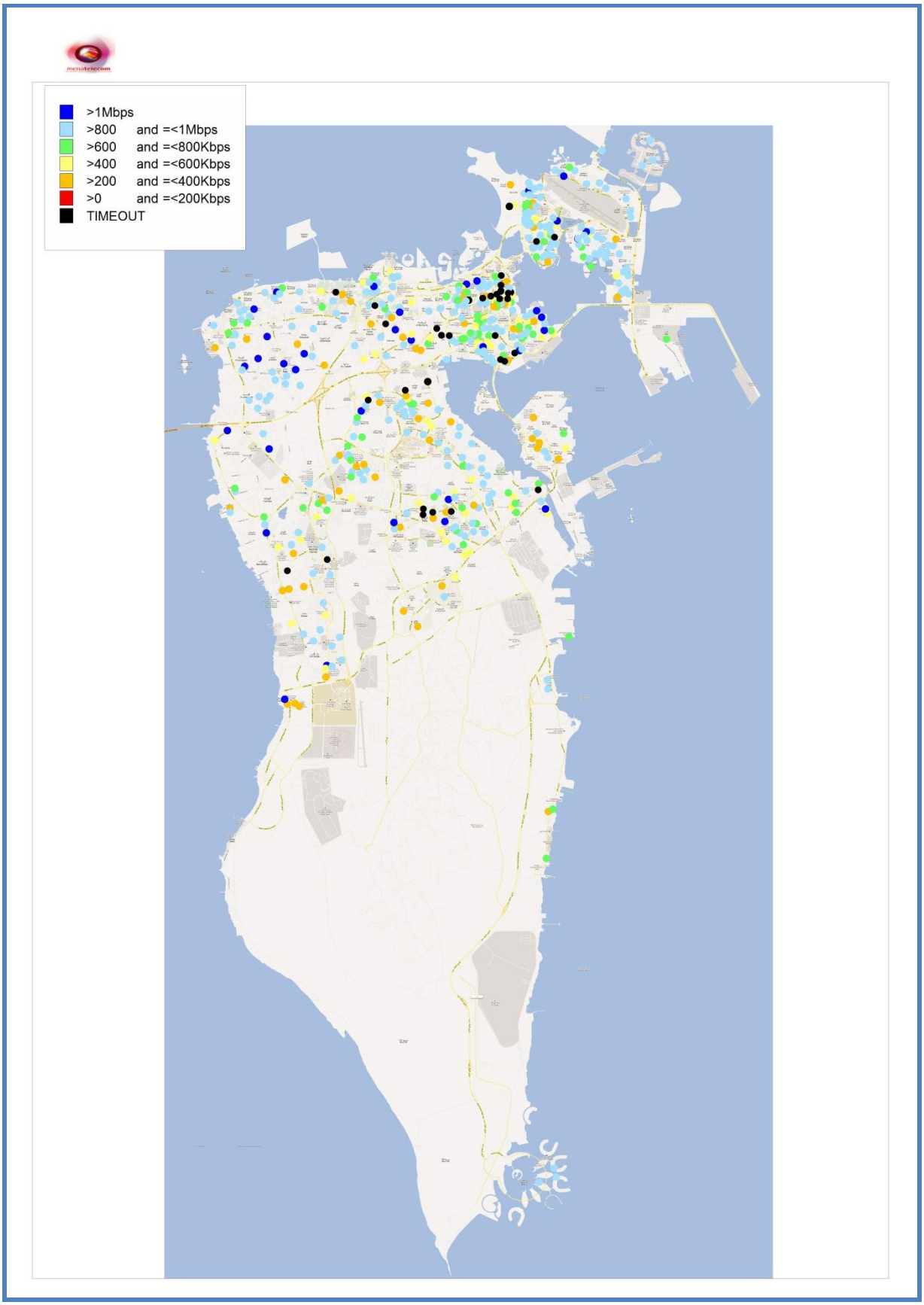


Figure 28: Menatelecom – Uplink FTP throughput

4.1.4. Web browsing

Web browsing results	Web Page Download time (s)
Random	4.5
Hotspots	4.0
Global	4.4

Table 22: Menatelecom – Average Web page download time

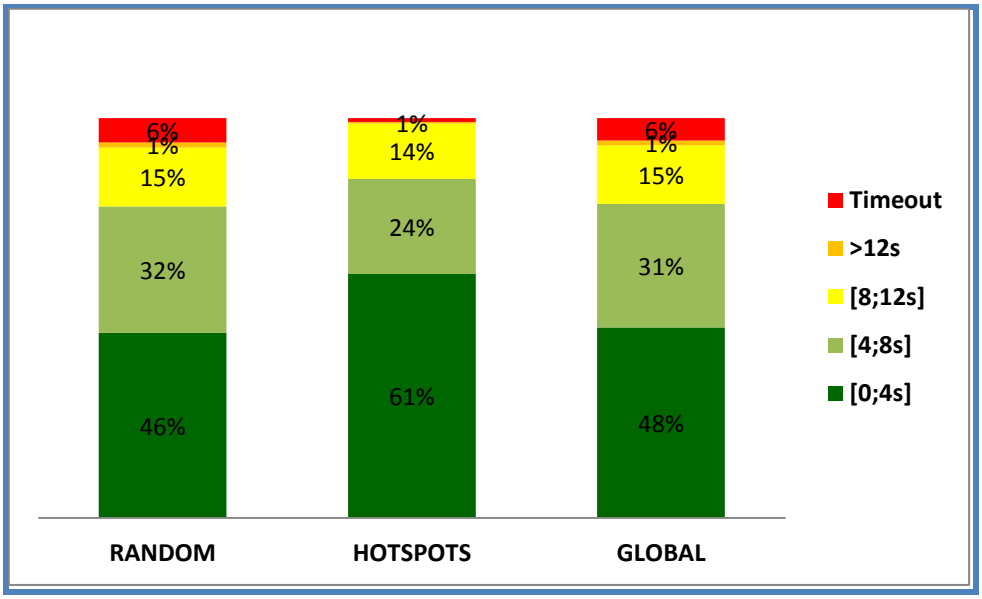


Figure 29: Menatelecom – Web page download time Distribution

- Web page Download time is very good in all random and hotspot locations.

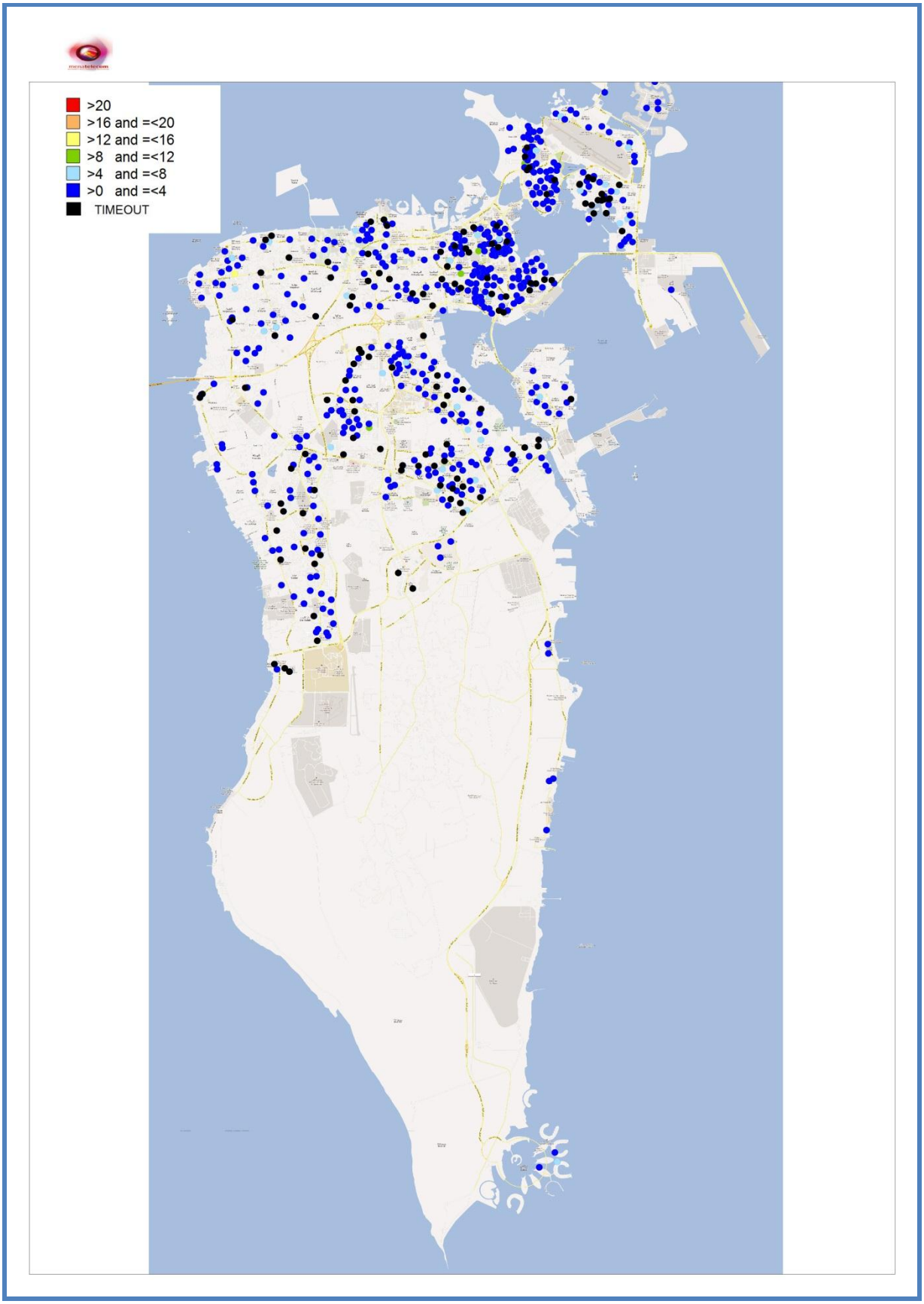


Figure 30: Menatelecom – Web browsing download time

4.1.5. Voice

Voice quality results	Number of calls	Perfect	Fair	Poor	Bad
Random	505	65%	29%	3%	3%
Hotspots	57	49%	46%	5%	0%
Global	562	63%	31%	3%	3%

Table 23: Menatelecom – Voice quality

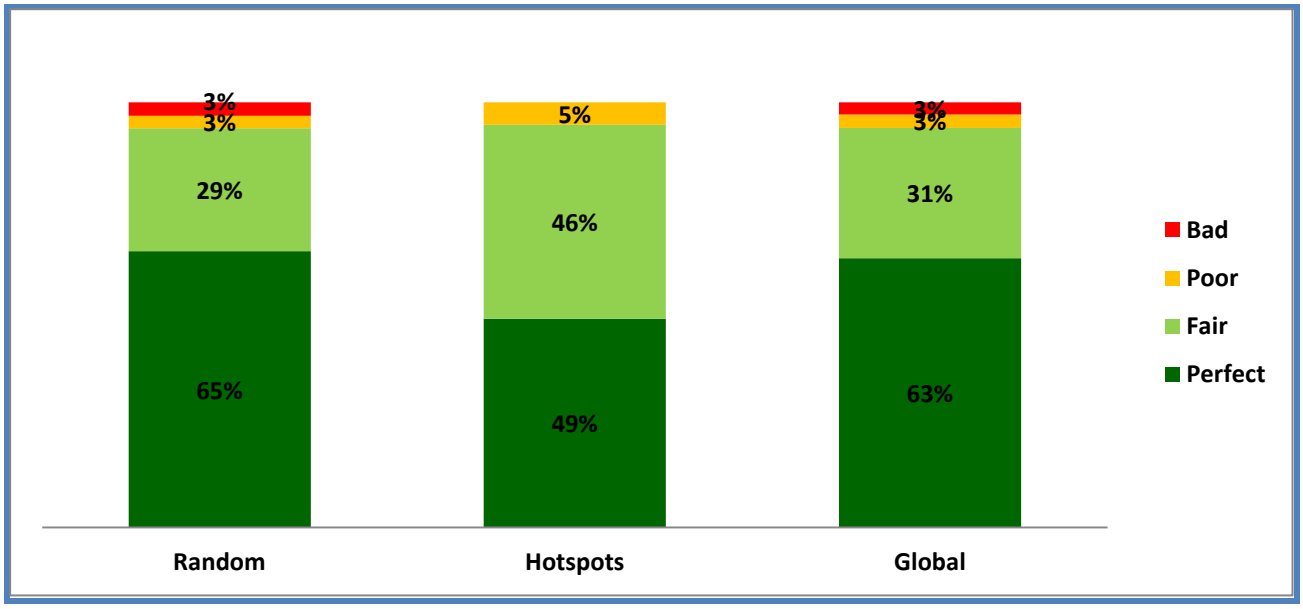


Figure 31: Menatelecom – Voice quality distribution

- 94% of voice calls offer a perfect or fair quality for random locations.
- 95% of voice calls offer a perfect or fair quality for hotspot locations.
- Menatelecom offer a fair to perfect voice quality in all governorates.

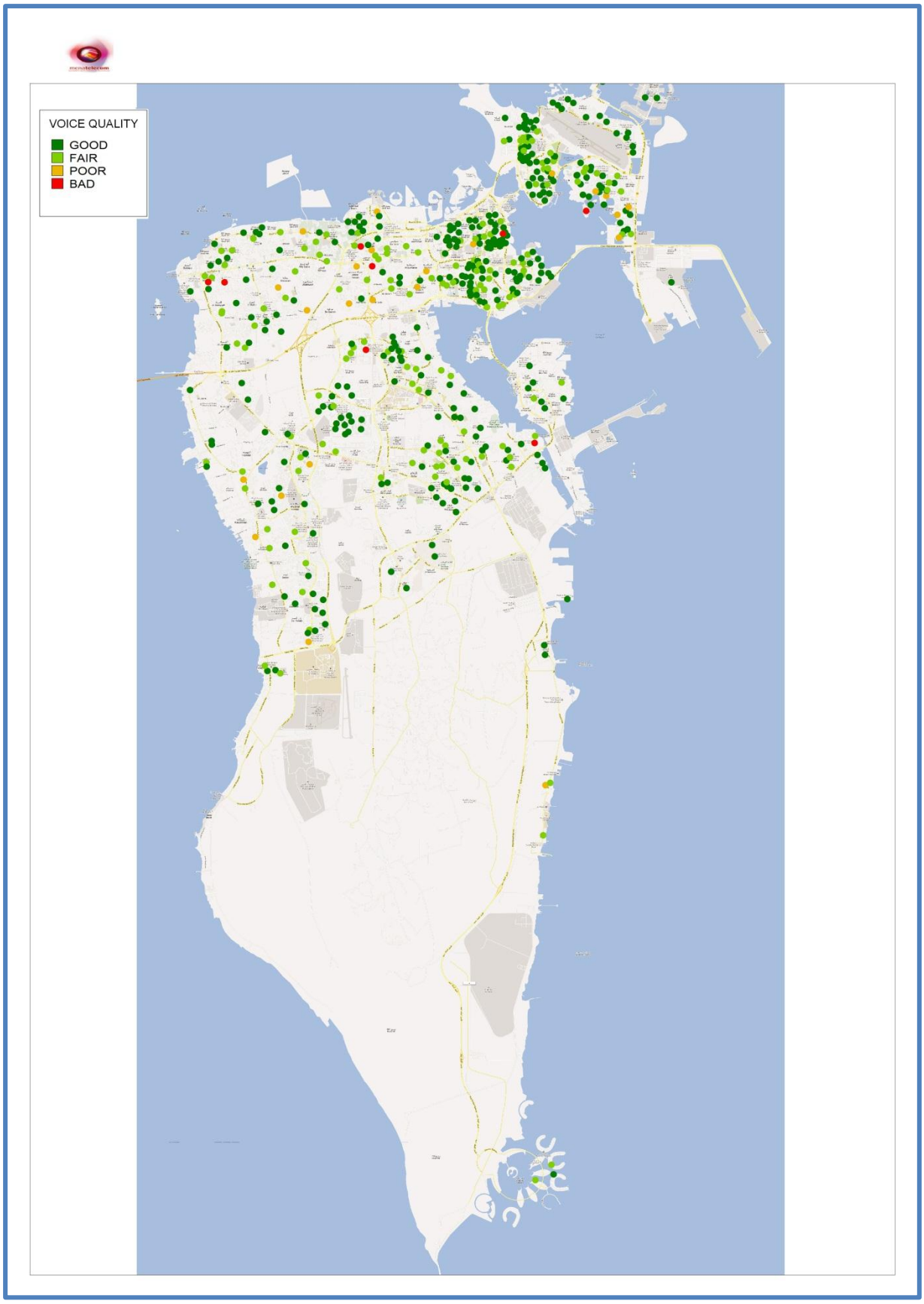


Figure 32: Menatelecom – Voice quality

4.2. Zain QoS

4.2.1. Latency

Latency results	Average latency (ms)
Random	74.4
Hotspots	67.2
Global	73.5

Table 24: Zain – Average latency

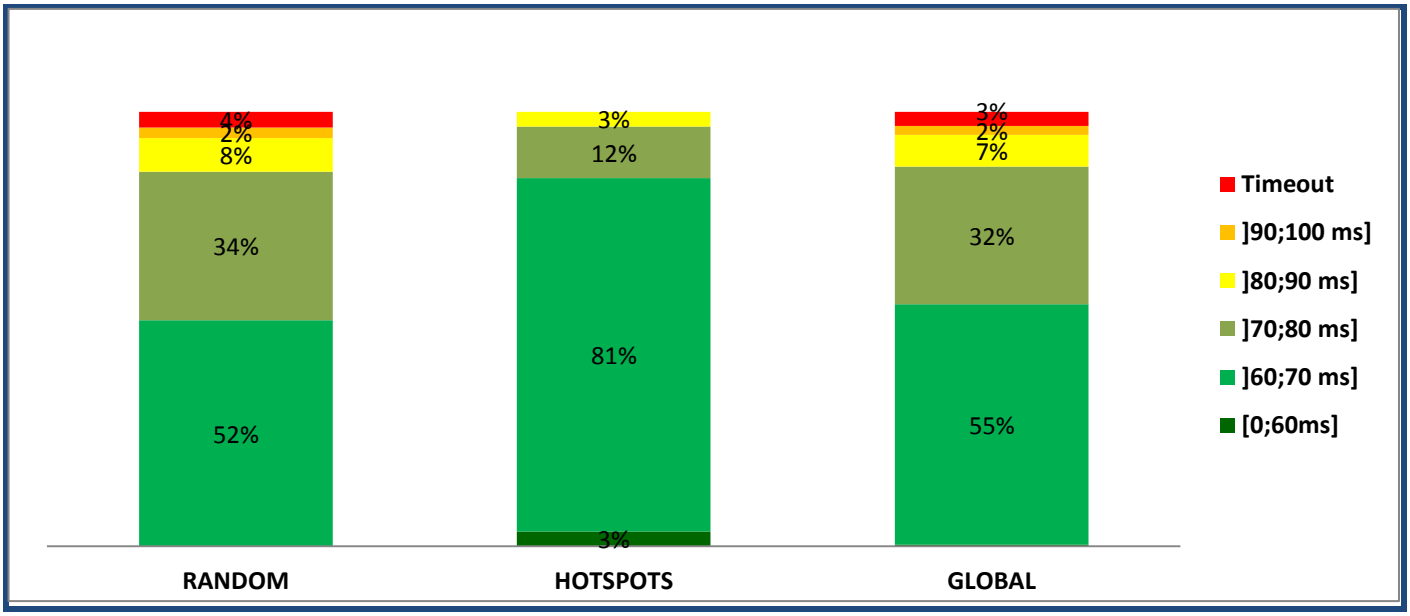


Figure 33: Zain – Latency Distribution

- The average latency offered by Zain is good in all governorates.
- As expected better performance has been observed in hotspot locations compared to random points.

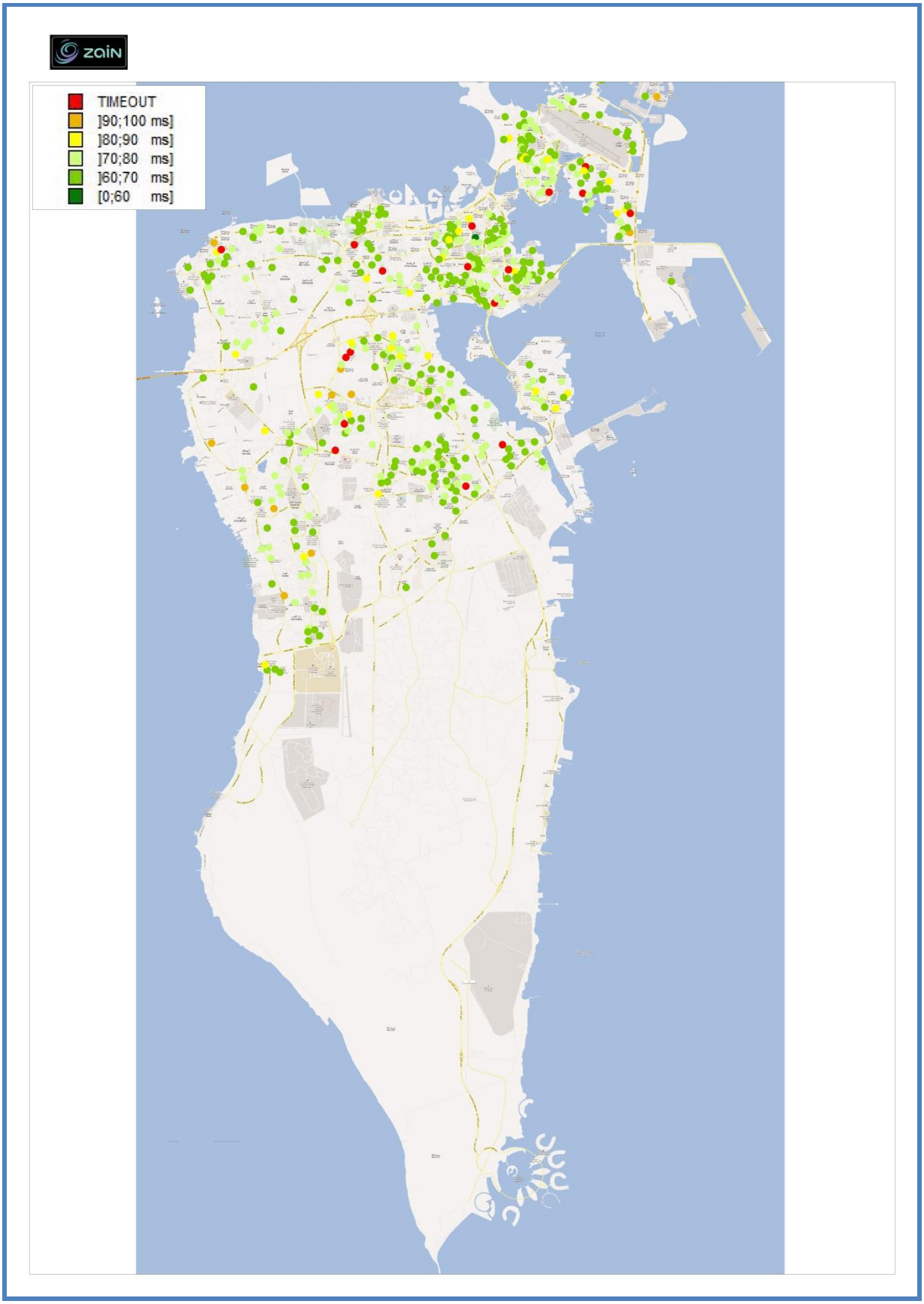


Figure 34: Zain – Latency time distribution

4.2.2. Download FTP

Download FTP	FTP transfer time (s)	Av Throughput (Mbps)	Max Throughput (Mbps)
Random	29.3	3.1	11.7
Hotspots	31.6	2.9	9.0
Global	29.5	3.1	11.7

Table 25: Zain – Download FTP results

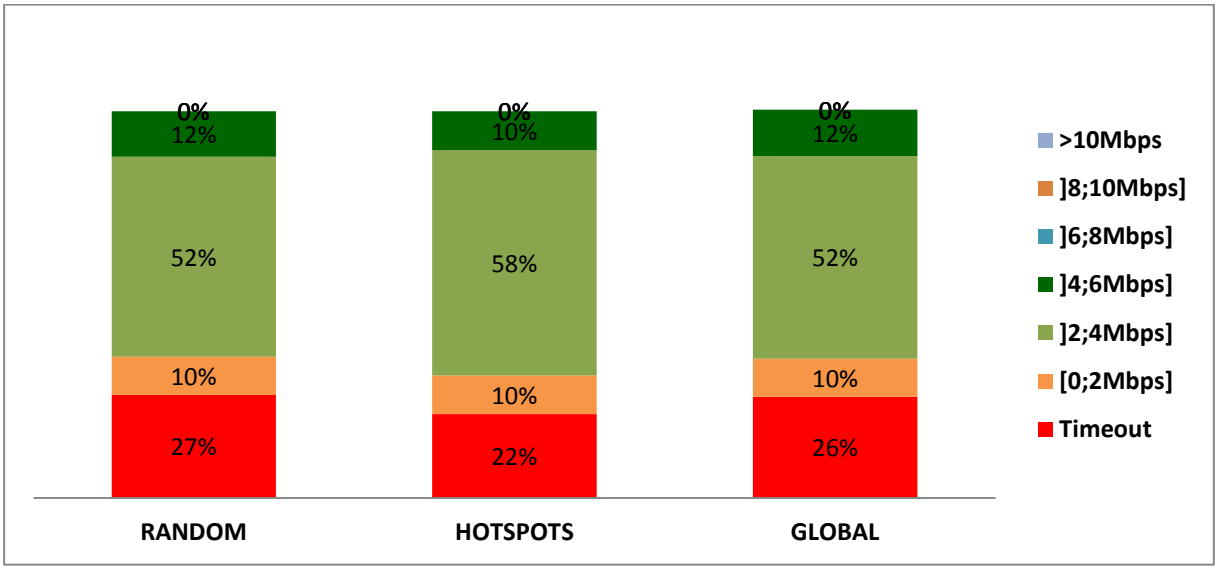


Figure 35: Zain – Distribution of Downlink FTP throughput

- Average throughput provided by Zain was 3.1 Mbps (tested package 4 Mbps).
- A large number of session timeouts has been observed in all governorates with the noticeable exception of Muharraq, indicating room for improvement.

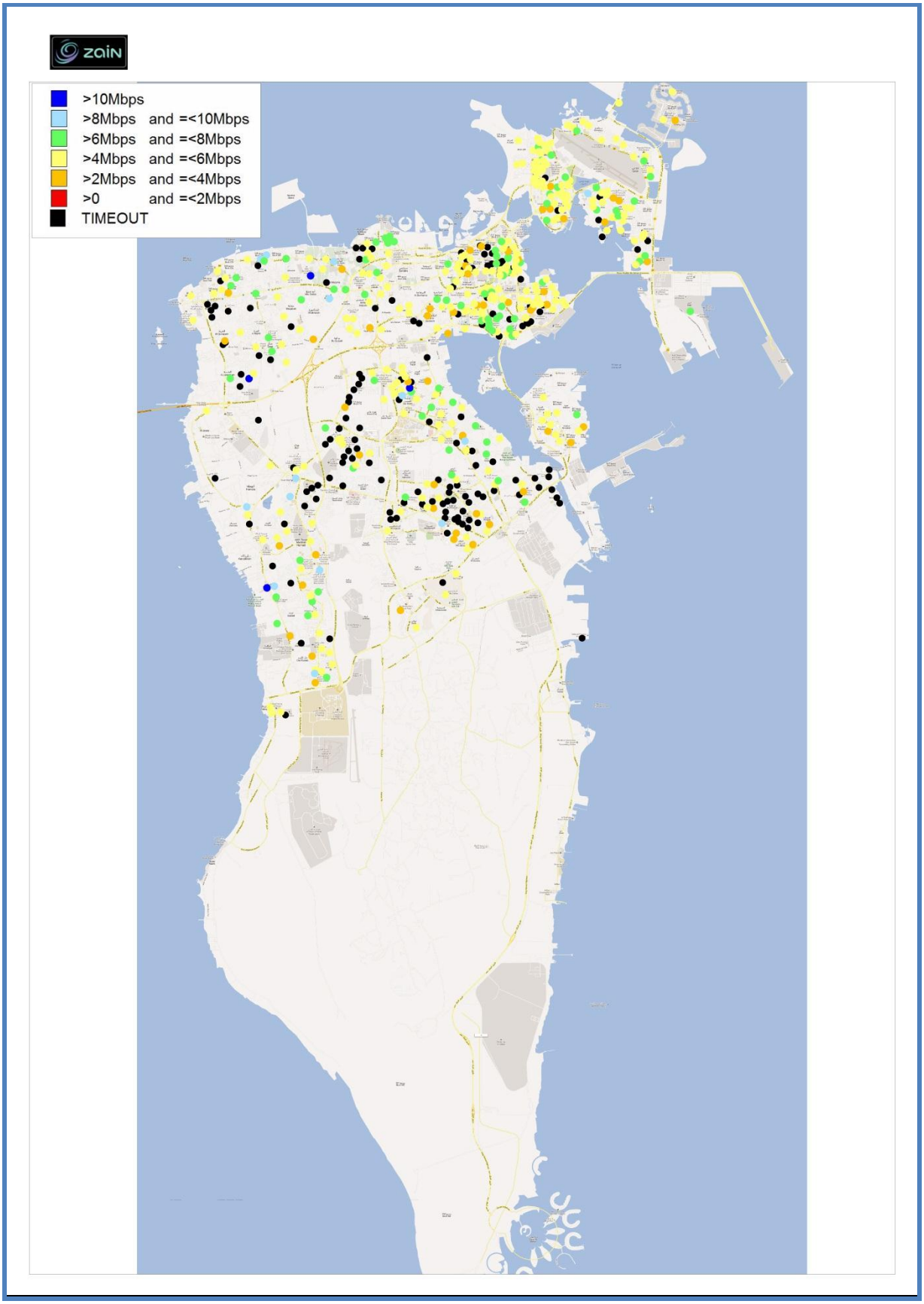


Figure 36: Zain – Distribution of Downlink FTP throughput

4.2.3. Upload FTP

Upload FTP	FTP transfer time (s)	Av Throughput (Mbps)	Max Throughput (Mbps)
Random	14.8	0.7	1.4
Hotspots	15.4	0.7	1.2
Global	14.9	0.7	1.4

Table 26: Zain – Upload FTP results

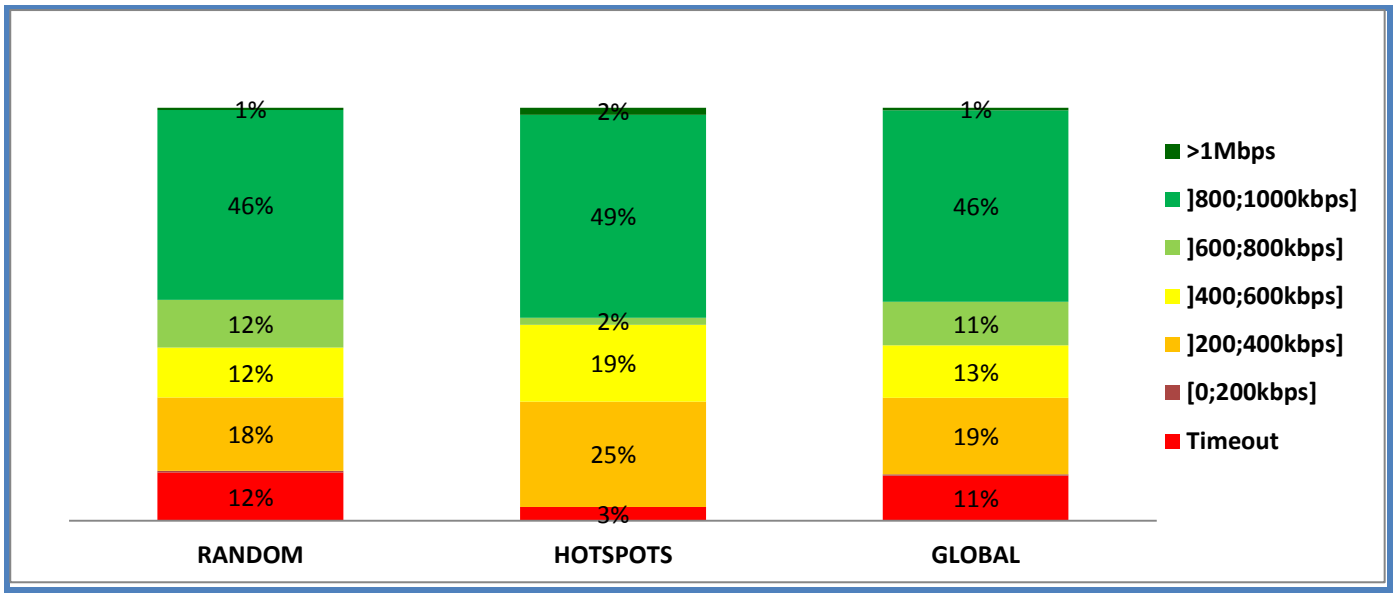


Figure 37: Zain – Distribution of Uplink FTP throughput

- The average upload throughput 0.7 Mbps is limited – common to all governorates

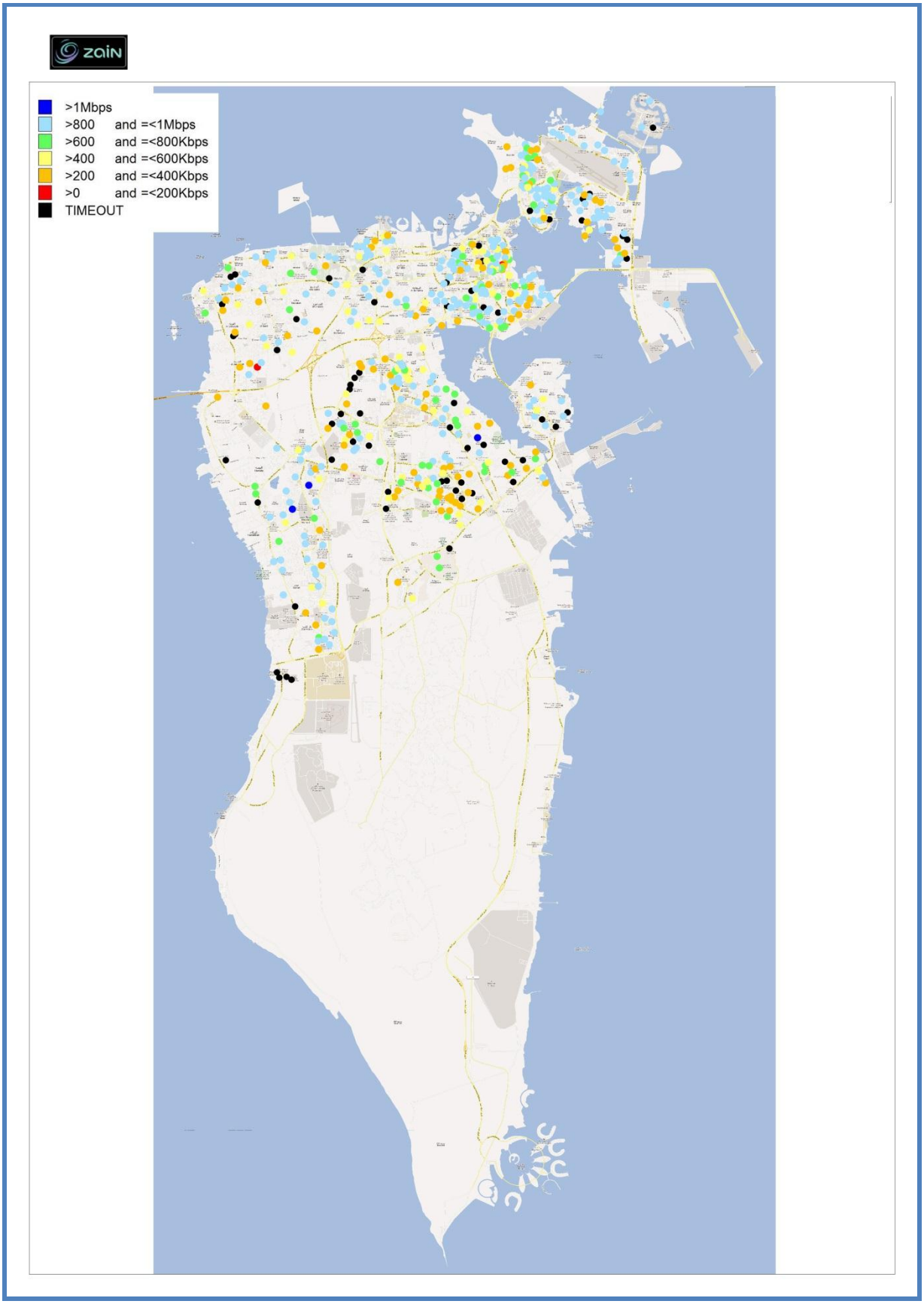


Figure 38: Zain – Uplink FTP throughput

4.2.4. Web browsing

Web browsing	Web Page Download time (s)
Random	6.3
Hotspots	4.5
Global	6.1

Table 27: Zain – Average Web page download time

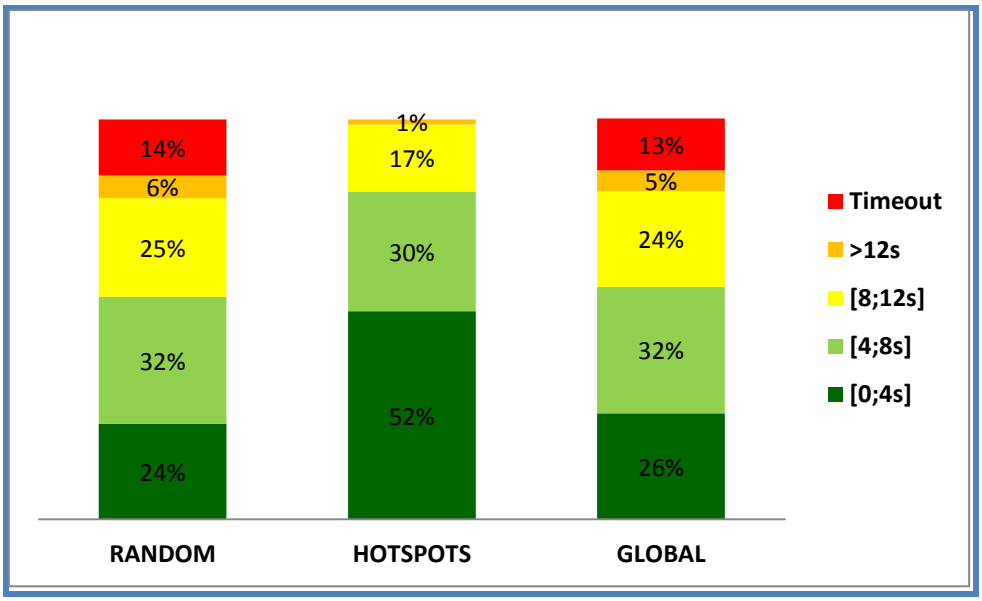


Figure 39: Zain – Web page download time distribution

- The average web Page Download time of Zain is acceptable.
- Muharraq and Capital governorates performance was lower than in other governorates.

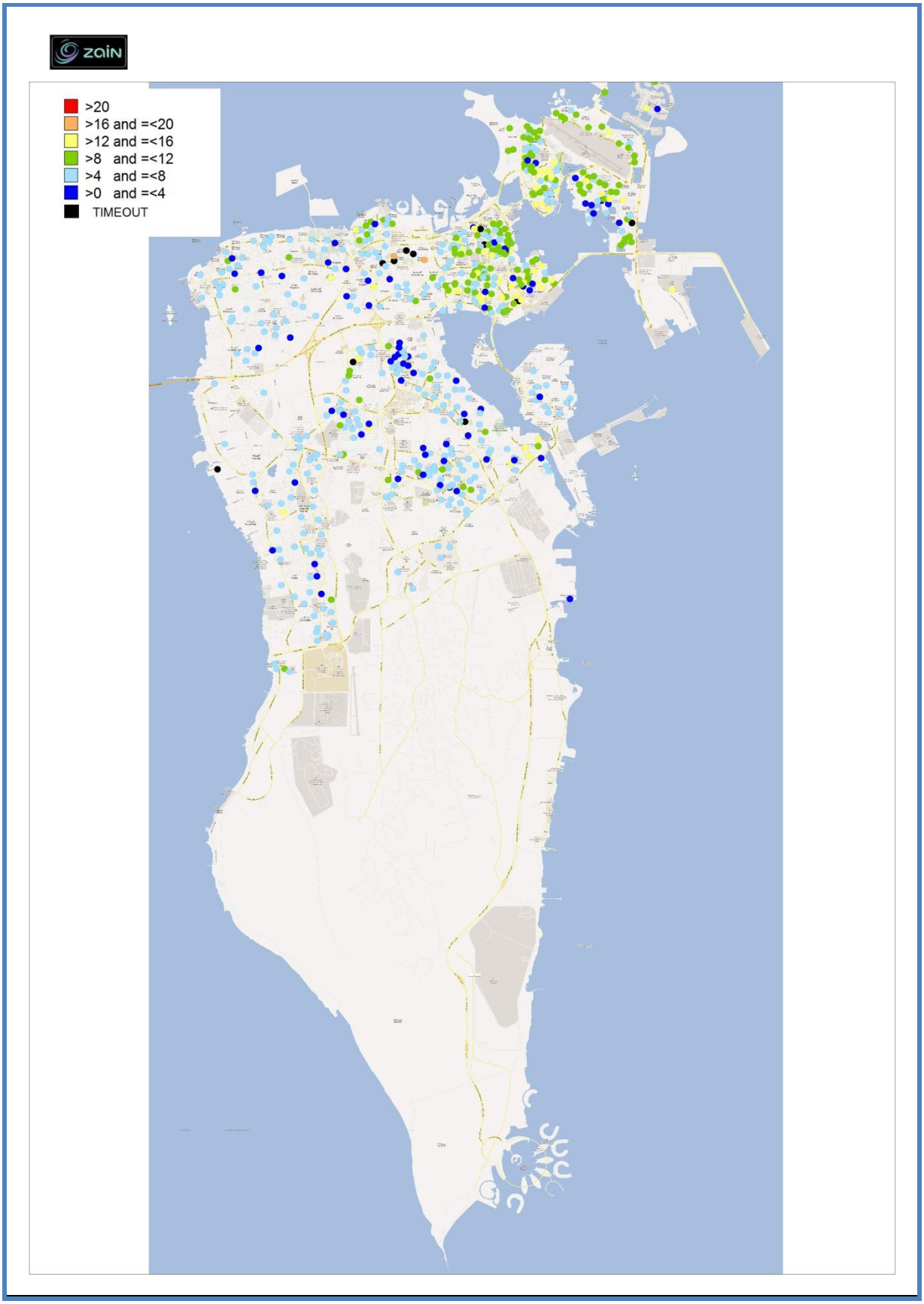


Figure 40: Zain – Web page download time

4.2.5. Voice

Voice quality results	Nb of calls	Perfect	Fair	Poor	Bad
Random	515	92%	5%	2%	1%
Hotspots	55	95%	5%	0%	0%
Global	570	92%	5%	2%	1%

Table 28: Zain – Voice quality

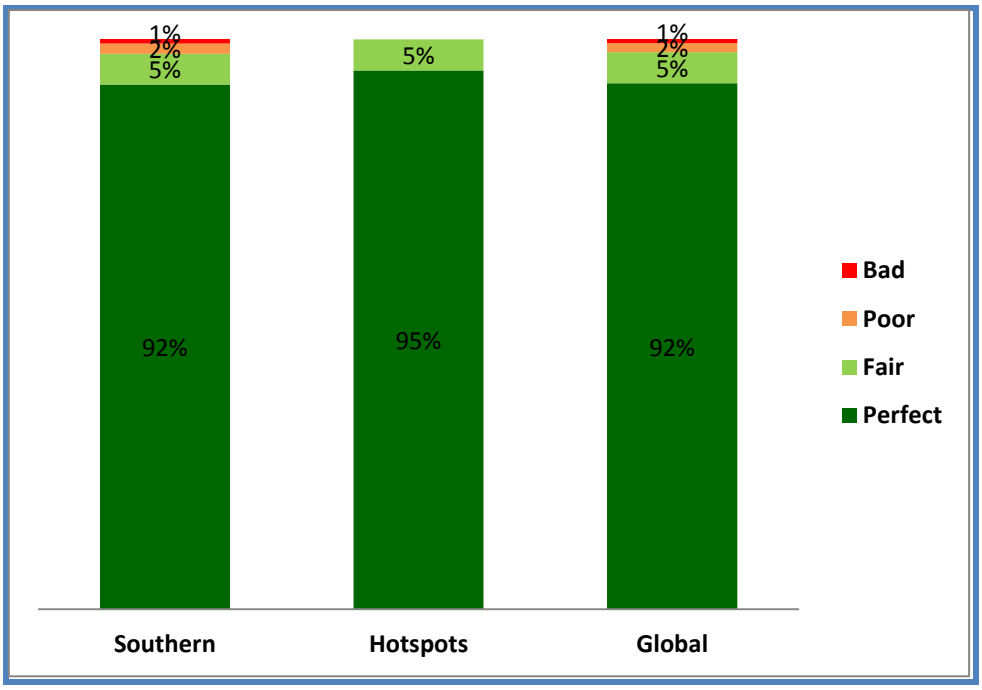


Figure 41: Zain - Voice quality distribution

- 97% of voice calls offer a perfect or fair quality for random locations.
- 100% of voice calls offer a perfect or fair quality for hotspot locations.
- Zain offered an excellent voice quality in all governorates (within coverage area).

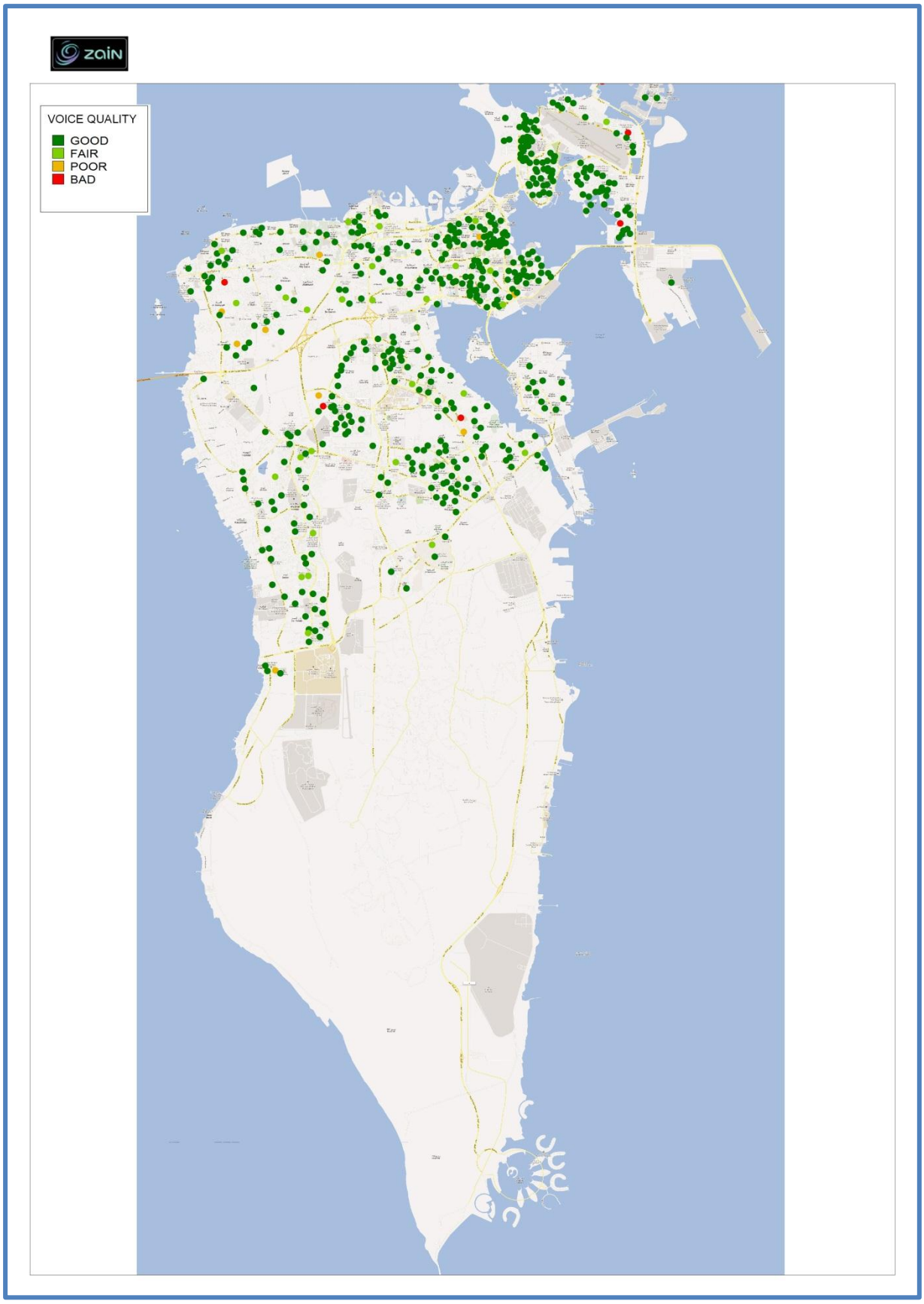


Figure 42: Voice quality distribution of Zain

GLOSSARY

dB	Decibel
dBi	Isotropic Decibel (antenna gain)
dBm	Decibel-milliwatt
CPE	Customer Premise Equipment
DL	Download
FTP	File Transfer Protocol
ICMP	Internet Control Message Protocol
Kbps	Kilo Bits Per Second
Mbps	Mega Bits Per second
QoS	Quality of Service
RTT	Round Trip Time (ms)
RSSI	Received Signal Strength Indication (dBm)
UL	Upload
WiMAX	Worldwide Interoperability for Microwave Access

End of document