Directique 》》》》

Telecommunications Regulatory Authority

Quality of Mobile Services

Kingdom of Bahrain - 2010

This study 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 study is to evaluate and benchmark Quality Levels offered by Mobile Network Operators, Batelco, Viva and Zain, in the Kingdom of Bahrain. The independent study was conducted with an objective End-user perspective by Cabinet Directique and does not represent any views of the TRA.

This study is the property of TRA. Any effort to use this Study for any purpose is permitted only upon TRA's written consent.

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1   READER'S ADVICE

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

Quality of Mobile Services Audit is a snapshot of the observed quality and performance offered by Mobile Operators at the time of the measurements campaign.

Mobile Operators are continuously performing modifications and upgrades (including during the audit). Performance at the time of reading the report may be different.

TRA deliberately chose to assess quality from the end user perspective, which involve for example carrying out measurements with mobile devices which are available in Mobile Operator shops, behaving like the user on the field and cross network testing. Please read section 4 carefully for a full understanding of the test protocol and measurement conditions.

As with any quality audit or survey, the statistical accuracy is systematically presented in the results tables. Accuracy is the error margin to the actual values, so any comparison between results should take this "confidence interval" into account.

To be consistent with this level of accuracy, results have been rounded up or down to the nearest tenth of a unit. It is reminded that:

- the 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 statistical aggregates used in the report are:

- **Standard deviation** shows how much variation there is from the average. A low standard deviation indicates that the data points tend to be very close to the mean, whereas high standard deviation indicates that the data are spread out over a large range of values.

- **Min** and **Max** show the worse and best results (such as delay, throughput) obtained during successful measurements.

- **Average** is always the arithmetic mean of the referred sample.

2 EXECUTIVE SUMMARY

2.1 Introduction

The availability and quality of modern telecommunications services are critical elements for the success of the Kingdom of Bahrain. Mobile telecommunications services are heavily used by consumers and businesses, either located in Bahrain or visiting the Kingdom.

In releasing this study, TRA aimed at evaluating and benchmarking quality levels offered by Mobile Network Operators in the Kingdom of Bahrain, Batelco, Viva and, Zain from an end-user perspective, for the following set of services:

- Voice,
- Short Message Services (SMS)
- Multi Media Messaging Services (MMS)
- File Transfer (FTP)
- Web Surfing
- eMails

The Authority selected Directique, an international consulting firm 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 is performed by Mobile Operators themselves on a regular basis.

This audit was conducted from 19 October 2010 to 12 November 2010 inclusive, with additional measurements taken until 1 December 2010. Measurements were performed between 9:00 am and 10:00 pm every day except Saturdays.

TRA benefited from a similar audit performed in 2009 on Batelco and Zain networks as a point of reference. Due to the imminent launch of Viva services at that time, TRA took the decision to keep the 2009 audit internal. However considering the 2009 audit results, some significant performance improvements have been observed on voice audio quality with about 3 percentage points performance increases in average.

Mobile services are going through an important evolution phase in the Kingdom, specifically in the mobile data arena. Since the audit was conducted, operators have performed significant networks modifications and upgrades; results should be understood in the specific context of the time of the study. To capture network changes and enhancement, it is TRA's intention to conduct a similar audit towards the end of 2011 and compare with the results of this audit in order to highlight any variation in service performance.

Directique would like to emphasis that without the Mobile Operators' cooperation during the review and validation of measurements this report would not have been possible.

2.2 Industry results

The following tables show the average combined results achieved by the three Mobile Operators for all measurements. Detailed results for each Operator are available in section 5 of this report.

2.2.1 Voice and messaging services

Global Voice Service		**7 059 tests**
Rate of calls set-up and held for 2 min		**96.6%**
	Statistical accuracy	*± 0.4%*
and marked	**4-perfect (PQR)**	**94.1%**
	Statistical accuracy	*± 0.5%*
	4-perfect or 3-fair (CQR)	**95.7%**
	Statistical accuracy	*± 0.5%*

The three networks offered good service with an average setup and held calls rate of 96.6%. Global audio quality, road links, cross network calls or performance during busy hours could still be improved.

SMS Service		**1 569 tests**
Rate of Received SMS within 2 min		**99.2%**
	Statistical accuracy	*± 0.4%*
Rate of Received SMS within 30 sec		**96.9%**
	Statistical accuracy	*± 0.9%*
Average time reception		**13.1 s**

All networks offered good SMS service within two minutes with less than 1% defects.

MMS Service		**1 404 tests**
Rate of MMS sent within 1 min		**92.0%**
	Statistical accuracy	*± 1.4%*
Rate of Received MMS within 2 min		**79.1%**
	Statistical accuracy	*± 2.1%*
Rate of Received MMS within 5 min		**81.1%**
	Statistical accuracy	*± 2.0%*
Average end to end time		**56.9 s**

Cross network MMS performance was poor and network interconnection for this service could be improved. The average 2 minutes reception rate for Mobile Operators own network was 91.5%, compared with 79.1% including cross networks results

2.2.2 Computer dongle services

Capital City and Towns of more than 50,000 inhabitants	3 018 tests
Rate of successful radio connections to network	**100.0%**
Statistical accuracy	*± 0.0%*
Rate of successful radio connections within 10 sec	**99.7%**
Statistical accuracy	*± 0.1%*

Data connexion was always available in the most frequent visited areas.

Hot Spots in Al Manamah	4 152 tests
Rate of successful radio connections to network	**98.8%**
Statistical accuracy	*± 0.3%*
Rate of successful radio connections within 10 sec	**98.7%**
Statistical accuracy	*± 0.3%*

Data connexion over best covered hotspots somewhat suffered some congestion during busy hours.

WEB Service	3 219 tests
Rate of succesful data transfers	**96.3%**
Statistical accuracy	*± 1.2%*
Average download time once connected	**7.2 s**

Websurfing performance could be improved as Zain and Viva both experienced one weaker hotspot while Batelco had a high failure rate with one tested website.

Mail Service 100KB	Email sent	Email received
	492 tests	492 tests
Rate of succesful data transfers	**100.0%**	**100.0%**
Statistical accuracy	*± 0.0%*	*± 0.0%*
Average sending/receiving time once connected	**13.4 s**	**4.4 s**

Mail Service 1MB	Email sent	Email received
	441 tests	441 tests
Rate of succesful data transfers	**99.5%**	**99.5%**
Statistical accuracy	*± 0.6%*	*± 0.6%*
Average sending/receiving time once connected	**38.7 s**	**11.1 s**

Nearly all emails could be received in less than 2 minutes.

FTP	Upload 1MB 1 002 tests	Download 5MB 2 016 tests
Rate of succesful data transfers	**98.8%**	**98.8%**
Statistical accuracy	*± 0.7%*	*± 0.7%*
Average Throughput	**376 kBp/s**	**1664 kBp/s**

Good overall performance for FTP data transfers, while average throughput should be enhanced in 2011 with network upgrades to HSPA.

2.2.3 SmartPhone Services

Smartphone services	Upload 1MB 2 076 tests	Download 5MB 2 494 tests
Rate of succesful data transfers	**100.0%**	**100.0%**
Statistical accuracy	*± 0.0%*	*± 0.0%*
Average Throughput	**286 kBp/s**	**1164 kBp/s**

Excellent results for smartphone data transfers, to note throughput observed was lower than with computer dongles.

3 BENCHMARK TO REFERENCE OPERATORS

The following charts are comparing the average results achieved by the three Mobile Operators in the Kingdom of Bahrain, Batelco, Viva and Zain, with the average results obtained by National Mobile Operators in the respective benchmarked markets. Measurements are based on the same test procedures and for the same services.

The results shown for Bahrain are the average combined results achieved by the three Mobile Operators.

In car voice call set-up and held for 2 min rate.
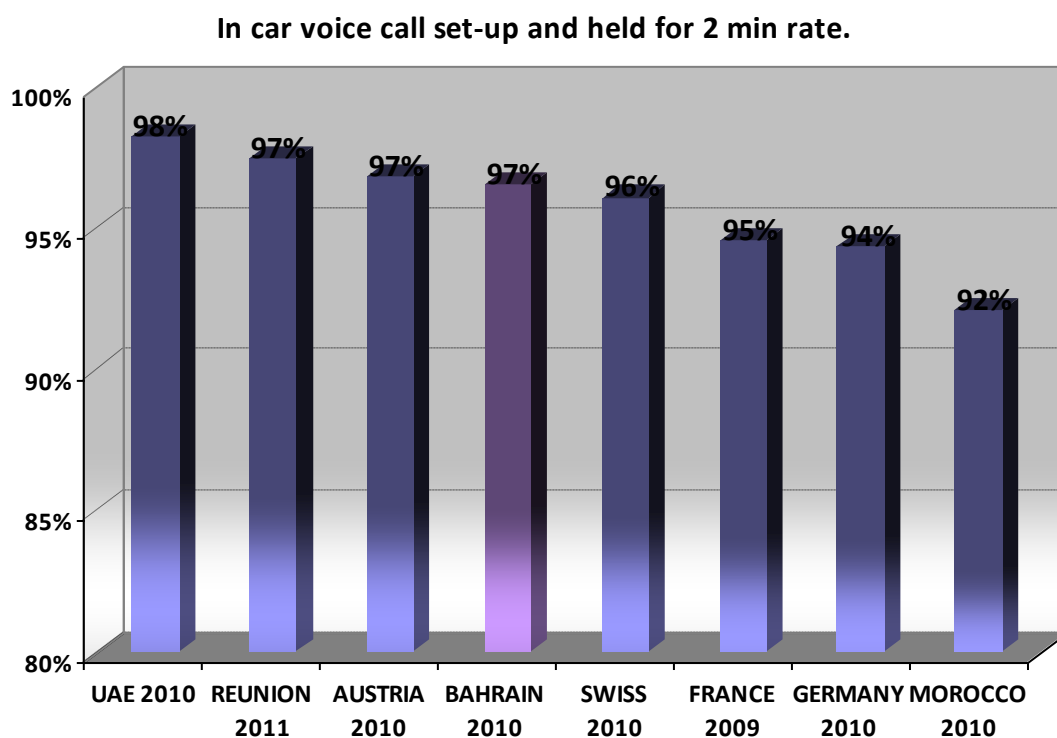
Batelco, Viva and Zain have achieved good performance for maintaining a 2 minutes call while driving in Towns and roads, performance comparable to Austria and Reunion market and better than France or Germany, but not as good as U.A.E.

SMS & MMS service: received message rate
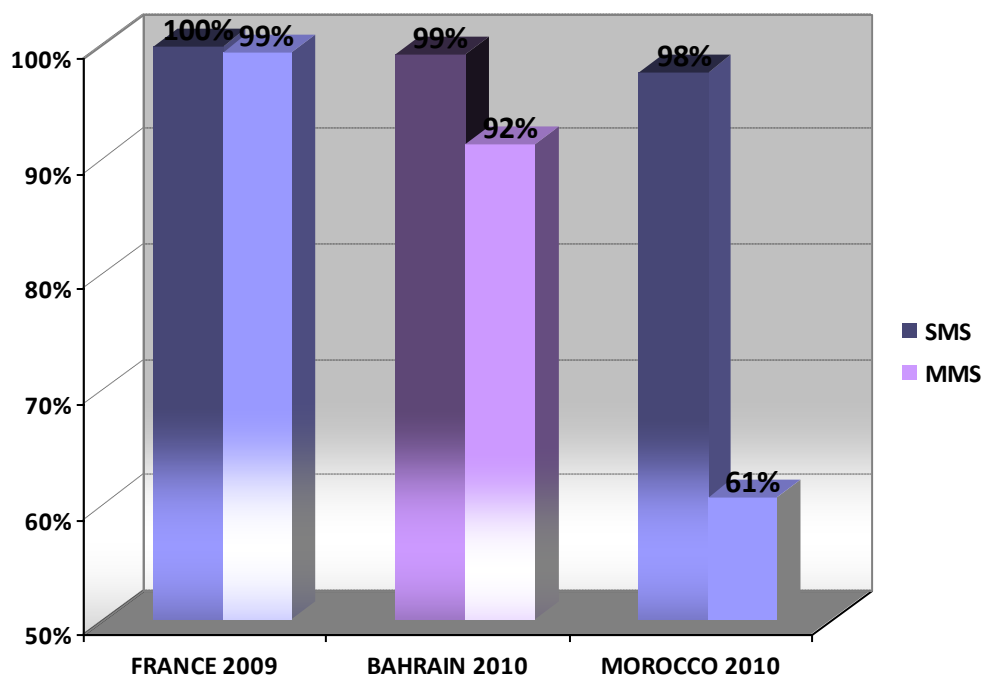
Bahrain's Mobile Operators offered a good performance concerning the successful rate of received SMS message within 2 minutes.

Their MMS performance concerning the successful rate of messages within 5 minutes (own network) was fair, with room for improvements compared to reference market performance such as France.

FTP service: successful data transferts rate
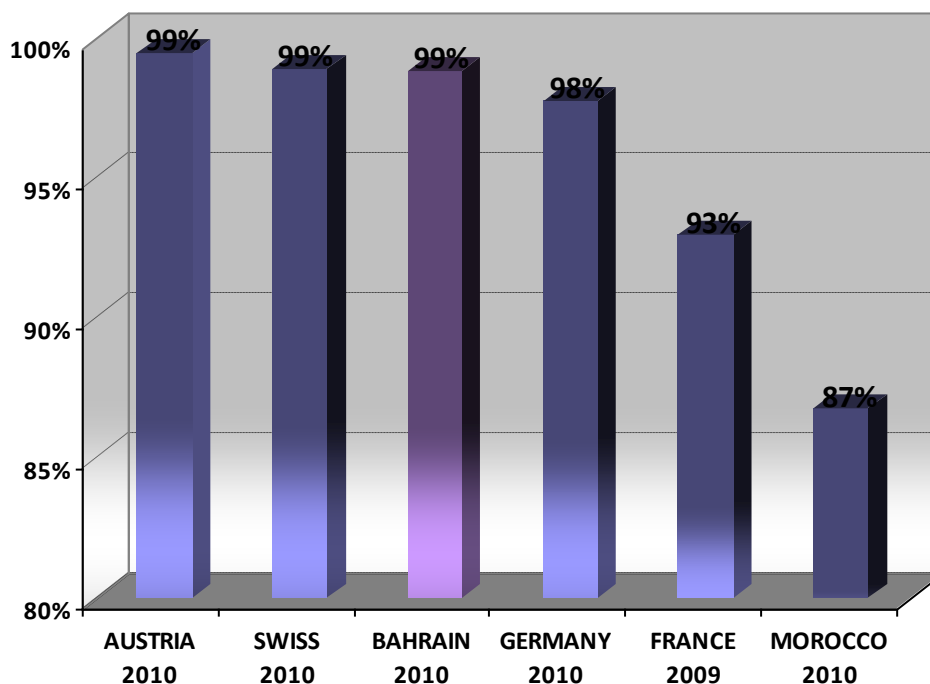
Batelco, Viva and Zain have obtained very good successful rate for Data Transfer (FTP) performances similar to best benchmarked reference markets.

WEB service: successful data transferts rate
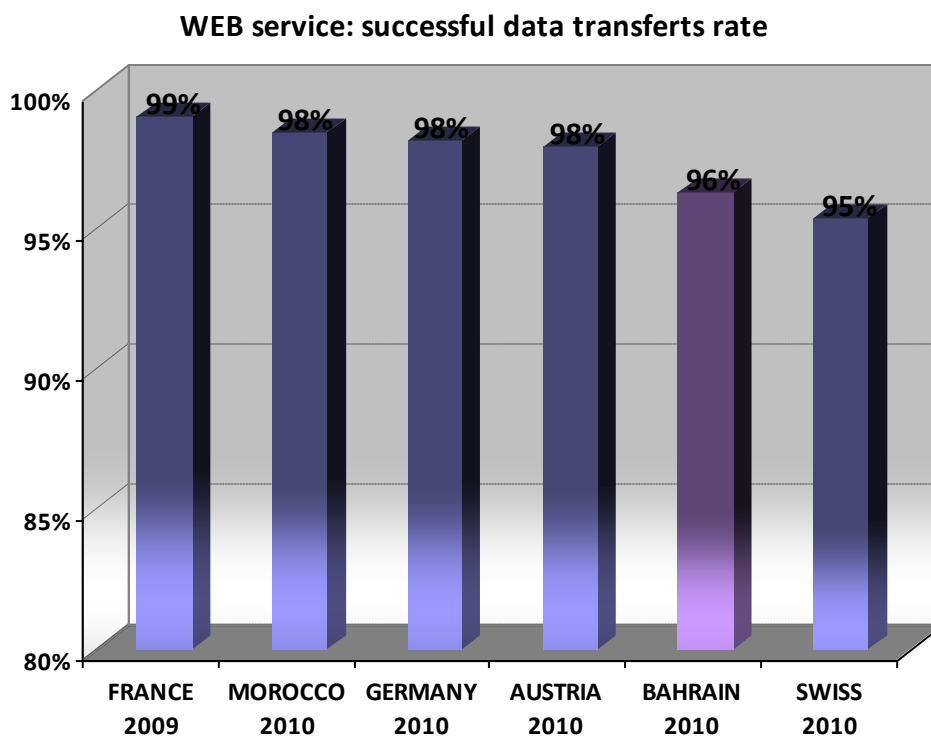
Bahrain's Operators offered fair successful web data transfer performances however in the lower range of the benchmarked reference markets.

4 MEASUREMENTS SPECIFICATION

4.1 Team and Equipment

4.1.1 Team

The project was managed by Directique Operations Director with the following project team on the ground:

- A dedicated project manager present in Al Manamah during audit launch phase.
- A field supervisor based in Al Manamah for the whole audit duration.
- Test team A performing voice and SMS measurements:
  - 2 engineers and a driver in the field,
  - 2 engineers in an office located in Seef area.
- Test team B performing MMS and data measurements:
  - 1 engineer in the field (tests were not carried out while driving),
  - 1 engineer in an office located in Seef area.

4.1.2 Equipment

The following mobile devices have been selected, in agreement with Mobile Operators:

Network	Voice / SMS / MMS	Fixed Phone	FTP / WEB	Smartphone
BATELCO	Nokia 6120C	BATELCO	Huawei E180	HTC Desire
ZAIN			Huawei E180	
VIVA			Bandluxe C321	

Test handsets and data dongles

All devices were compatible with voice, SMS and MMS technologies and were recommended or sold by Mobile Operators for 2G and 3G technologies. Batelco land lines were equipped with a standard fixed phone.

During In car measurements, mobile phones were used without external antenna. For all voice measurements, a hands-free kit was used with mobile phones.

4.1.3 Sim cards

SIM cards were sourced locally.

| SIM	Usage	BATELCO	ZAIN	VIVA
Prepaid SIM	Voice SMS MMS	SimSimShabab SimSim Cool	Eezee	Viva prepaid
Postpaid Sim		Super 30 Freetime 100	Hewar 990	Viva post-paid
Data post-paid Sim	FTP WEB Mail	Onet Mobile Broadband	Ego Mobile Internet Broadband	Viva Broadband unlimited

Test Sim Cards (packages)

4.2 Voice service quality testing

4.2.1 Measurement

A voice measurement was a call attempt followed by a 2 minutes conversation. Calls were placed on all networks simultaneously from the same physical location. A measurement was therefore a set of three calls, one per Mobile Operator.

A field engineer was conversing over his mobile phone with an engineer in the Seef office. The engineer in the office was using either a fixed-line phone or a mobile phone.

Each field team had one phone for each mobile network. Either side could initiate the call following pre-defined call sample objectives.
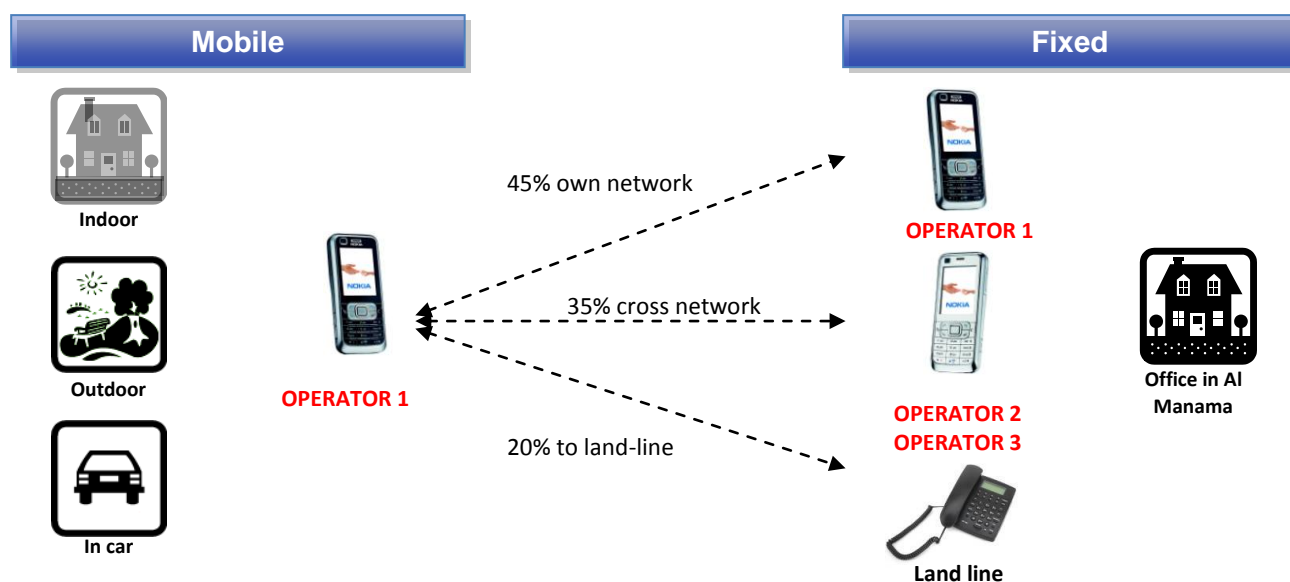
- **Voice Service Levels**:

Voice measurements were performed in three configurations:

- Indoor : Pedestrian Indoor in public and private buildings

- Outdoor: Pedestrian Outdoor in the busiest outdoor places. 1/3 of the measurements were dynamic, walking from one point to another and 2/3 were static.

- In car: On road links (In car Road) and within Town borders (In car Town)

Calls included 45% Mobile to Mobile (MTM) own network, 35% MTM cross networks and 20% Mobile to land line.

- **Audio Quality marking:**

Failed and dropped calls were registered in the database. Otherwise the audio quality was evaluated for established and 2 minutes maintained calls. Once a call was established, engineers followed a speech guideline, simulating an average conversation, and audio quality was marked on a scale of 1 to 4 as follow:

Level 4 : Perfect	Engineer doesn't notice any defect
Level 3 : Fair	One defect occurs while the conversation goes on uninterrupted
Level 2 : Poor	The natural flow of the conversation is altered and the engineer has to repeat himself
Level 1 : Bad	The defect is so strong that conversation cannot proceed.

As the call went on, each engineer took note of the identified defects such as: metallic noises, voice distortion, echo...At the end of the call the fixed located engineer collected both marks on a scale of 1 to 4, did input results in the database, along with standard description of specific defect(s), if any. In the case field and fixed-end engineers had different evaluation for the call, the worst mark was retained.

4.2.2 Testing Area and sample size

Sampling distribution between towns was based on population data and organised as follow:

Towns / Roads	In car town	Indoor	Outdoor	Total
Capital city	303	152	152	607
Towns > 50K inhabitants	326	159	158	643
Towns < 50K inhabitants	408	225	213	846
Road links				257
Total	**1037**	**536**	**523**	**2353**

Test calls repartition

The total number of voice test calls performed was over 7,000

Tested Towns and roads
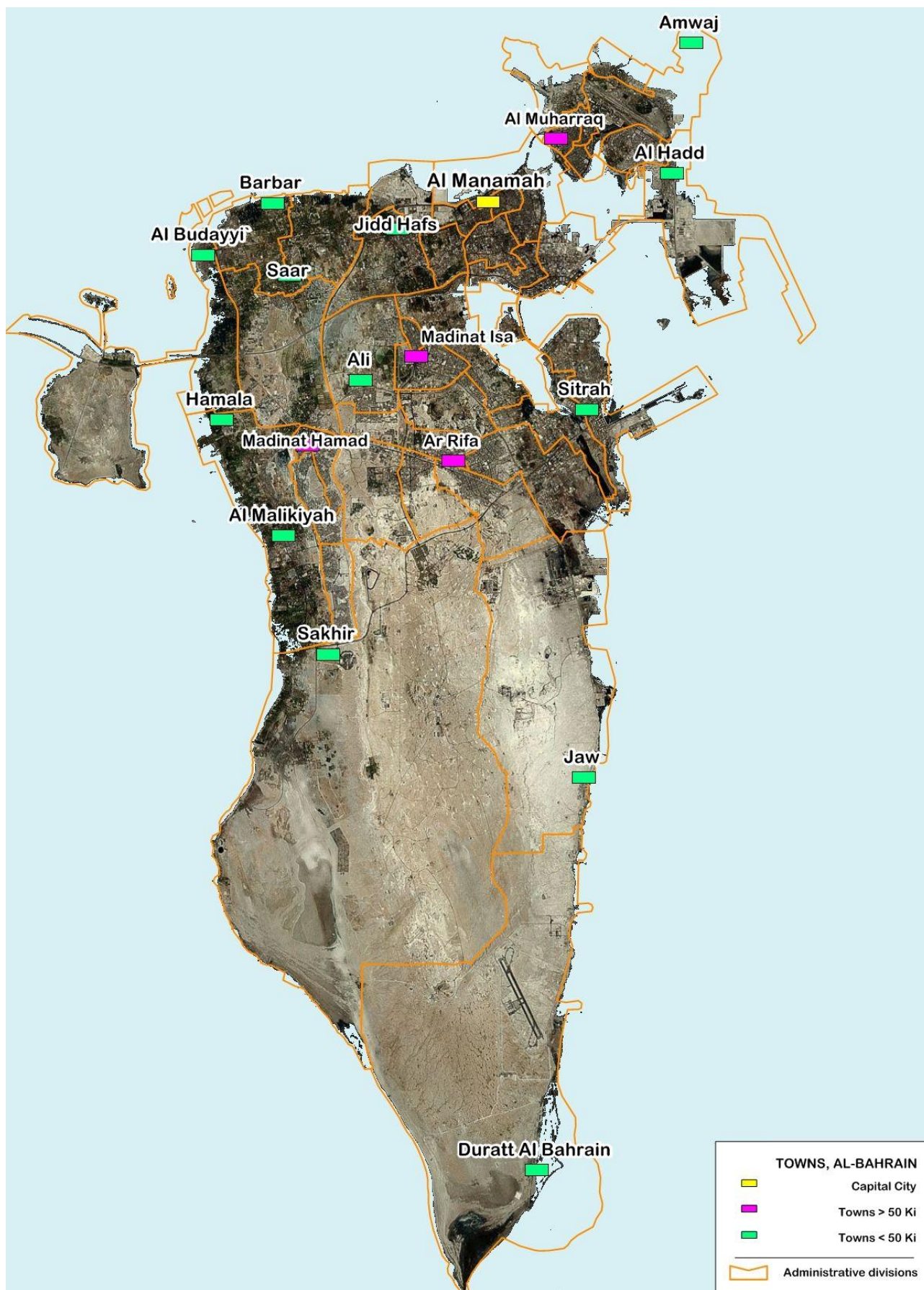
4.2.3 Measurements specifications - Towns

- *In car measurements*

In Towns of more than 50,000 inhabitants, tested zone was divided into equal areas, and a number of calls were allocated to each of these areas. Field engineers did adapt their journey depending on external events (traffic, one way roads…), with the aim of covering the whole area as per test plan.

In smaller Towns (less than 50,000 inhabitants), measurements were performed on a paths that included major roads and constructed zones (Downtown, malls, stations, touristic places and business centres).

- *Pedestrian measurements*

Pedestrian measurements were equally distributed over an area to ensure good test coverage.

Pedestrian outdoor measurements

1/3 of measurements were dynamic (from a point to another) and 2/3 were static. A single test was performed for each location, to always ensure best repartition over the tested zone. Locations were selected among high-attendance pedestrian places (buildings, parks, malls, ...).

Pedestrian indoor measurements

Calls were placed preferably on daylight indoor (less than 3 meters from a window) or on deep indoor. Any floor in a particular building was tested, except basement and above 12th floor.

Measurements were adapted by building type: 46% in the public places and 54% in offices and residential areas:

- Large places : 3 to 4 measurements were performed
- Small places : 1 to 2 measurements were performed

Cites	Own	Cross	Fixed	Total	In car Town	Outdoor	Indoor
Al Budayyi`	51	30	19	100	50	25	25
Al Hadd	22	13	9	44	22	11	11
Al Malikiyah	24	14	9	47	23	12	12
Al Manama	231	251	125	607	303	152	152
Al Muharraq	87	59	35	181	89	45	47
Ali	58	32	23	113	56	27	30
Amwaj	23	13	9	45	23	11	11
Ar Riffa	86	50	34	170	85	42	43
Barbar	7	11	4	22	12	5	5
Durat Al Bahrain	26	15	10	51	12	5	5
Hamala	11	6	5	22	96	31	39
Jaw	26	15	11	52	69	33	33
Jidd Hafs	54	82	30	166	83	38	36
Madinat Hamad	66	41	28	135	20	17	17
Madinat Isa	78	47	32	157	10	10	10
Saar	16	28	10	54	50	25	25
Sakhir	15	9	6	30	17	17	18
Sitrah	49	32	19	100	17	17	17
Total	**930** *44%*	**748** *36%*	**418** *18%*	**2096**	**1037**	**523**	**536**

Pedestrian sample distribution

4.2.4 Measurements specifications - Road links

Road links	Own	Cross	Fixed	Total
Al Budayyi` - Hamala	4	1	2	7
Al Malikiyah - Sakhir	7	3	2	12
Al Malikiyah -Jidd Hafs	4	4	2	10
Al Manama - Al Malikiyah	7	6	3	16
Al Manama - Al Muharraq	6	5	3	14
Al Manama - Hamala	8	4	2	14
Al Manama - Jidd Hafs	11	6	5	22
Al Manama - Sitrah	4	4	2	10
Al Muharraq - Al Hadd	4	3	2	9
Al Muharraq - Amwaj	3	2	1	6
Ali - Madinat Hamad	5	3	2	10
Ar Riffa - Madinat Isa	3	1	2	6
Ar Riffa - Sakhir	4	2	1	7
Barbar - Al Budayyi`	4	2	2	8
Durat Al Bahrain - Ar Riffa	11	7	4	22
Hamala - Al Malikiyah	3	2	2	7
Jaw - Durat Al Bahrain	8	5	3	16
Jidd Hafs - Al Budayyi`	3	2	2	7
Jidd Hafs - Barbar	3	2	1	6
Madinat Hamad - Madinat Isa	6	2	1	9
Madinat Isa - Al Manama	3	2	2	7
Madinat Isa - Sitrah	4	3	2	9
Sakhir-Ali	5	4	2	11
Sitrah - Jaw	6	4	2	12
Total	**126** *49%*	**79** *31%*	**52** *20%*	**257**

Road links sample distribution

4.2.5 Global Voice Measurements Distribution

Definition		Realized
Calls origins	MTM own	45%
	MTM cross	35%
	Fixed	20%
Hours	Busy hours	37%
Outdoor	Stationary	67%
	Moving	33%
Indoor	Daylight	49%
	Deep	51%
Type of Indoor	Private (Offices and Habitation)	54%
	Public	46%

4.2.6 Method

Test methodology followed ITU ref P.800 Mean Opinion Score for voice specification.

The corner stone of Directique test methodology is based on a training method performed on a specifically developed software **FormaTest** ©.This training method allows for a clear and faithful marking system of audio and video quality problems. Directique guarantee consistency across engineers, and a minimum standard deviation of the marks.

All tests were timed stamped and GPS tagged, in order to ensure full traceability of each measurement.

Test phones were verified on a daily basis, and when allocated for field testing, handsets were rotated between teams regularly to avoid bias due potential to small differences between same model phones in radio frequency sensitivity and processor performance.

Measurements software assisted by **ChronoTest** ©, were started simultaneously by the mobile and the fixed operators to synchronize call start. The software provided engineers with all necessary information related to a test call, when a call had to be placed (either mobile originated or mobile terminated) and ended, in order to guarantee a strict adherence to test protocol. **ChronoTest** © was combined with a GPS receiver recording the location of the mobile team every second.

All information concerning test location and call marks were recorded by the engineer at the fixed-end location in a database who ran live coherence checks to guarantee error free recording.

Hands-free kits were used on mobile phones in order to minimizes ambient noise and provide a better environment to the field engineer to measure quality of the voice service.

Outdoor, the phone was either held by hand, or placed in a pocket in areas where discretion was required.

4.2.7 No default procedure

In order to guarantee the same level of assessment for all Mobile Operators, engineers were regularly switched from one operator to another.

In order to prevent a faulty phone polluting measurement samples, phones used for the test were new and tested prior the start of measurements campaign.

Any abnormal behaviour of a handset was recorded and the phone was removed from the test pool.

Every week, test results were computed in a way that singled out any problem that could be related to a test phone.

Test phones were rotated between Mobile Networks every half day.

4.3 SMS and MMS measurements

4.3.1 SMS Measurements

The mobile phones used to receive SMS were at a fixed location in an area served by a strong radio signal from the Mobile Operators. The mobile phones transmitting the SMS were in the field with the testing team. SMS were sent from indoor and outdoor locations used for voice testing or from the fixed location in Seef area. During a test both phones stayed still.

A measurement, made simultaneously on all Mobile Networks, consisted of:

- Sending a 26 characters message including an index, and recording time

- Observing on the phone when transmission was acknowledged and taking note of the time

- Observing reception of the message on the other phone and taking note of the time; a message not received after 2 minutes elapse time was marked as failed.

- Opening and checking integrity of the received message and index matching
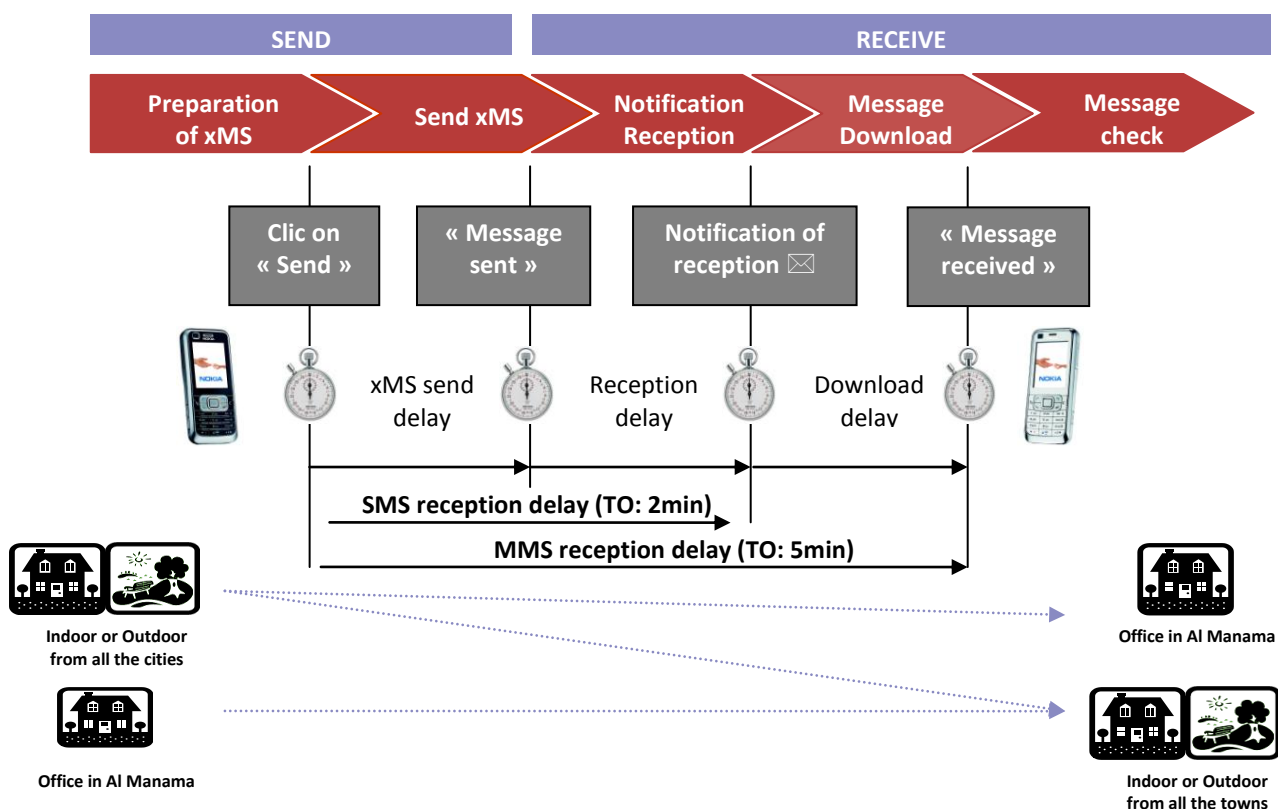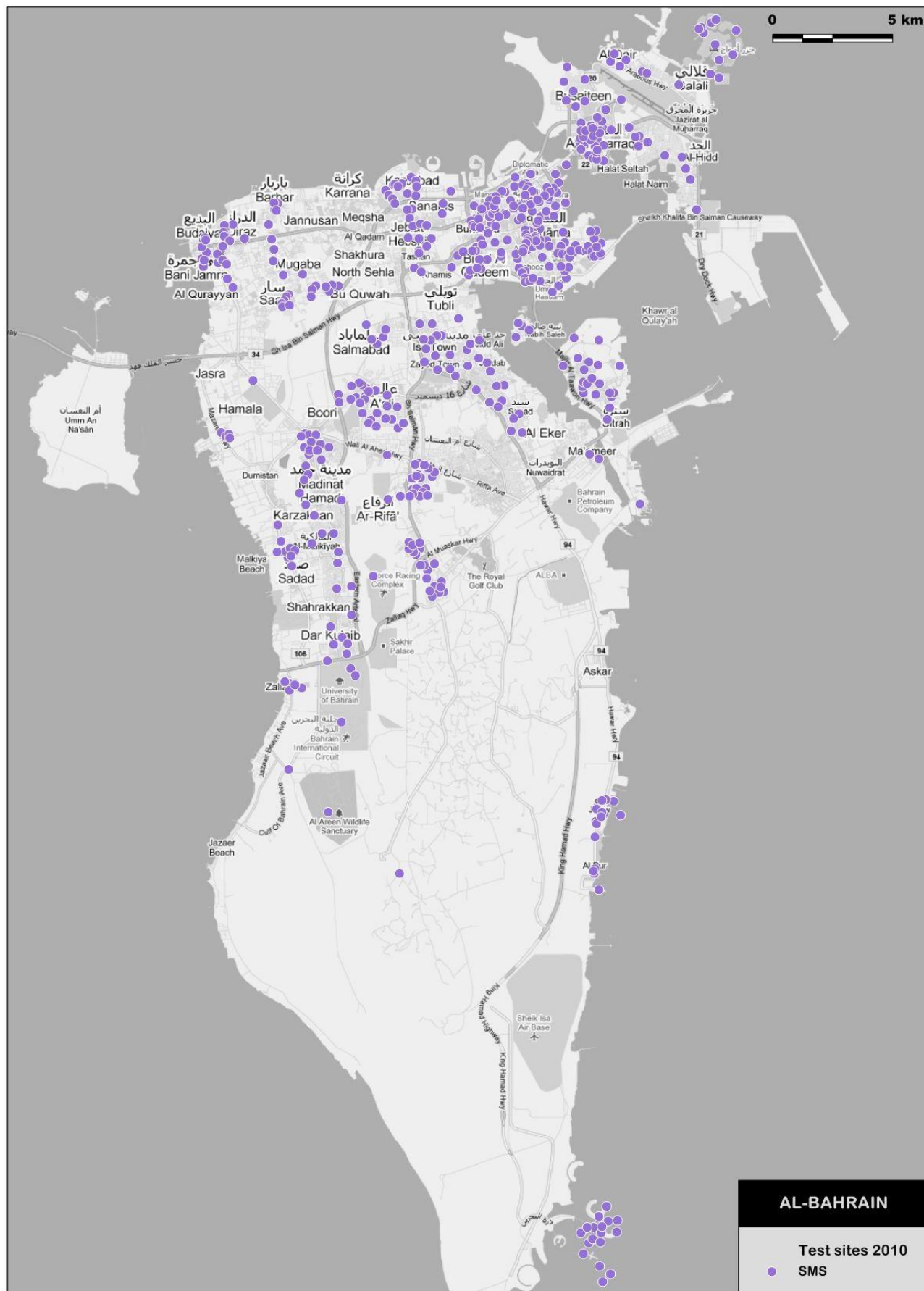
SMS test areas excluded road links, SMS testing schedule was the same as for voice testing.

The following table show the SMS test sample repartition:

Towns	Own	Cross	Total	Emission Al Manamah	Reception Al Manamah	Emission and Reception in towns
Al Budayyi`	11	14	25	9	8	8
Al Hadd	7	4	11	4	3	4
Al Malikiyah	6	6	12	4	4	4
Al Manama	76	76	152	52	50	50
Al Muharraq	23	22	45	13	16	16
Ali	12	15	27	9	8	10
Amwaj	6	5	11	4	3	4
Ar Riffa	21	21	42	14	15	13
Barbar	2	3	5	1	2	2
Durat Al Bahrain	9	8	17	5	6	6
Hamala	3	2	5	2	2	1
Jaw	8	9	17	6	6	5
Jidd Hafs	16	15	31	10	12	9
Madinat Hamad	16	17	33	10	12	11
Madinat Isa	19	19	38	12	13	13
Saar	10	7	17	6	6	5
Sakhir	6	4	10	4	2	4
Sitrah	12	13	25	9	8	8
Total	**263**	**260**	**523**	**174**	**176**	**173**
	50%	*50%*		*33%*	*34%*	*33%*

Map of SMS measurements

4.3.2 MMS Measurements

MMS measurements were performed in a similar manner to the SMS, with the addition MMS were made of 26 characters, an index, plus a 25 KB data attachment; receiving phone parameters were set to automatic reception.

Testing MMS area excluded road links and small towns, MMS testing schedule was the same as for voice testing.

The following table shows MMS test sample repartitions:

Towns	Own	Cross	Total	Emission Al Manamah	Reception Al Manamah	Emission and Reception in the Towns
Al Manamah	30	30	60	20	20	20
Al Muharraq	53	49	102	34	34	34
Al Riffa	52	50	102	34	34	34
Madinat Hamad	50	52	102	34	34	34
Madinat Isa	50	52	102	34	34	34
Total	**235** *50%*	**233** *50%*	**468**	**156** *33%*	**156** *33%*	**156** *33%*

Map of MMS measurements
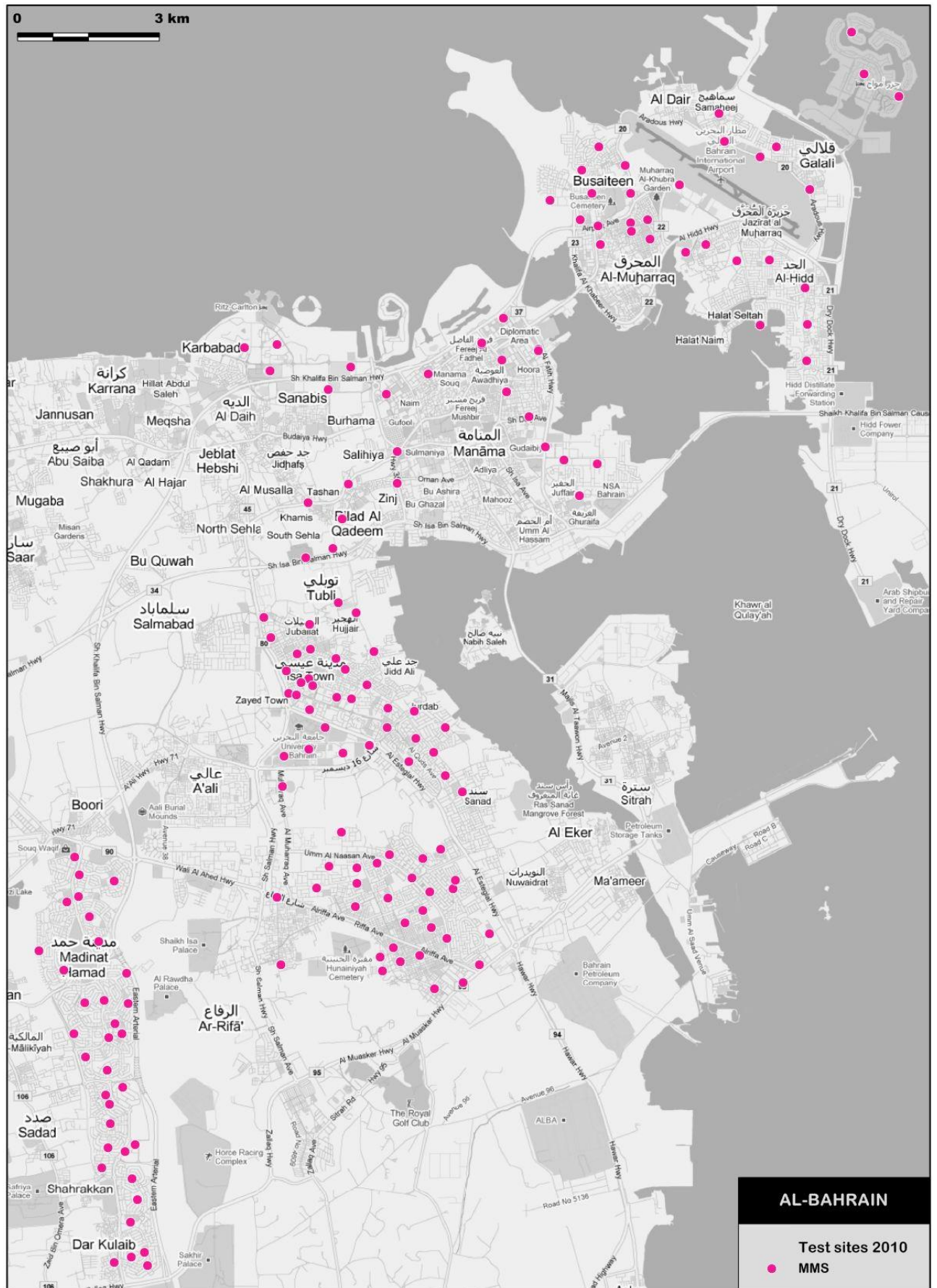
4.4 Data service testing

4.4.1 FTP measurements

Data measurements were carried out automatically via **Mobi.Net** ©, Directique's software data test.

Test handset were connected to a laptop and **Mobi.Net** © was launched on each selected test point.

On each network, a measurement consisted of:

- Attempting to set up a radio connection before a 1 minute timeout. Connection time was recorded.

- Downloading 1MB and 5MB file via FTP. Download time of the entire file was recorded (test of integrity)

- Uploading 1MB file via FTP. Uploading time of the entire file was recorded

In case of error, the software did record the error type based on pre-defined error codes such as: FTP server connection error, radio signal drop, data transfer timed out set at 10 minutes etc.
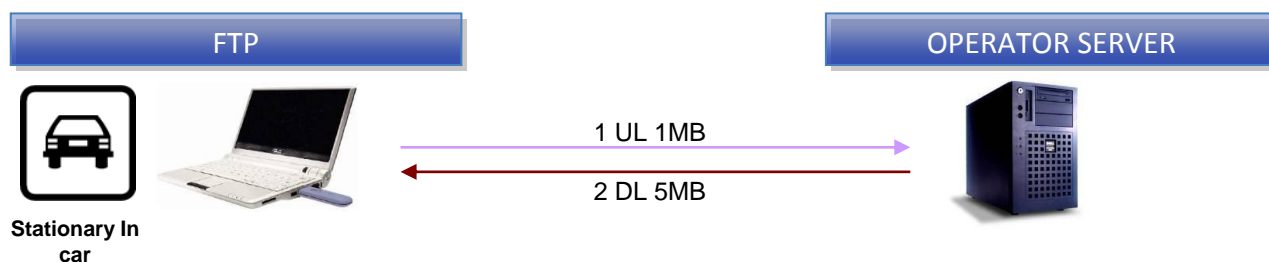
Quality of Service assessment offered by the access network with FTP Download and Upload tests was distributed over Capital City and Towns of more than 50,000 inhabitants.

Towns	Connexion	FTP DL 5MB	FTP UL 1MB
Al Manamah	208	139	69
Al Muharraq	195	130	65
Al Riffa	192	128	64
Isa Town	206	137	69
Madinat Hamad	205	137	68
Total	**1006**	**671**	**335**

FTP test samples repartition

4.4.2 Web and Mail measurement

Web and Mail measurements were carried out automatically with **Mobi.Net** © (introduced earlier).
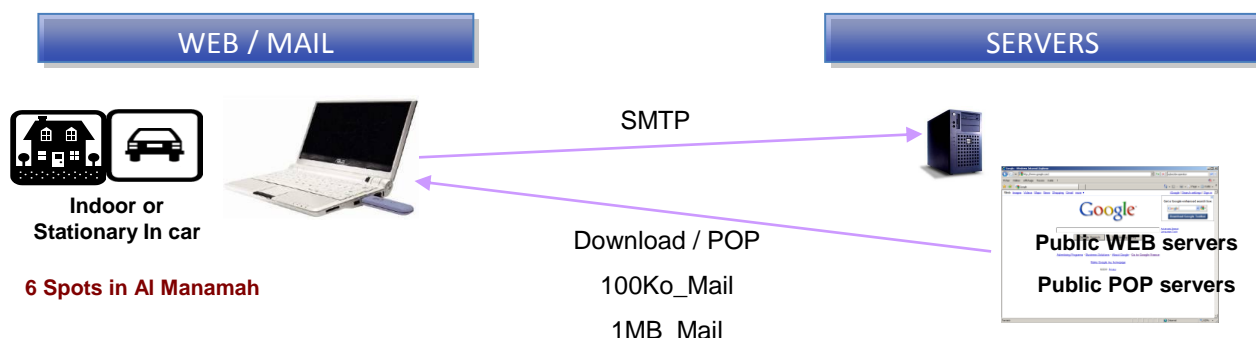
The test 3G+ USB dongle was connected to a laptop and **Mobi.Net** © was launched on each selected test point.

On each network, a measurement consisted of:

- Attempting to set up a radio connection before timeout set to 1 minute. Record connection time.

- For Web : downloading one of the 10 most visited public homepages and the homepage of each operator, taking note of completion time, errors on page if any, with a 2 minutes timeout.

Batelco	Zain	Viva
http://www.batelco.com	http://www.bh.zain.com/portal/page/portal/home	http://www.viva.com.bh/static/CorporatePortal/English/Home/index.htm
http://www.alwasatnews.com/	http://www.alwasatnews.com/	http://www.alwasatnews.com/
http://www.facebook.com/	http://www.facebook.com/	http://www.facebook.com/
http://www.google.com.bh/	http://www.google.com.bh/	http://www.google.com.bh/
http://www.google.com/	http://www.google.com/	http://www.google.com/
http://www.kooora.com/	http://www.kooora.com/	http://www.kooora.com/
http://www.live.com	http://www.live.com	http://www.live.com
http://www.maktoob.com/	http://www.maktoob.com/	http://www.maktoob.com/
http://www.msn.com/	http://www.msn.com/	http://www.msn.com/
http://www.yahoo.com/	http://www.yahoo.com/	http://www.yahoo.com/
http://www.youtube.com/	http://www.youtube.com/	http://www.youtube.com/

HTTP tested webpages

- For Mail (SMTP/POP): sending and receiving an e-mail, with an attached document 100Ko or 1MB.

Sample Web and Mail

Test of the end to end usage from a fixed location with the best data coverage with web surfing and mail: 6 locations (Hot Spots) provided by each operator in Al Manamah.

Hot Spots			Samples	
Batelco	**Zain**	**Viva**	**Mail 100Ko/1Mo**	**Web**
Bahrain Society of Engineers	Dairy Queen, Al Qufool	Al Fateh Road 2442	25/25	166
Dnata Travels	Imperial Mansoori Mansion	Al Guful Road 1224	25/25	166
Dome Restaurant	Juffair 2	Al Hoora Road 1902	25/25	166
Maggies Restaurant	Manama Block 337	Al Suwayfiyah Road 5115	25/25	166
Mars Computers	Ras Ruman 306	Center Sa'Sa'Ah Avenue	25/25	166
Modern Knowledge School	Zinj 2	Gudaibiya Road 2113	25/25	166

Mail test samples repartition

4.4.3 Smartphone measurement

The test mobile was connected to a laptop and **MobiSpeed** © was launched on each selected test point.

On each network, a measurement consisted of:

- Downloading and 5MB file via FTP. Download time of the entire file was recorded (test of integrity).

- Uploading 1MB file via FTP. Uploading time of the entire file was recorded

- Downloading and 5MB file via HTTP. Download time of the entire file was recorded (test of integrity).

- Uploading 1MB file via HTTP. Uploading time of the entire file was recorded

In cases of error, the software did record the error type based on pre-defined error codes such as: FTP server connection error, radio signal drop, data transfer timed out set at 10 minutes etc

FTP   OPERATOR SERVER

Stationary In car

FTP / HTTP : UL 1MB
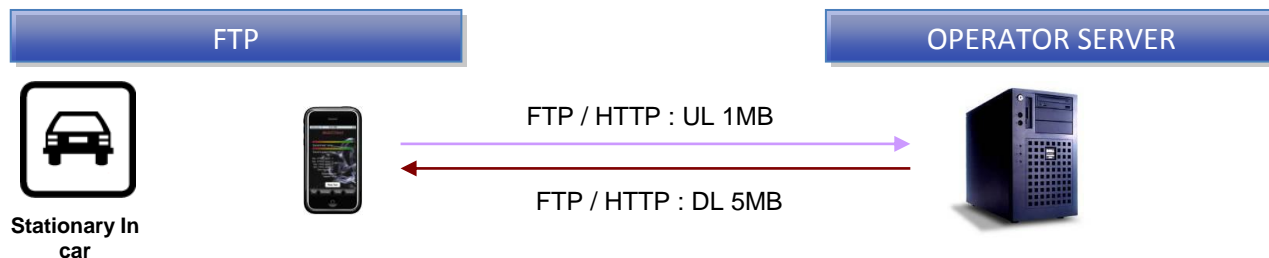
FTP / HTTP : DL 5MB

Smartphone testing area excluded road links, testing schedule was the same as for voice pedestrians testing.

Towns	FTP UL 1MB	FTP DL 5MB	HTTP UL 1MB	HTTP DL 5MB	Accessibility
Al Budayyi	13	20	21	20	507
Al Hadd	7	8	9	11	828
Al Malikiyah	3	10	10	11	564
Al Manama	83	119	176	178	4752
Al Muharraq	21	38	41	41	1768
Ali	12	18	21	22	1209
Amwaj	5	5	9	8	466
Ar Riffa	21	36	37	41	1278
Barbar	6	6	6	5	233
Durat Al Bahrain	9	9	12	12	252
Hamala	3	5	3	5	609
Jaw	9	14	16	15	283
Jidd Hafs	16	22	21	22	1066
Madinat Hamad	12	23	27	28	1793
Madinat Isa	15	29	29	33	2144
Saar	7	10	12	12	919
Sakhir	4	10	9	9	540
Sitrah	10	17	21	20	1140
Total	**256**	**399**	**480**	**493**	**20351**

Smartphone test sample repartition

Map of DATA measurements
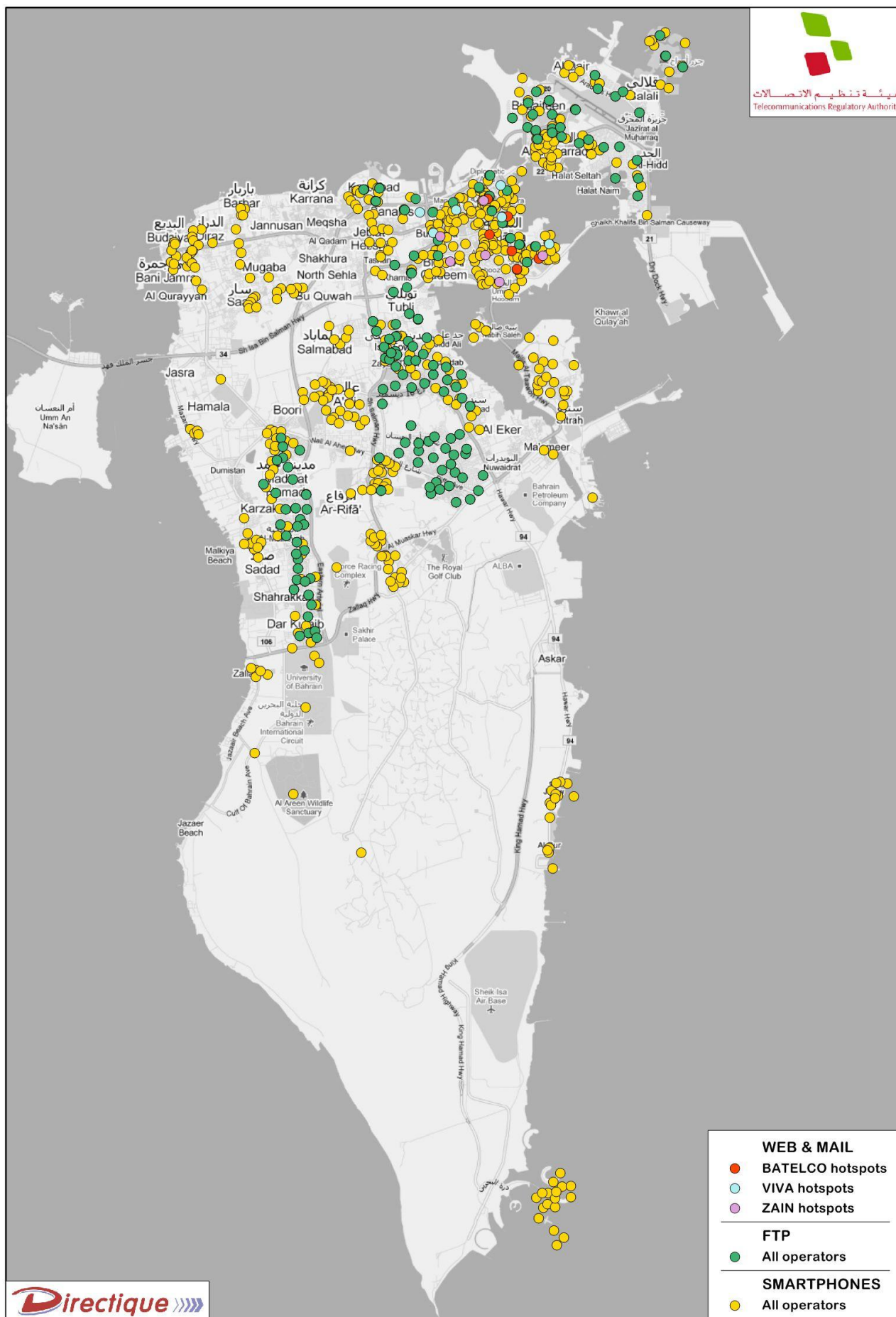
5   AUDIT RESULTS

5.1 Key Performance Indicators

5.1.1   Voice KPIs

A voice measurement is a successful call attempt followed by a 2 minutes conversation, with an assessment of the audio voice quality for each operator service.

KPIs	Definition
SHC (Set-up and held for 2 min calls)	% of calls set-up and held for 2 min. Call set-up on first attempt and held for 2 min without drop. Rate is based on the total sample
PQR (Perfect quality rate)	% of calls set-up held for 2 min and marked 4. Calls excluded = failed on first attempt, dropped before 2 min, or been marked 3 or lower Rate is based on the total sample
CQR (Correct quality rate)	% of calls set-up held for 2 min and marked 3 or 4 Calls excluded = failed on first attempt, dropped before 2 min, or been marked 2 or lower Rate is based on the total sample

5.1.2   SMS KPIs

KPIs	Definition
RS2 (% of received SMS within 2 minutes)	SMS not refused when sent out and received within 2 minutes without being altered Rate is based on the total number of SMS send attempts.
RS30 (% of SMS received SMS within 30 sec)	SMS not refused when sent out and received within 30 seconds without being altered.

5.1.3   MMS KPIs

KPIs	Definition
RM5 (% of received MMS within 5 minutes)	MMS not refused when sent out and received within 5 minutes without being altered Rate is based on the total number of MMS send attempts.
RM2 (% of received MMS within 2 min)	MMS not refused when sent out and received within 2 minutes without being altered.

5.1.4   FTP, HTTP, Web and Mail KPIs

KPIs	Definition
% of successful radio connections within 1 minute	Connection within 1 minute timeframe. The indicator is based on the total number of connection attempts
% of successful radio connections within 10 seconds	Same as above but within 10 seconds timeframe
% of successful data transfers	Successful data file when received in full and without radio drop, within 10 minutes (FTP) or 2 minutes (Web & eMails) once connected. Indicator is based on the total number of connection attempts
Average download time once connected	Average download time once connected applied only to successful data transfers
Standard download time deviation	Standard download time deviation applied only to successful data transfers

5.2 Batelco results

5.2.1 Global voice results (Towns & Roads)

Global Voice Service			BATELCO 2 353 tests
Rate of calls set-up and held for 2 min			**96.0%**
		Statistical accuracy	*± 0.8%*
and marked	**4-perfect (PQR)**		**93.8%**
		Statistical accuracy	*± 1.0%*
	4-perfect or 3-fair (CQR)		**95.6%**
		Statistical accuracy	*± 0.8%*

5.2.1.1   Towns voice results (In car-Indoor-Outdoor)

Towns Voice Service			BATELCO 2 096 tests
Rate of calls set-up and held for 2 min			**95.9%**
		Statistical accuracy	*± 0.8%*
and marked	**4-perfect (PQR)**		**93.9%**
		Statistical accuracy	*± 1.0%*
	4-perfect or 3-fair (CQR)		**95.6%**
		Statistical accuracy	*± 0.9%*
Difference between busy hours and others			**1.2%**
		Statistical accuracy	*± 0.5%*

Towns Incar Voice Service			BATELCO 1 037 tests
Rate of calls set-up and held for 2 min			**95.5%**
		Statistical accuracy	*± 1.3%*
and marked	**4-perfect (PQR)**		**94.1%**
		Statistical accuracy	*± 1.4%*
	4-perfect or 3-fair (CQR)		**95.5%**
		Statistical accuracy	*± 1.3%*

5.2.1.2   Roads Links voice results

Road Links Voice Service		**BATELCO** **257 tests**
Rate of calls set-up and held for 2 min		**96.9%**
	Statistical accuracy	*± 2.1%*
and marked	**4-perfect (PQR)**	**92.2%**
	Statistical accuracy	*± 3.3%*
	4-perfect or 3-fair (CQR)	**95.3%**
	Statistical accuracy	*± 2.6%*
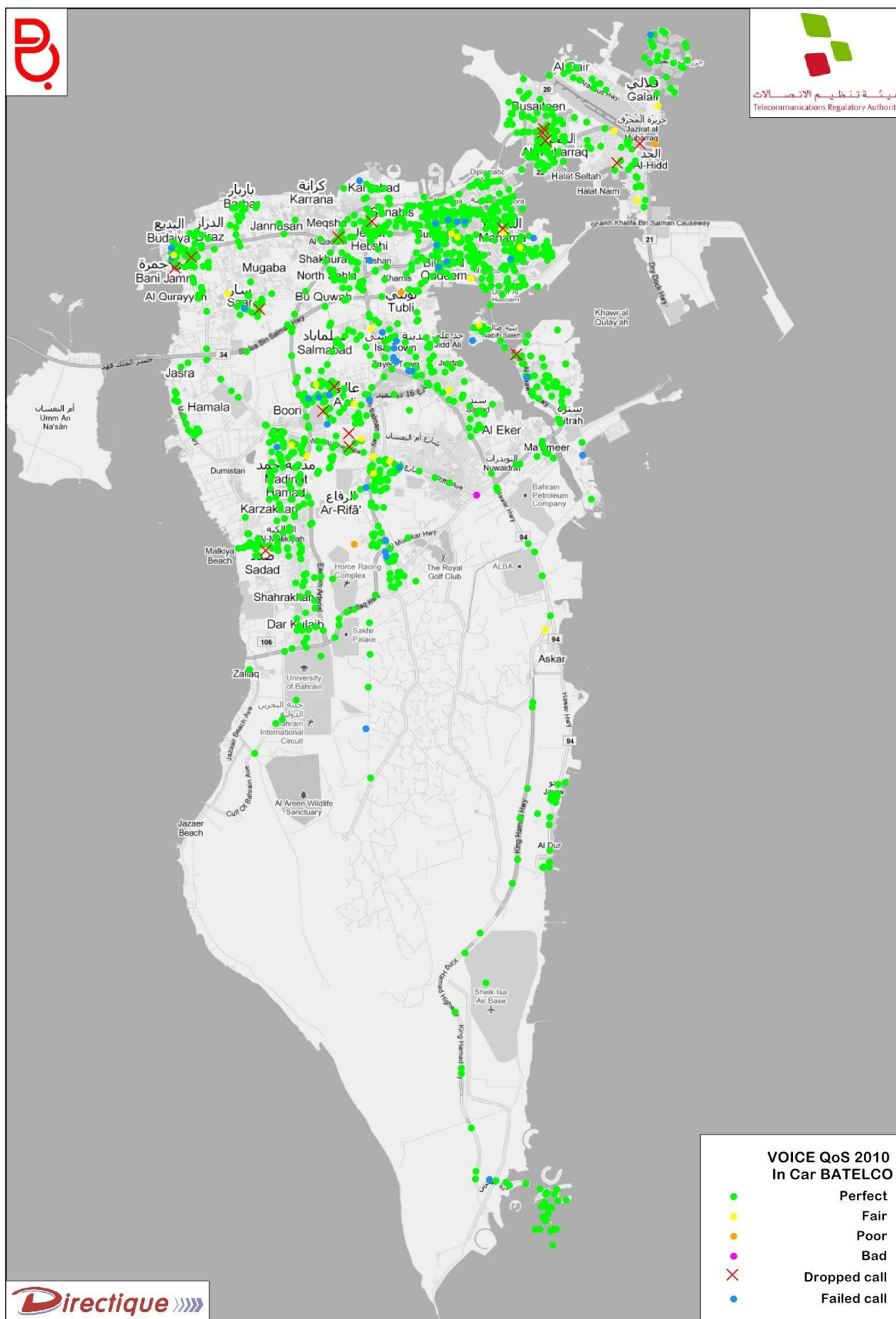
In car voice results

5.2.2 Data results

5.2.2.1 SMS results

SMS Service	BATELCO 523 tests
Rate of Received SMS within 2 min	**98.5%**
Statistical accuracy	*± 1.1%*
Rate of Received SMS within 30 sec	**97.3%**
Statistical accuracy	*± 1.4%*
Average time reception	**12.5 s**

5.2.2.2 MMS results

MMS Service	BATELCO 468 tests
Rate of MMS sent within 1 min	**91.9%**
Statistical accuracy	*± 2.5%*
Rate of Received MMS within 2 min	**77.1%**
Statistical accuracy	*± 3.8%*
Rate of Received MMS within 5 min	**78.2%**
Statistical accuracy	*± 3.7%*
Average end to end time	**51.9 s**
Average time emission	**13.3 s**
Average time reception notification	**33.1 s**
Average time downloaded message	**5.5 s**

5.2.2.3 Data accessibility results

Capital City and Towns of more than 50,000 inhabitants	BATELCO 1 006 tests
Rate of successful radio connections to network	**100.0%**
Statistical accuracy	*± 0.0%*
Rate of successful radio connections within 10 sec	**99.8%**
Statistical accuracy	*± 0.3%*

Hot Spots in Al Manamah	BATELCO 1 378 tests
Rate of successful radio connections to network	**99.8%**
Statistical accuracy	*± 0.2%*
Rate of successful radio connections within 10 sec	**99.7%**
Statistical accuracy	*± 0.3%*

5.2.2.4 WEB service results

WEB Service	BATELCO 1 083 tests
Rate of succesful data transfers	**95.5%**
Statistical accuracy	*± 1.2%*
Average download time once connected	**7.9 s**
Min download time once connected	**0.9 s**
Max download time once connected	**58.0 s**
Standard deviation download time once connected	**10.2 s**

5.2.2.5 FTP results

FTP BATELCO	Upload 1MB 332 tests	Download 5MB 674 tests
Rate of succesful data transfers	**98.5%**	**99.3%**
Statistical accuracy	*± 1.3%*	*± 0.6%*
Average Throughput	**281 kBp/s**	**749 kBp/s**
Min Throughput	**48 kBp/s**	**82 kBp/s**
Max Throughput	**767 kBp/s**	**3130 kBp/s**
Standard deviation Throughput	**124 kBp/s**	**506 kBp/s**

5.2.2.6 Mail results

Mail Service BATELCO	Email sent 100KB 168 tests	Email received 100KB 168 tests	Email sent 1MB 127 tests	Email received 1MB 127 tests
Rate of succesful data transfers	**100.0%**	**100.0%**	**98.4%**	**98.4%**
Statistical accuracy	*± 0.0%*	*± 0.0%*	*± 2.2%*	*± 2.2%*
Average sending/receiving time once connected	**16.8 s**	**4.9 s**	**51.5 s**	**11.6 s**
Min sending/receiving time once connected	**7.4 s**	**4.1 s**	**19.8 s**	**9.6 s**
Max sending/receiving time once connected	**73.5 s**	**9.5 s**	**97.6 s**	**22.9 s**
Standard deviation sending/receiving time once	**8.7 s**	**0.6 s**	**19.0 s**	**2.3 s**

5.2.3 SmartPhone results

5.2.3.1   *Data Coverage*

Smartphone Data Coverage	BATELCO 20 351 tests
GPRS	**0.0%**
Statistical accuracy	*± 0.0%*
EDGE	**3.5%**
Statistical accuracy	*± 0.3%*
UMTS	**69.6%**
Statistical accuracy	*± 0.6%*
HSPA	**27.0%**
Statistical accuracy	*± 0.6%*

This table provides the technology breakdown used by Mobile Operators as recorded during all measurements. Every minute, the mobile is recording the observed technology. These samples have been taken in towns and on road links. They are shown as contextual information at the time of the audit.

27% of the measurements for BATELCO were achieved using HSPA[1], versus 69.6% for UMTS[2].

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[1] HSPA High Speed Packet Access

[2] UMTS Universal Mobile Telecommunications System
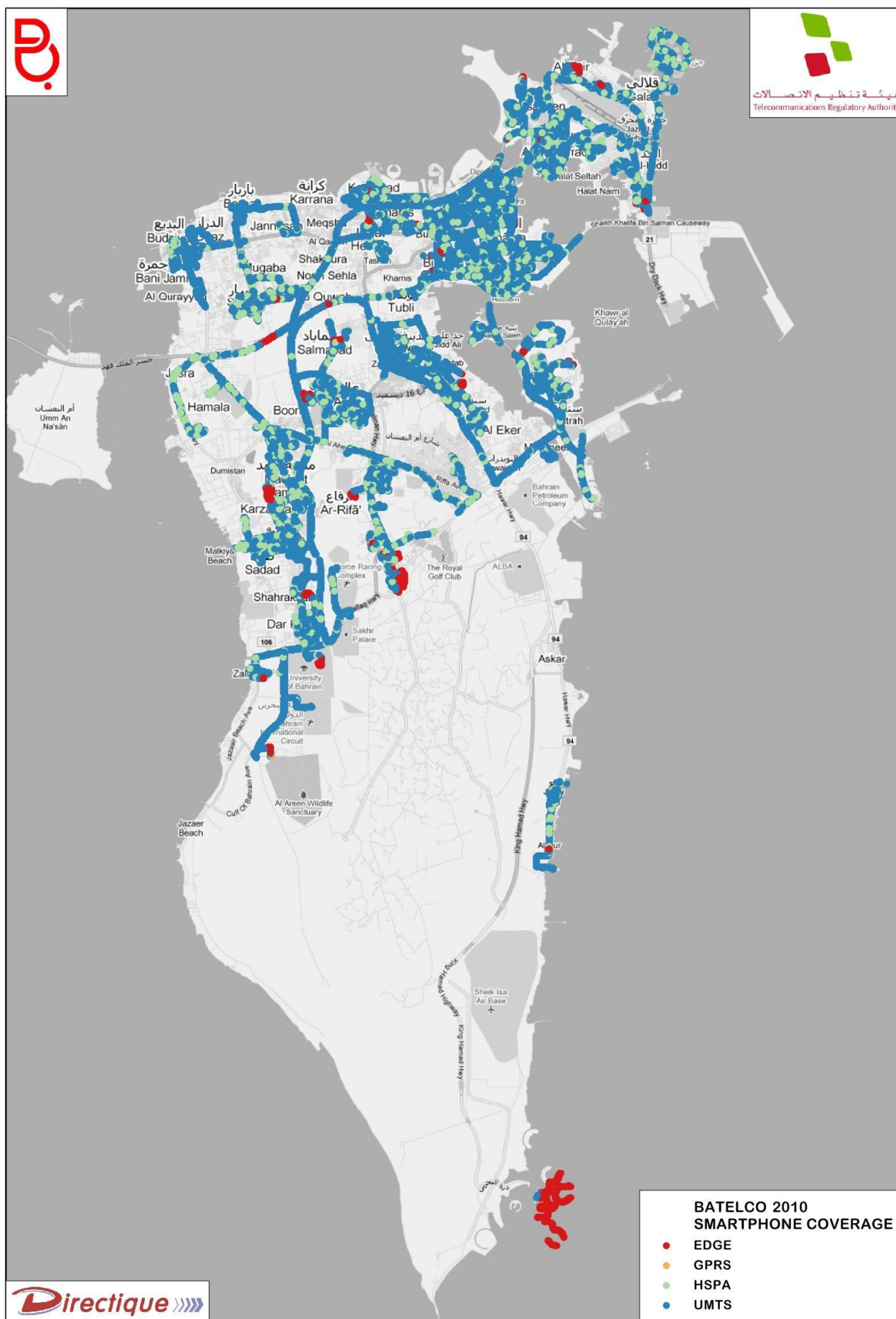
Smartphone Service: Data Coverage

5.2.3.2   FTP

Smartphone FTP BATELCO	Upload 1MB	Download 5MB
	256 tests	**399 tests**
Rate of succesful data transfers	**100.0%**	**100.0%**
Statistical accuracy	*± 0.0%*	*± 0.0%*
Average Throughput	**107 kBp/s**	**356 kBp/s**
Min Throughput	**2 kBp/s**	**11 kBp/s**
Max Throughput	**384 kBp/s**	**1907 kBp/s**
Standard deviation Throughput	**92 kBp/s**	**303 kBp/s**

5.2.3.3   HTTP

Smartphone HTTP BATELCO	Upload 1MB	Download 5MB
	493 tests	**480 tests**
Rate of succesful data transfers	**100.0%**	**100.0%**
Statistical accuracy	*± 0.0%*	*± 0.0%*
Average Throughput	**167 kBp/s**	**404 kBp/s**
Min Throughput	**6 kBp/s**	**11 kBp/s**
Max Throughput	**624 kBp/s**	**1289 kBp/s**
Standard deviation Throughput	**108 kBp/s**	**272 kBp/s**

5.3 Viva results

5.3.1 Global voice results (Towns & Roads)

Global Voice Service			VIVA 2 353 tests
Rate of calls set-up and held for 2 min			**97.0%**
		Statistical accuracy	*± 0.7%*
and marked	**4-perfect (PQR)**		**95.4%**
		Statistical accuracy	*± 0.8%*
	4-perfect or 3-fair (CQR)		**96.6%**
		Statistical accuracy	*± 0.7%*

5.3.1.1   Towns voice results (In car-Indoor-Outdoor)

Towns Voice Service			VIVA 2 096 tests
Rate of calls set-up and held for 2 min			**96.9%**
		Statistical accuracy	*± 0.7%*
and marked	**4-perfect (PQR)**		**95.4%**
		Statistical accuracy	*± 0.9%*
	4-perfect or 3-fair (CQR)		**96.5%**
		Statistical accuracy	*± 0.8%*
Difference between busy hours and others			**0.2%**
		Statistical accuracy	*± 0.2%*

Towns Incar Voice Service			VIVA 1 037 tests
Rate of calls set-up and held for 2 min			**96.5%**
		Statistical accuracy	*± 1.1%*
and marked	**4-perfect (PQR)**		**95.6%**
		Statistical accuracy	*± 1.3%*
	4-perfect or 3-fair (CQR)		**96.3%**
		Statistical accuracy	*± 1.1%*

5.3.1.2   Roads Links voice results

Road Links Voice Service		VIVA 257 tests
Rate of calls set-up and held for 2 min		**98.1%**
	Statistical accuracy	*± 1.7%*
and marked	**4-perfect (PQR)**	**95.3%**
	Statistical accuracy	*± 2.6%*
	4-perfect or 3-fair (CQR)	**98.1%**
	Statistical accuracy	*± 1.7%*
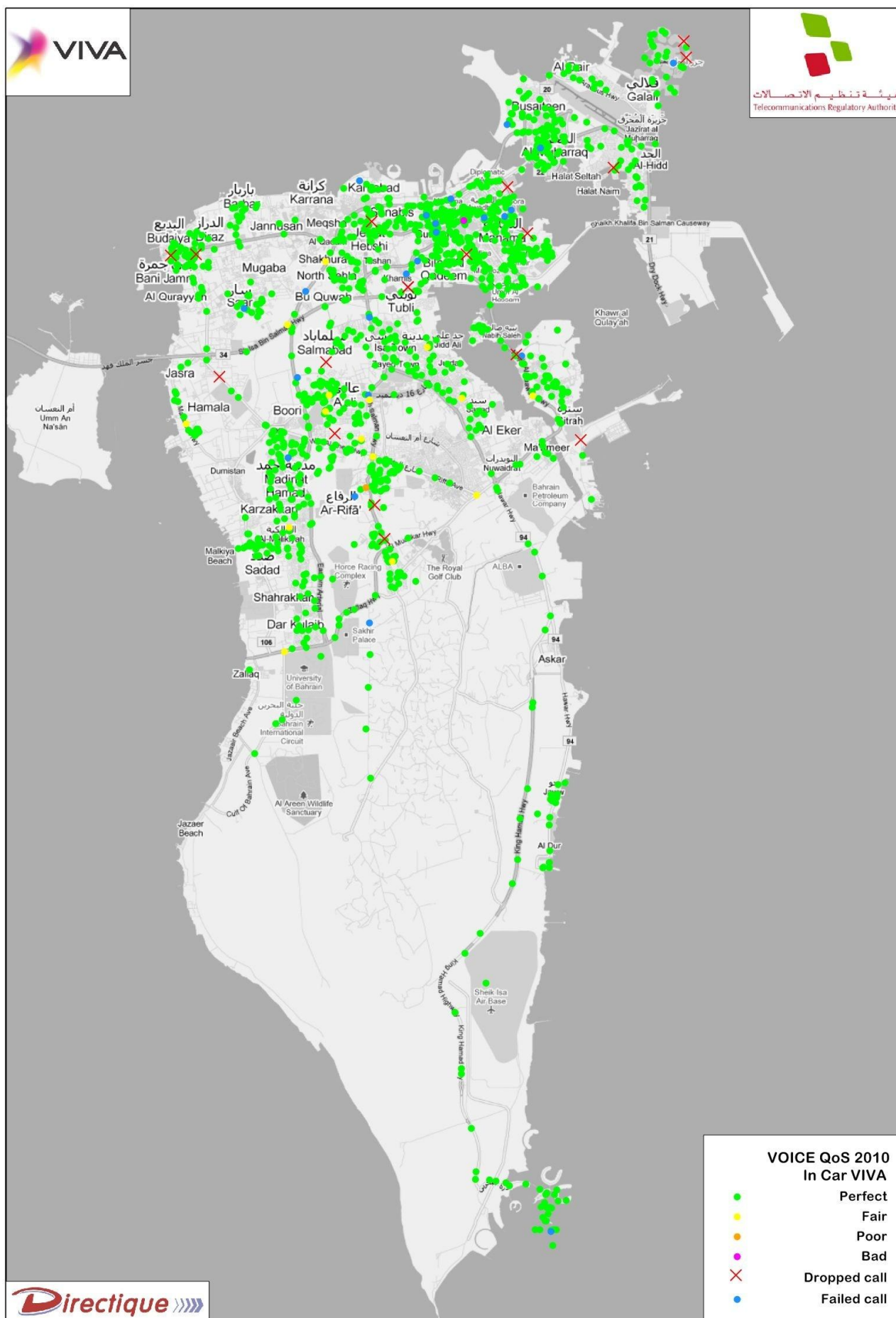
In car voice results

5.3.2 Data results

5.3.2.1   SMS results

SMS Service	VIVA 523 tests
Rate of Received SMS within 2 min	**99.6%**
Statistical accuracy	*± 0.5%*
Rate of Received SMS within 30 sec	**97.5%**
Statistical accuracy	*± 1.3%*
Average time reception	**11.3 s**

5.3.2.2   MMS results

MMS Service	VIVA 468 tests
Rate of MMS sent within 1 min	**93.4%**
Statistical accuracy	*± 2.3%*
Rate of Received MMS within 2 min	**83.1%**
Statistical accuracy	*± 3.4%*
Rate of Received MMS within 5 min	**84.4%**
Statistical accuracy	*± 3.3%*
Average end to end time	**53.9 s**
Average time emission	**13.1 s**
Average time reception notification	**35.6 s**
Average time downloaded message	**5.1 s**

5.3.2.3   Data accessibility results

Capital City and Towns of more than 50,000 inhabitants	VIVA 1 006 tests
Rate of successful radio connections to network	**100.0%**
Statistical accuracy	*± 0.0%*
Rate of successful radio connections within 10 sec	**99.7%**
Statistical accuracy	*± 0.3%*

Hot Spots in Al Manamah	VIVA 1 462 tests
Rate of successful radio connections to network	**99.5%**
Statistical accuracy	*± 0.4%*
Rate of successful radio connections within 10 sec	**99.3%**
Statistical accuracy	*± 0.4%*

5.3.2.4   WEB service results

WEB Service	VIVA 1 126 tests
Rate of succesful data transfers	97.6%
Statistical accuracy	*± 0.9%*
Average download time once connected	6.6 s
Min download time once connected	1.3 s
Max download time once connected	61.0 s
Standard deviation download time once connected	5.8 s

5.3.2.5   FTP results

FTP VIVA	Upload 1MB 335 tests	Download 5MB 671 tests
Rate of succesful data transfers	98.5%	97.8%
Statistical accuracy	*± 1.3%*	*± 1.1%*
Average Throughput	568 kBp/s	2379 kBp/s
Min Throughput	33 kBp/s	77 kBp/s
Max Throughput	706 kBp/s	4132 kBp/s
Standard deviation Throughput	123 kBp/s	928 kBp/s

5.3.2.6   Mail results

Mail Service VIVA	Email sent 100KB 173 tests	Email received 100KB 173 tests	Email sent 1MB 163 tests	Email received 1MB 163 tests
Rate of succesful data transfers	100.0%	100.0%	100.0%	100.0%
Statistical accuracy	*± 0.0%*	*± 0.0%*	*± 0.0%*	*± 0.0%*
Average sending/receiving time once connected	11.9 s	4.8 s	22.6 s	12.1 s
Min sending/receiving time once connected	8.7 s	2.4 s	18.3 s	9.5 s
Max sending/receiving time once connected	47.7 s	7.4 s	46.0 s	35.7 s
Standard deviation sending/receiving time once	4.9 s	0.5 s	5.3 s	3.7 s

5.3.3 SmartPhone results

5.3.3.1 *Data Coverage*

Smartphone Data Coverage	VIVA 12 011 tests
GPRS	**0.2%**
Statistical accuracy	*± 0.1%*
EDGE	**2.6%**
Statistical accuracy	*± 0.3%*
UMTS	**0.0%**
Statistical accuracy	*± 0.0%*
HSPA	**97.2%**
Statistical accuracy	*± 0.3%*

This table provides the technology breakdown used by Mobile Operators as recorded during all measurements. Every minute, the mobile is recording the observed technology. These samples have been taken in towns and on road links. They are shown as contextual information at the time of the audit.

97.2% of the measurements for Viva were achieved using HSPA[3], versus 2.6% for EDGE[4].

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[3] HSPA High Speed Packet Access

[4] EDGE Enhanced Data Rates for GSM Evolution
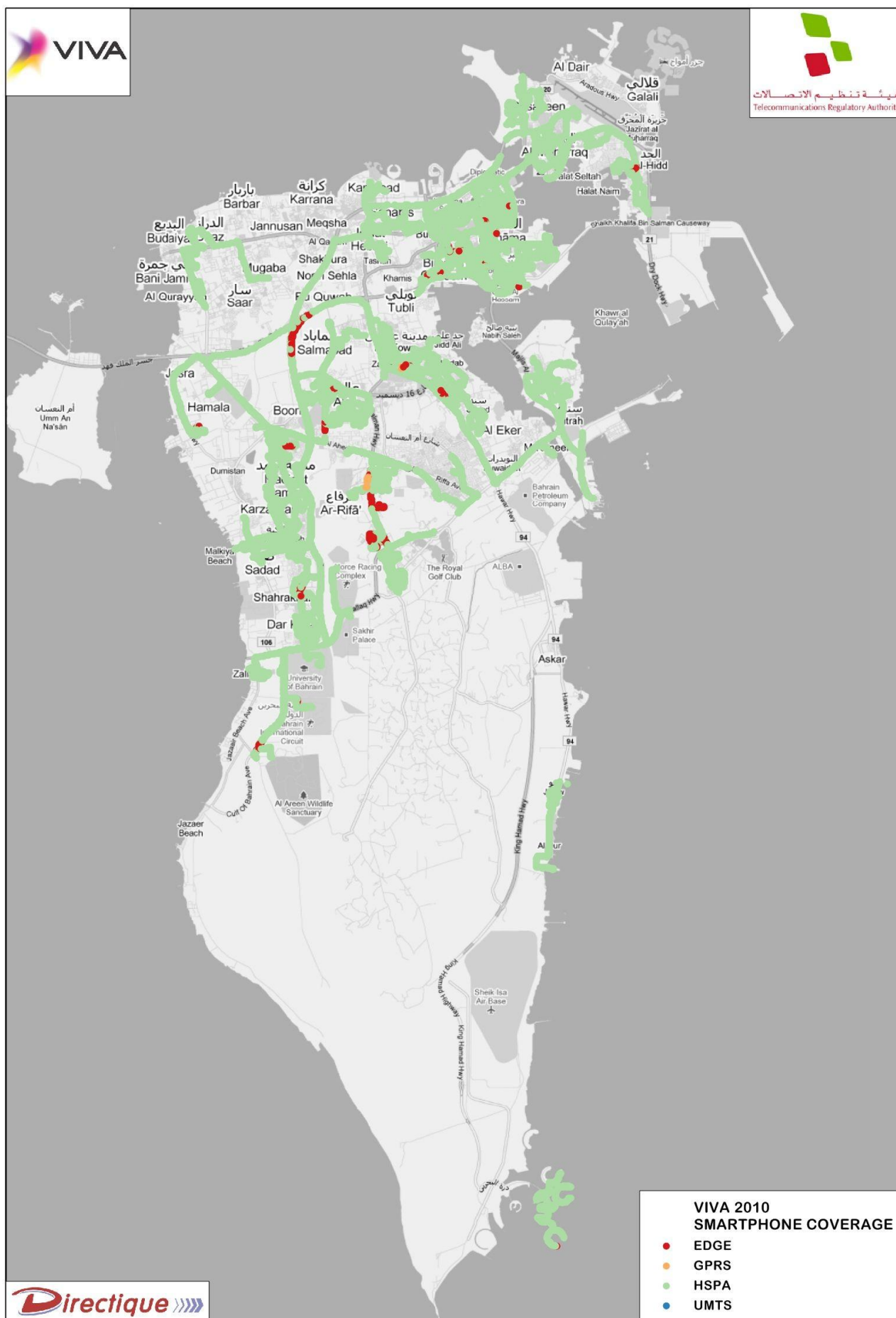
Smartphone Service: Data Coverage

5.3.3.2   FTP

Smartphone FTP VIVA	Upload 1MB	Download 5MB
	216 tests	319 tests
Rate of succesful data transfers	**100.0%**	**100.0%**
Statistical accuracy	*± 0.0%*	*± 0.0%*
Average Throughput	**489 kBp/s**	**1611 kBp/s**
Min Throughput	**4 kBp/s**	**65 kBp/s**
Max Throughput	**1027 kBp/s**	**3405 kBp/s**
Standard deviation Throughput	**186 kBp/s**	**651 kBp/s**

5.3.3.3   HTTP

Smartphone HTTP VIVA	Upload 1MB	Download 5MB
	374 tests	375 tests
Rate of succesful data transfers	**100.0%**	**100.0%**
Statistical accuracy	*± 0.0%*	*± 0.0%*
Average Throughput	**440 kBp/s**	**2107 kBp/s**
Min Throughput	**13 kBp/s**	**19 kBp/s**
Max Throughput	**928 kBp/s**	**4321 kBp/s**
Standard deviation Throughput	**138 kBp/s**	**1046 kBp/s**

5.4 Zain results

5.4.1 Global voice results (Towns & Roads)

Global Voice Service			ZAIN 2 353 tests
Rate of calls set-up and held for 2 min			**96.9%**
		Statistical accuracy	*± 0.7%*
and marked	**4-perfect (PQR)**		**93.2%**
		Statistical accuracy	*± 1.0%*
	4-perfect or 3-fair (CQR)		**94.9%**
		Statistical accuracy	*± 0.9%*

5.4.1.1   Towns voice results (In car-Indoor-Outdoor)

Towns Voice Service			ZAIN 2 096 tests
Rate of calls set-up and held for 2 min			**97.1%**
		Statistical accuracy	*± 0.7%*
and marked	**4-perfect (PQR)**		**93.4%**
		Statistical accuracy	*± 1.1%*
	4-perfect or 3-fair (CQR)		**95.2%**
		Statistical accuracy	*± 0.9%*
Difference between busy hours and others			**1.6%**
		Statistical accuracy	*± 0.5%*

Towns Incar Voice Service			ZAIN 1 037 tests
Rate of calls set-up and held for 2 min			**96.9%**
		Statistical accuracy	*± 1.1%*
and marked	**4-perfect (PQR)**		**93.2%**
		Statistical accuracy	*± 1.5%*
	4-perfect or 3-fair (CQR)		**94.7%**
		Statistical accuracy	*± 1.4%*

5.4.1.2   Roads Links voice results

Road Links Voice Service		ZAIN 257 tests
Rate of calls set-up and held for 2 min		**94.6%**
	Statistical accuracy	*± 2.8%*
and marked	**4-perfect (PQR)**	**91.1%**
	Statistical accuracy	*± 3.5%*
	4-perfect or 3-fair (CQR)	**93.0%**
	Statistical accuracy	*± 3.1%*
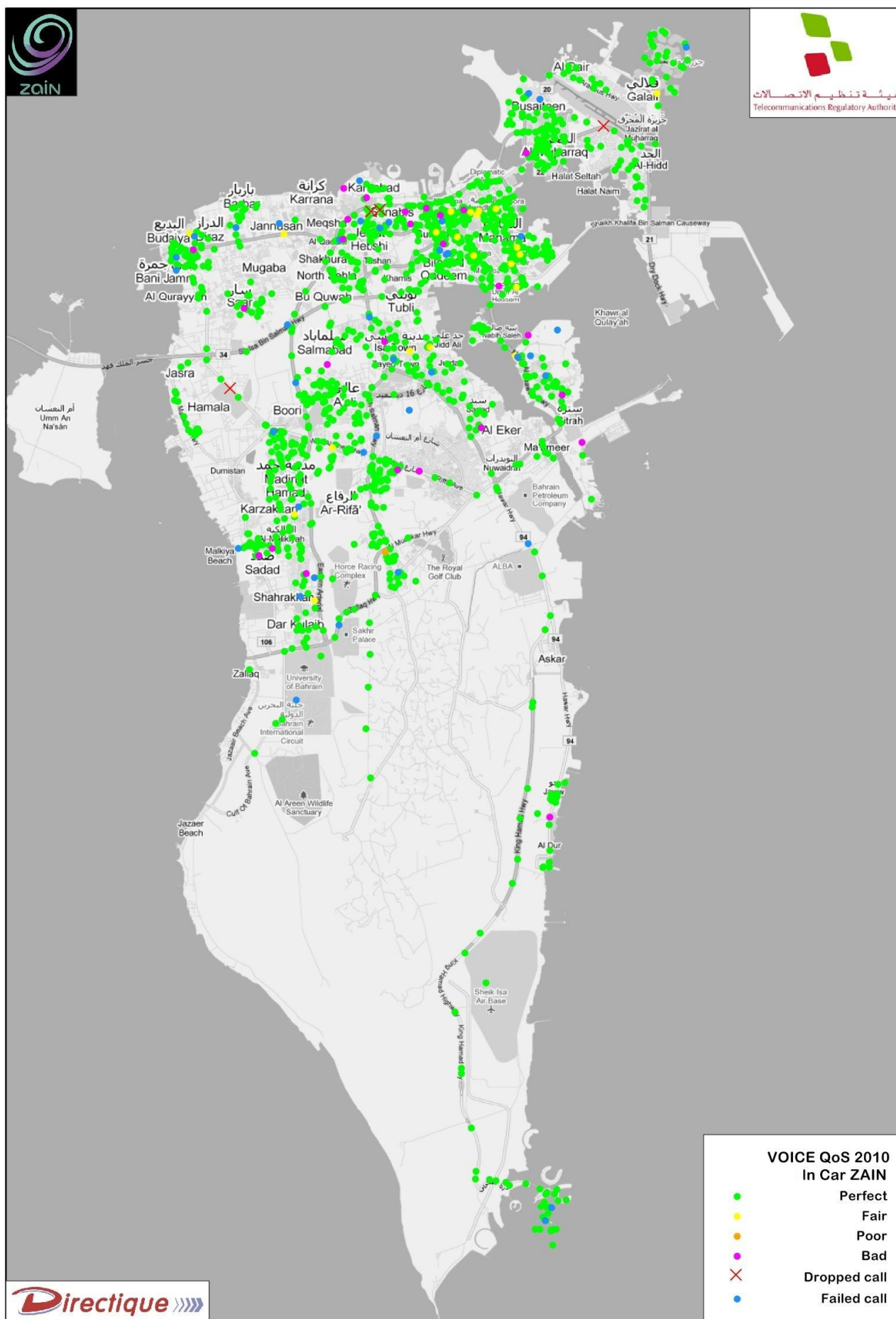
In car voice results

5.4.2 Data results

5.4.2.1 SMS results

SMS Service	ZAIN 523 tests
Rate of Received SMS within 2 min	**99.6%**
Statistical accuracy	*± 0.5%*
Rate of Received SMS within 30 sec	**95.8%**
Statistical accuracy	*± 1.7%*
Average time reception	**15.4 s**

5.4.2.2 MMS results

MMS Service	ZAIN 468 tests
Rate of MMS sent within 1 min	**90.6%**
Statistical accuracy	*± 2.6%*
Rate of Received MMS within 2 min	**76.9%**
Statistical accuracy	*± 3.8%*
Rate of Received MMS within 5 min	**80.6%**
Statistical accuracy	*± 3.6%*
Average end to end time	**64.9 s**
Average time emission	**13.9 s**
Average time reception notification	**45.1 s**
Average time downloaded message	**6.0 s**

5.4.2.3 Data accessibility results

Capital City and Towns of more than 50,000 inhabitants	ZAIN 1 006 tests
Rate of successful radio connections to network	**100.0%**
Statistical accuracy	*± 0.0%*
Rate of successful radio connections within 10 sec	**99.7%**
Statistical accuracy	*± 0.3%*

Hot Spots in Al Manamah	ZAIN 1 312 tests
Rate of successful radio connections to network	**97.2%**
Statistical accuracy	*± 0.9%*
Rate of successful radio connections within 10 sec	**97.0%**
Statistical accuracy	*± 0.9%*

5.4.2.4 WEB service results

WEB Service	ZAIN 1 010 tests
Rate of succesful data transfers	**95.8%**
Statistical accuracy	*± 1.2%*
Average download time once connected	**7.0 s**
Min download time once connected	**2.1 s**
Max download time once connected	**60.0 s**
Standard deviation download time once connected	**6.1 s**

5.4.2.5 FTP results

FTP ZAIN	Upload 1MB 335 tests	Download 5MB 671 tests
Rate of succesful data transfers	**99.4%**	**99.3%**
Statistical accuracy	*± 0.8%*	*± 0.7%*
Average Throughput	**277 kBp/s**	**1868 kBp/s**
Min Throughput	**53 kBp/s**	**129 kBp/s**
Max Throughput	**306 kBp/s**	**2321 kBp/s**
Standard deviation Throughput	**47 kBp/s**	**477 kBp/s**

5.4.2.6 Mail results

Mail Service Zain	Email sent 100KB 151 tests	Email received 100KB 151 tests	Email sent 1MB 151 tests	Email received 1MB 151 tests
Rate of succesful data transfers	**100.0%**	**100.0%**	**100.0%**	**100.0%**
Statistical accuracy	*± 0.0%*	*± 0.0%*	*± 0.0%*	*± 0.0%*
Average sending/receiving time once connected	**11.5 s**	**3.3 s**	**45.4 s**	**9.6 s**
Min sending/receiving time once connected	**9.1 s**	**2.6 s**	**40.7 s**	**6.0 s**
Max sending/receiving time once connected	**26.5 s**	**6.5 s**	**73.3 s**	**32.9 s**
Standard deviation sending/receiving time once	**3.1 s**	**0.6 s**	**5.5 s**	**3.9 s**

5.4.3 SmartPhone results

5.4.3.1   Data Coverage

Smartphone Data Coverage	ZAIN 20 004 tests
GPRS	**0.0%**
Statistical accuracy	*± 0.0%*
EDGE	**0.5%**
Statistical accuracy	*± 0.1%*
UMTS	**70.1%**
Statistical accuracy	*± 0.6%*
HSPA	**29.4%**
Statistical accuracy	*± 0.6%*

This table provides the technology breakdown used by Mobile Operators as recorded during all measurements. Every minute, the mobile is recording the observed technology. These samples have been taken in towns and on road links. They are shown as contextual information at the time of the audit.

29.4% of the measurements for Zain were achieved using HSPA[5], versus 70.1% for UMTS[6].

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[5] HSPA High Speed Packet Access

[6] UMTS Universal Mobile Telecommunications System

ZAIN 2010
SMARTPHONE COVERAGE
- EDGE
- GPRS
- HSPA
- UMTS

Smartphone Service: Data Coverage

5.4.3.2   FTP

| Smartphone FTP ZAIN | Upload 1MB | Download 5MB |
	252 tests	442 tests
Rate of succesful data transfers	**100.0%**	**100.0%**
Statistical accuracy	*± 0.0%*	*± 0.0%*
Average Throughput	**296 kBp/s**	**1325 kBp/s**
Min Throughput	**4 kBp/s**	**20 kBp/s**
Max Throughput	**375 kBp/s**	**2383 kBp/s**
Standard deviation Throughput	**89 kBp/s**	**468 kBp/s**

5.4.3.3   HTTP

| Smartphone HTTP ZAIN | Upload 1MB | Download 5MB |
	485 tests	479 tests
Rate of succesful data transfers	**100.0%**	**100.0%**
Statistical accuracy	*± 0.0%*	*± 0.0%*
Average Throughput	**286 kBp/s**	**1414 kBp/s**
Min Throughput	**20 kBp/s**	**12 kBp/s**
Max Throughput	**384 kBp/s**	**2507 kBp/s**
Standard deviation Throughput	**81 kBp/s**	**569 kBp/s**

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