المجلس الأعلى للإتصالات و تكنولوجيا المعلومات
Supreme Council of Information & Communication Technology

Quality of Service Measurements- Mobile Services Network Audit 2012

Quality of Service REPORT

The purpose of the study is to evaluate and benchmark Quality Levels offered by Mobile Network Operators, Qtel and Vodafone, in the state of Qatar. The independent study was conducted with an objective End-user perspective by Directique and does not represent any views of ictQATAR.

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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 Methodology

2.1 Team and Equipment

2.1.1 Team

The project was managed with the following project team on the ground:

- A dedicated project manager present in Doha during audit launch phase.
- A field supervisor based in Doha for the whole audit duration.
- One team performing Coverage measurements.
- 2 teams performing Voice and SMS measurements:
  - 2 Engineers and a driver on the field.
  - 2 Engineers in an office located in Doha.
- 3 teams performing Data measurements.

2.1.2 Equipment

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

Voice / SMS / MMS	Data Dongles	Data Smartphone
Samsung Galaxy SIII Blackberry Bold 9900	**VODAFONE** : USB Broadband (K3806Z) **QTEL** : 21Mbps USB Modem (Huawei)	Samsung Galaxy SIII

All devices were compatible with voice, SMS and MMS technologies and were recommended or sold by Mobile Operators for 2G and 3G technologies.

Land lines were equipped with a standard fixed phone.

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

2.1.3 Sim Cards

50% of the QoS measurements were done with prepaid plans, 50% with postpaid plans..

Prepaid Plans :

	Qtel	*VODAFONE*
VOICE/SMS/BBM	HALA QR 500	Pre-paid QR 500 BlackBerry Monthly
DATA	Hala Mobile Broadband	Internet Monthly Pack 200

Postpaid Plans :

	Qtel	*VODAFONE*
VOICE/SMS/BBM	Shahry 575	PLATINUM
Data Smartphone	Shahry 60 + Data Extreme Pack 3GB	GOLD + extra 1GB
Data Dongle	Broadband Plus (5GB)	Broadband Super (6GB)

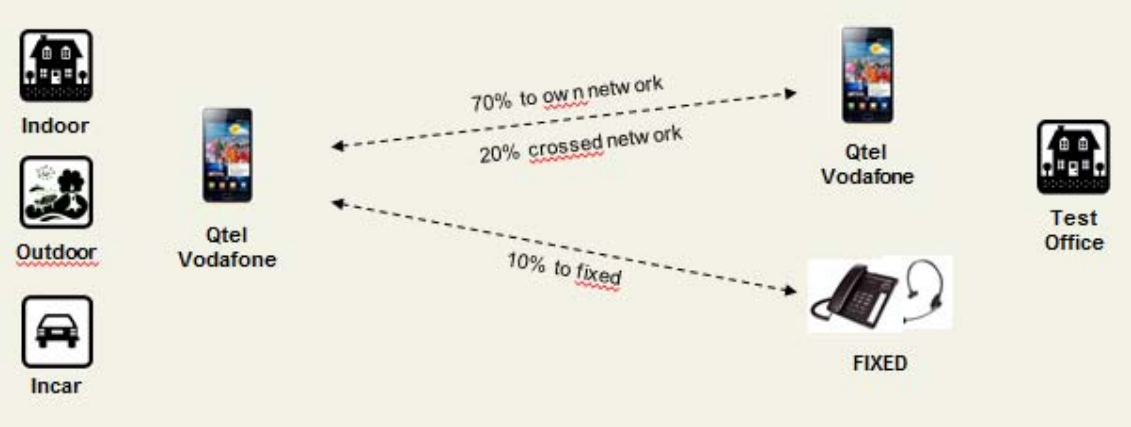
2.2 Voice Service Quality Testing

2.2.1 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 tester was conversing over his mobile phone with a tester in Doha office. The tester in the office was using either a fixed-line phone for 10% of the calls or a mobile phone.

Each field team had 2 types of phone for each mobile network: one Samsung Galaxy SIII and one Blackberry Bold 9900. 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.
- Incar: On road links (Incar Road) and within Town borders (Incar Town)

Calls included 70% Mobile to Mobile (MTM) own network, 20% MTM cross networks and 10% Mobile to land line.

- **Audio Quality Marking:**

Failed and dropped calls were registered in the database. The audio quality was evaluated for calls established and maintained for 2 minutes. 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.

2.2.2 Testing Area and Sample Size

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

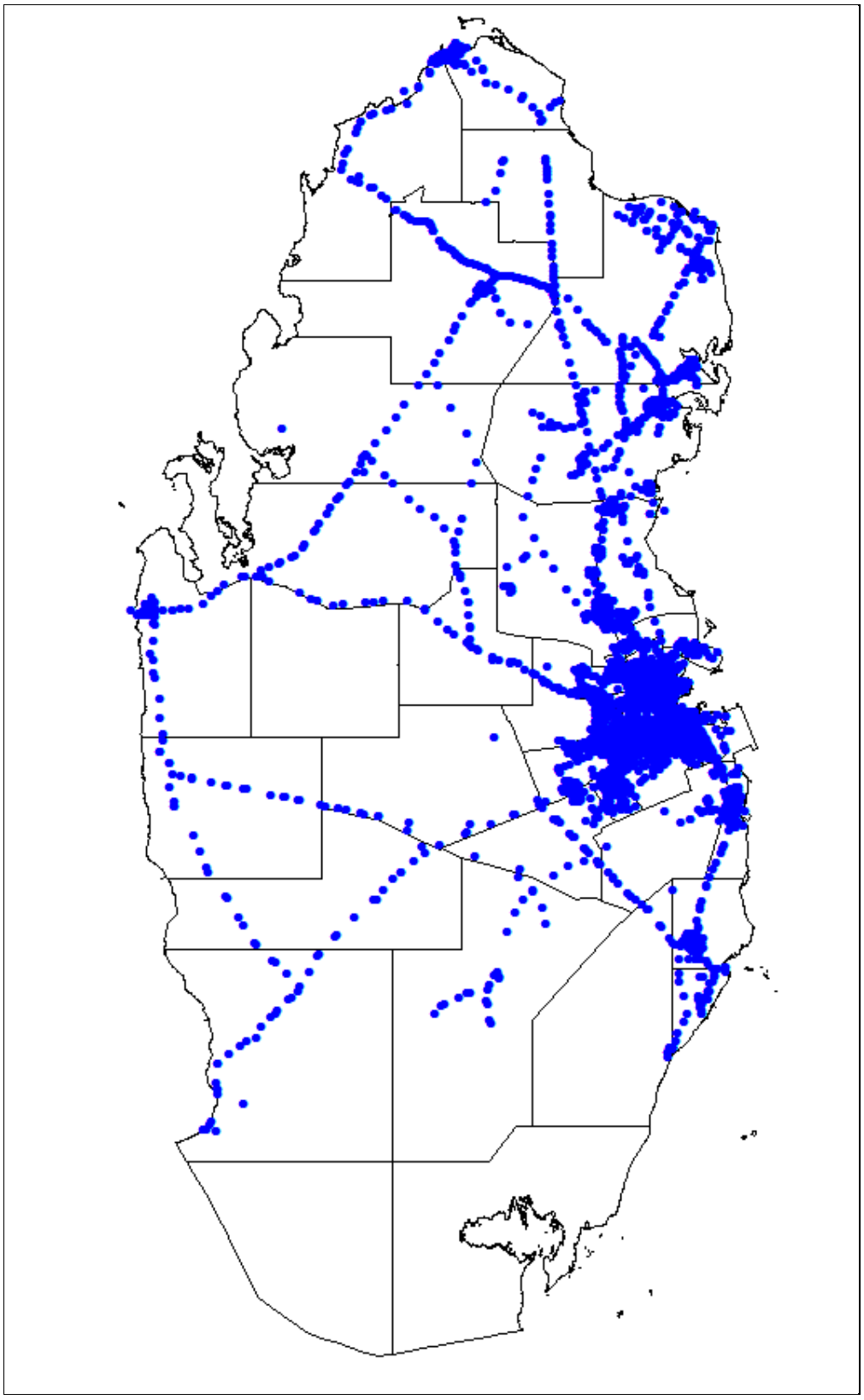
Cities	Population	% pop	% mes. *	Incar	Indoor	Oudoor	Total
DOHA	796947	47%	30.5%	457	457	457	1 372
AL RAYYAN	455623	27%	23.1%	346	346	346	1 038
AL KHOR and AL THAKHIRA	183893	11%	15.0%	226	226	226	677
AL WAKRA	141222	8%	12.8%	193	193	193	578
UMM SLAL	60509	4%	8.4%	126	126	126	378
AL DAAYEN	43176	3%	7.1%	106	106	106	319
MADINAT ALSHAMAL	7975	0%	3.1%	46	46	46	137
Total	**1 699 435**	**100%**	**100%**	**1500**	**1500**	**1500**	**4 500**

Test Calls Repartition

The total number of voice test calls performed was almost 5,000.

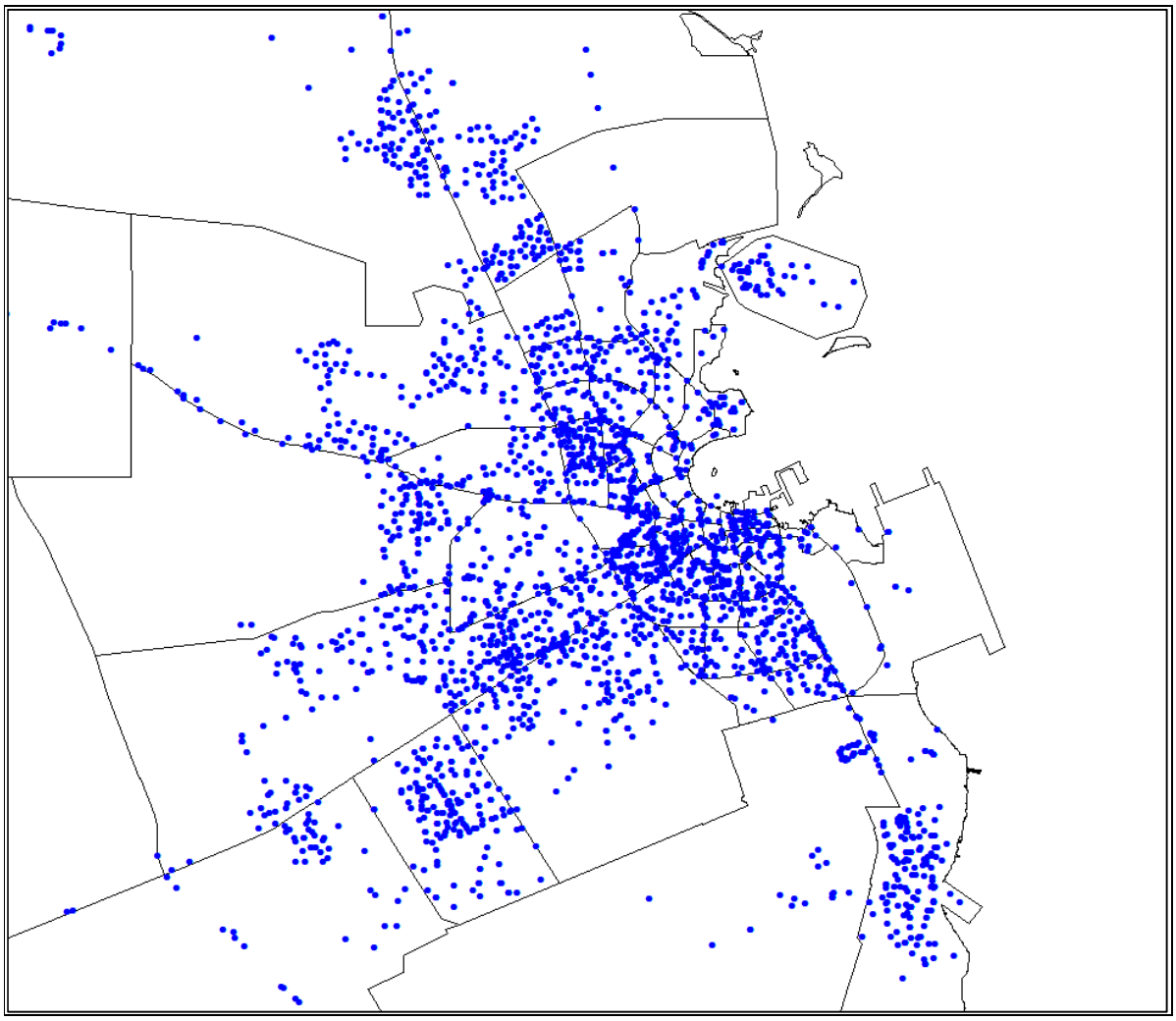
Cities Populated Zones

Map of VOICE Measurements



Map of VOICE Measurements

Zoom on DOHA



2.2.3 Measurements Specifications - Towns

- ***In-car Measurements***

Measurements were performed on a paths that included major roads and constructed zones (Downtown, malls, stations, touristic places and business centers).

- ***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, etc…).

  - 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:

- 56% in the public places
- 22% in offices
- 22% in residential areas

Number of measurements depended on the size of the building:

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

Voice Sample - Cities	INCAR Cities	INDOOR	OUTDOOR Dynamic	OUTDOOR Static
DOHA	631 mes	622 mes	313 mes	141 mes
AL RAYYAN	331 mes	411 mes	261 mes	314 mes
AL KHOR	59 mes	23 mes	36 mes	7 mes
MADINAT AL SHAMAL	27 mes	24 mes	47 mes	12 mes
WAKRAH	76 mes	67 mes	48 mes	27 mes
DUKHAN	19 mes	2 mes	0 mes	1 mes
MASAIEED	63 mes	16 mes	12 mes	6 mes
RAS LAFFAN	67 mes	12 mes	16 mes	5 mes
OTHER TOWNS AND VILLAGES	166 mes	156 mes	318 mes	99 mes
TOTAL	**1439 mes**	**1333 mes**	**1051 mes**	**612 mes**

Cities Voice Sample Distribution

2.2.4 Measurements Specifications - Road Links

Voice Sample - Road links	INCAR Roads
Doha-Al Wakra	10 mes
Al-Wakra-Umm Said	10 mes
Doha-Al Salwa	16 mes
Al Wakra (via Humm bab) - Al Dukhaan	92 mes
Saudi Arabia border-Umm Bab	9 mes
Al Dukhaan-Doha	73 mes
Khawzan-Al Ghuwariyah	24 mes
Al Ghuwariyah-Al Zubarah	56 mes
Al Zubarah-Al Ruwais	11 mes
Al Ruwais - Doha	73 mes
TOTAL	**374 mes**

Road Links Sample Distribution

2.2.5 Global Voice Measurements Distribution

Definition		Realized
Calls Type	MTM own	70%
	MTM cross	20%
	MTF	10%
Hours	Busy Hours	41%
Outdoor	Stationnary	37%
	Moving	63%
Indoor Type	Public places	55.6%
	Offices	22.5%
	Private places	21.9%

2.2.6 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.

2.2.7 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.

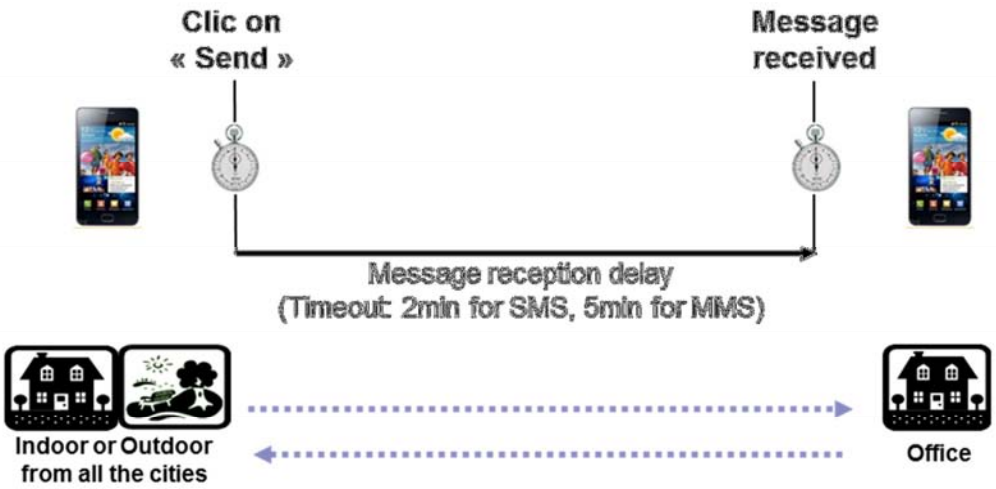
2.3 SMS, MMS and BBM Measurements

2.3.1 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 Doha. 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 when transmission was acknowledged on the phone 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 and that has 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:

SMS SAMPLE	INDOOR	OUTDOOR
DOHA	308 mes	228 mes
AL RAYYAN	206 mes	284 mes
AL KHOR	12 mes	20 mes
MADINAT AL SHAMAL	12 mes	29 mes
Wakrah	32 mes	39 mes
MASAIEED	8 mes	7 mes
RAS LAFFAN	6 mes	10 mes
OTHER TOWNS AND VILLAGES	74 mes	217 mes
TOTAL	**658 mes**	**834 mes**

2.3.2 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 50 KB picture 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:

MMS SAMPLE	INDOOR	OUTDOOR
DOHA	314 mes	223 mes
AL RAYYAN	205 mes	291 mes
AL KHOR	11 mes	23 mes
MADINAT AL SHAMAL	12 mes	30 mes
Wakrah	35 mes	36 mes
MASAIEED	6 mes	10 mes
RAS LAFFAN	6 mes	11 mes
OTHER TOWNS AND VILLAGES	82 mes	200 mes
TOTAL	**671 mes**	**824 mes**

2.3.3 BBM Measurements

BBM measurements were performed in a similar manner to the SMS, on Blackberry devices only.

The following table shows BBM test sample repartitions:

BBM SAMPLE	INDOOR	OUTDOOR
DOHA	149 mes	121 mes
AL RAYYAN	106 mes	138 mes
AL KHOR	4 mes	12 mes
MADINAT AL SHAMAL	6 mes	13 mes
Wakrah	16 mes	19 mes
MASAIEED	4 mes	4 mes
RAS LAFFAN	3 mes	5 mes
OTHER TOWNS AND VILLAGES	41 mes	105 mes
TOTAL	**329 mes**	**417 mes**

2.4 Data Service Testing

2.4.1 FTP Measurements

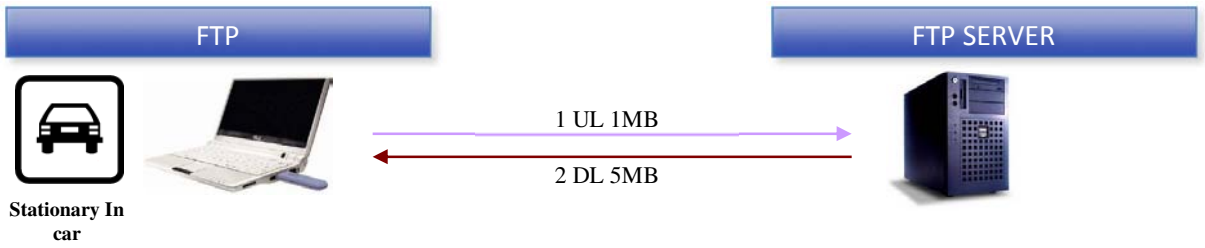
Data measurements were carried out automatically via **Mobi.Net** ©, Directique's software data test.

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 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.,



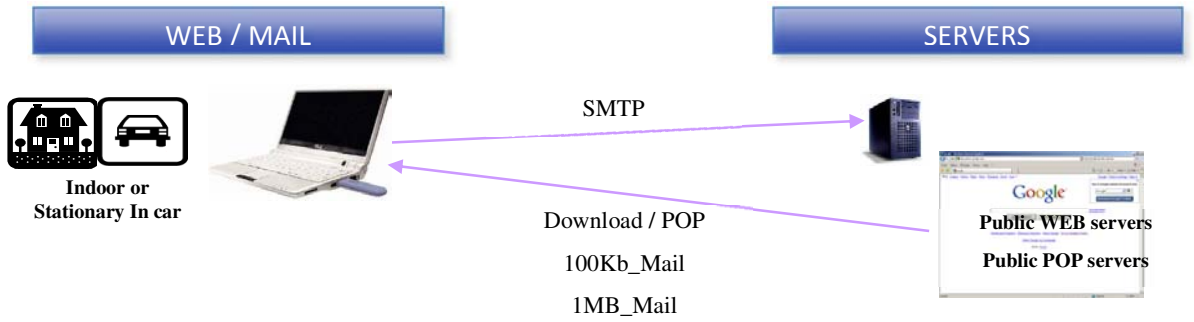
Quality of Service assessment offered by the access network with FTP Download and Upload tests was distributed over main Cities of Qatar.

	Connection	*FTP DL 5MB*	*FTP UL 1MB*
DOHA	3 869	1 881	1 878
AL RAYYAN	1 738	861	861
AL KHOR	48	24	24
MADINAT AL SHAMAL	22	11	11
Wakrah	296	146	146
DUKHAN	64	32	32
MASAIEED	76	35	35
RAS LAFFAN	78	38	38
OTHER TOWNS AND VILLAGES	614	301	301
TOTAL	**6 805**	**3 329**	**3 326**

FTP Test Samples Repartition

2.4.2 Web Browsing and Email 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 the homepage of the operator and 4 of the most visited public homepages, taking note of completion time, errors on page if any, with a 2 minutes timeout.

HTTP Tested Webpages:

http://www.facebook.com
http://www.google.com
http://www.qtel.qa
http://www.vodafone.com.qa
http://www.yahoo.com
http://www.youtube.com

	FACEBOOK	*GOOGLE*	*QTEL*	*VODAFONE*	*YAHOO*	*YOUTUBE*
DOHA	1 831 mes	1 836 mes	966 mes	913 mes	1 836 mes	1 836 mes
AL RAYYAN	854 mes	855 mes	432 mes	422 mes	854 mes	854 mes
AL KHOR	24 mes	24 mes	12 mes	12 mes	24 mes	24 mes
MADINAT AL SHAMAL	11 mes	11 mes	6 mes	5 mes	11 mes	11 mes
Wakrah	146 mes	146 mes	74 mes	72 mes	146 mes	146 mes
DUKHAN	32 mes	32 mes	16 mes	16 mes	32 mes	32 mes
MASAIEED	35 mes	35 mes	18 mes	17 mes	35 mes	35 mes
RAS LAFFAN	37 mes	37 mes	19 mes	18 mes	37 mes	37 mes
OTHER TOWNS AND VILLAGES	297 mes	299 mes	153 mes	146 mes	297 mes	297 mes
TOTAL	**3 267 mes**	**3 275 mes**	**1 696 mes**	**1 621 mes**	**3 272 mes**	**3 272 mes**

WEB Test Samples Repartition

Email Testing :

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

	100Kb File	*1Mb File*
DOHA	1 847 mes	1 852 mes
AL RAYYAN	842 mes	844 mes
AL KHOR	23 mes	23 mes
MADINAT AL SHAMAL	11 mes	11 mes
Wakrah	146 mes	146 mes
DUKHAN	32 mes	33 mes
MASAIEED	35 mes	35 mes
RAS LAFFAN	37 mes	37 mes
OTHER TOWNS AND VILLAGES	295 mes	297 mes
TOTAL	**3 268 mes**	**3 278 mes**

MAIL Test Samples Repartition

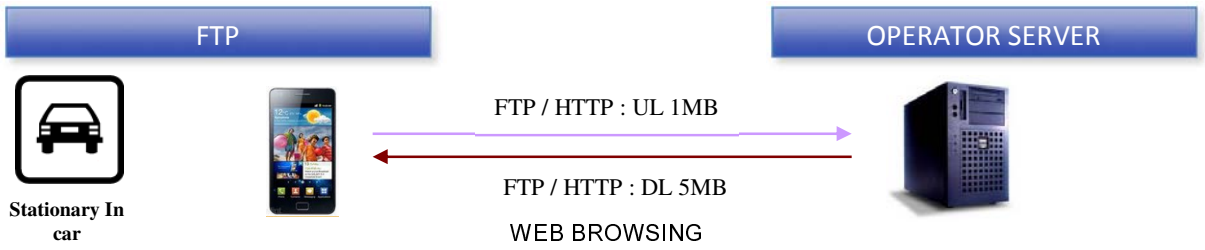
2.4.3 Smartphone Measurement

The test was launched automatically by the android App **MobiSpeed ©**.

On each network, a measurement consisted of:

- Downloading 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 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.
- WEB: Downloading the homepage of the operator and 4 of the most visited public homepages, taking note of completion time, errors on page if any, with a 2 minutes timeout.

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.,



	WEB	*HTTP*	*FTP*
DOHA	9 500 mes	1 899 mes	1 899 mes
AL RAYYAN	4 315 mes	863 mes	863 mes
AL KHOR	120 mes	24 mes	24 mes
MADINAT AL SHAMAL	60 mes	12 mes	12 mes
Wakrah	735 mes	147 mes	147 mes
DUKHAN	160 mes	32 mes	32 mes
MASAIEED	200 mes	40 mes	40 mes
RAS LAFFAN	200 mes	40 mes	40 mes
OTHER TOWNS AND VILLAGES	1 505 mes	301 mes	301 mes
TOTAL	**16 795 mes**	**3 358 mes**	**3 358 mes**

Smartphone Test Sample Repartition

2.4.4 Video Streaming (Smartphones and Dongles)

Objectives : Assess the quality of a popular YouTube video

Protocol :

- The evaluation lasts 2 minutes.
- Each video and audio defect is categorized and its duration is collected in order to determine if the viewing is perfect, fair, poor or bad.
- Once the sequence has been completed, a grade is given to describe 3 global appraisal criteria (sharpness, audio/video synchronization and sound quality)

Testers trained with Golden eyes : computerized training system based on several hundreds of video samples representative of all characteristics defects associated with mobile networks.

The reference video for this audit is a popular YouTube video tested in guaranteed throughput conditions prior to the audit.

Defects correspond to damages occurring during the assessment and detailed hereafter:

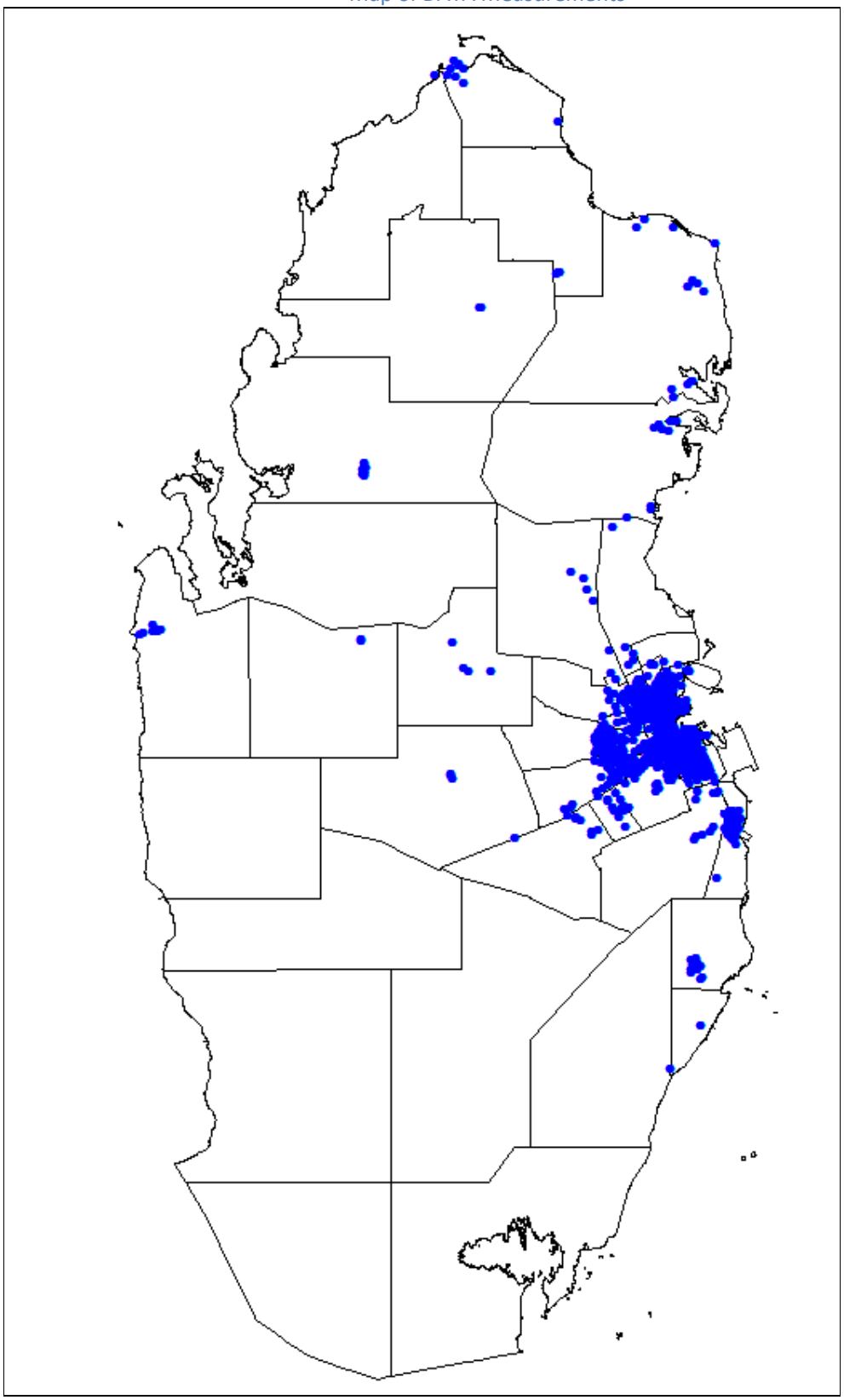
Video appraisal criteria	
SUPERIMPOSITION	Bad transition between frames triggering superimposition or interlaced images
PIXELATION	Single-colored square display elements that comprise the bitmap are visible.
BUFFERING	The sequence stops, a message showing the buffering percentage appears.
JERKINESS	When the frame rate is not fast enough, individual still images may be perceived by the viewer.
FREEZE	A Freeze occurs when the sequence shows a still image during a few seconds

Audio appraisal criteria	
AUDIO INTERRUPTIONS	Silences are categorized as furtive (< 1s), short (< 3s) or long (> 3s)
AUDIO DEFECTS	Punctual audio defects perceived by the user including distortions, crackling, metallic sounds and echoes.

Sample :

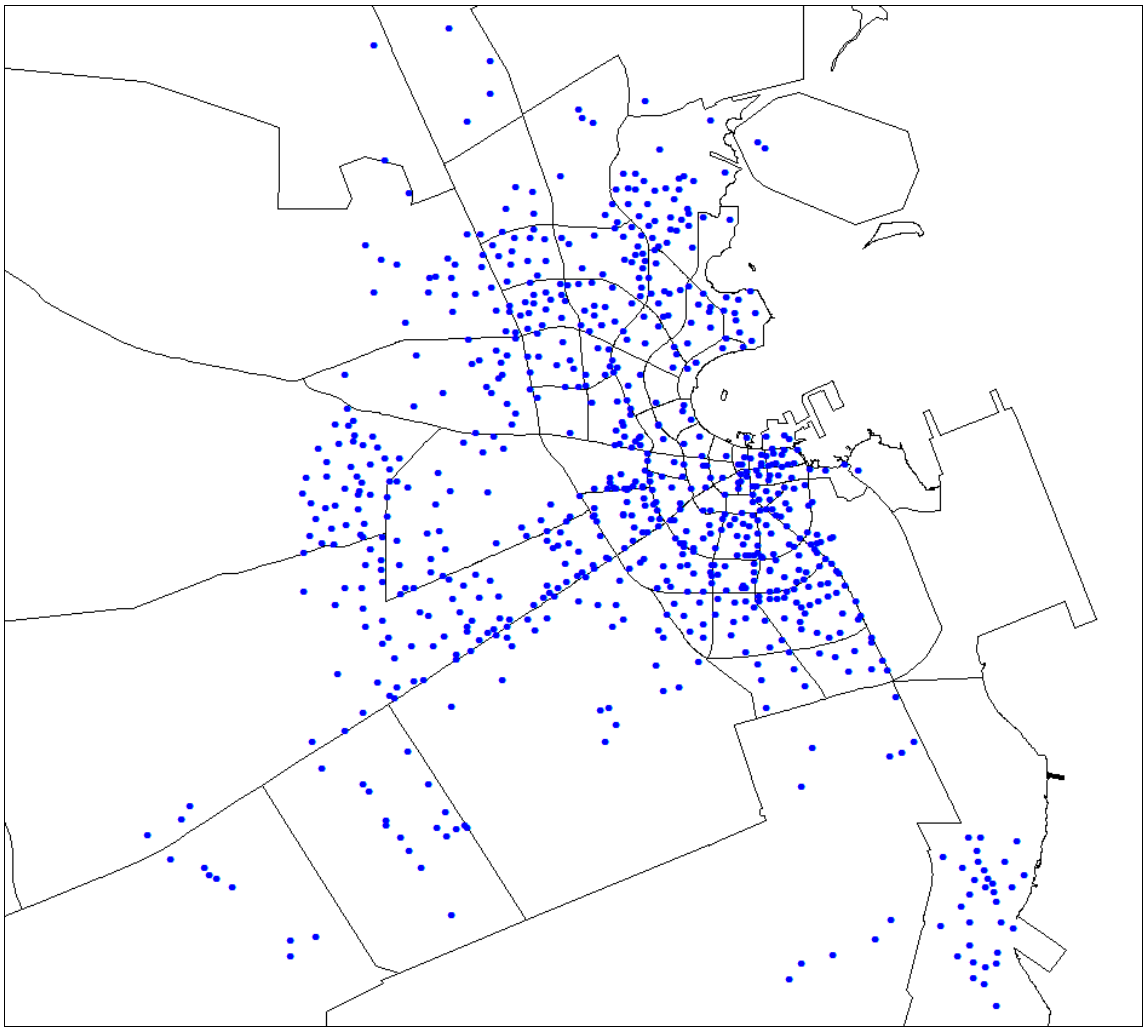
Smartphone		Dongle	
Qtel	*Vodafone*	*Qtel*	*Vodafone*
850 mes	*850 mes*	*852 mes*	*851 mes*

Map of DATA Measurements



Map of DATA Measurements

Zoom on DOHA



2.5 Key Performance Indicators

2.5.1 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

2.5.2 BBM KPIs

KPIs	Definition
RS2 (% of received BBM within 2 minutes)	BBM 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 received BBM within 30 sec)	BBM not refused when sent out and received within 30 seconds without being altered.

2.5.3 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 received SMS within 30 sec)	SMS not refused when sent out and received within 30 seconds without being altered.

2.5.4 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.

2.5.5 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.

2.5.6 Video Streaming

KPIs	Definition
END to END non-Quality rate	Rate of non-successful sessions, from the access to You tube, till the end of the video.
TNQ - Access to the video	Rate of sessions failed acceding to You tube or launching the video.
You tube sequences dropped	Rate of sessions dropped while viewing the video.
You tube sequences with quality defaults	Rate of sessions affected by audio or video quality problems.

3 Industry results and international benchmark

3.1 Introduction

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

In releasing this study, ictQATAR aimed at evaluating and benchmarking quality levels offered by Mobile Network Operators in the state, Qtel and Vodafone from an end-user perspective, for the following set of services:

- Voice
- Short Message Services (SMS)
- Multi Media Messaging Services (MMS)
- BlackBerry Messenger (BBM)
- Video Streaming
- Web Surfing
- File Transfer (FTP and HTTP)
- 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 20th December 2012 to 4th February 2013, except 18th December 2012 (Qatar National day).

Measurements were performed between 8:00 am and 11:00 pm every day except Saturdays.

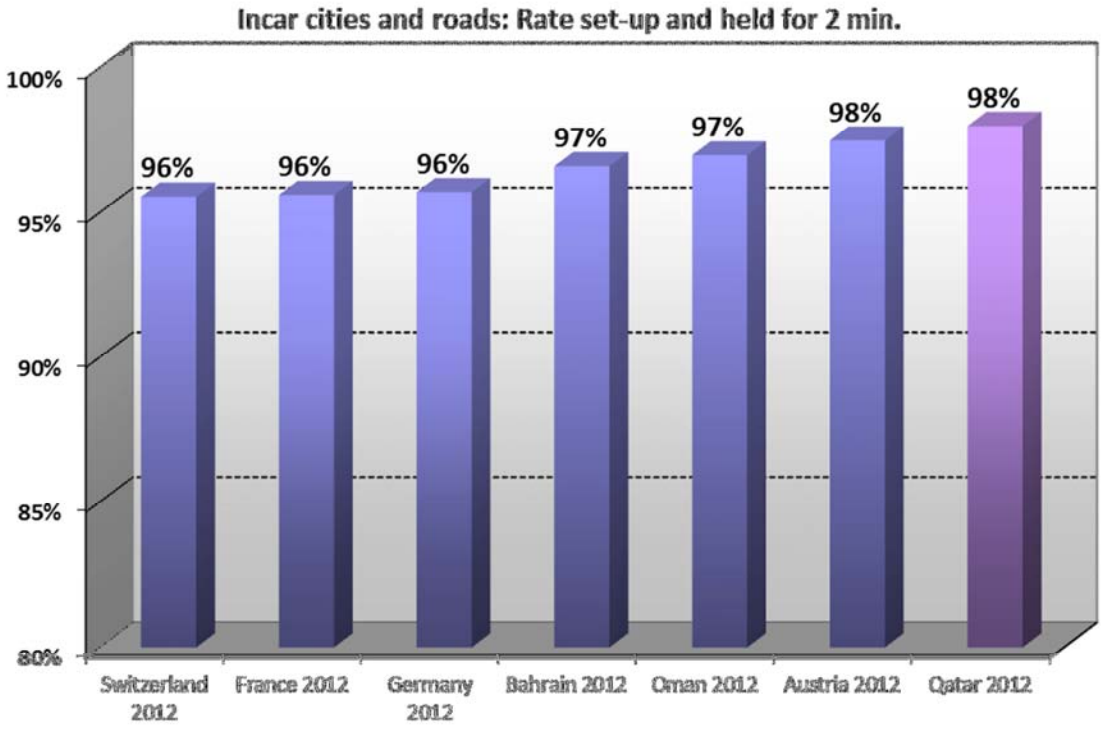
3.2 Industry Results

The following tables show the average combined results achieved by the three Mobile Operators for all measurements.

3.2.1 Voice and Messaging Services

		Sample	*9 934 mes*
Rate of calls set-up and held for 2 min			**98.2%**
		Statistic accuracy	*+/-0.3%*
and marked	4-perfect (PQR)		**97.7%**
		Statistical accuracy	*± 0.3%*
	4-perfect or 3-fair (CQR)		**98.0%**
		Statistical accuracy	*± 0.3%*

International benchmark:

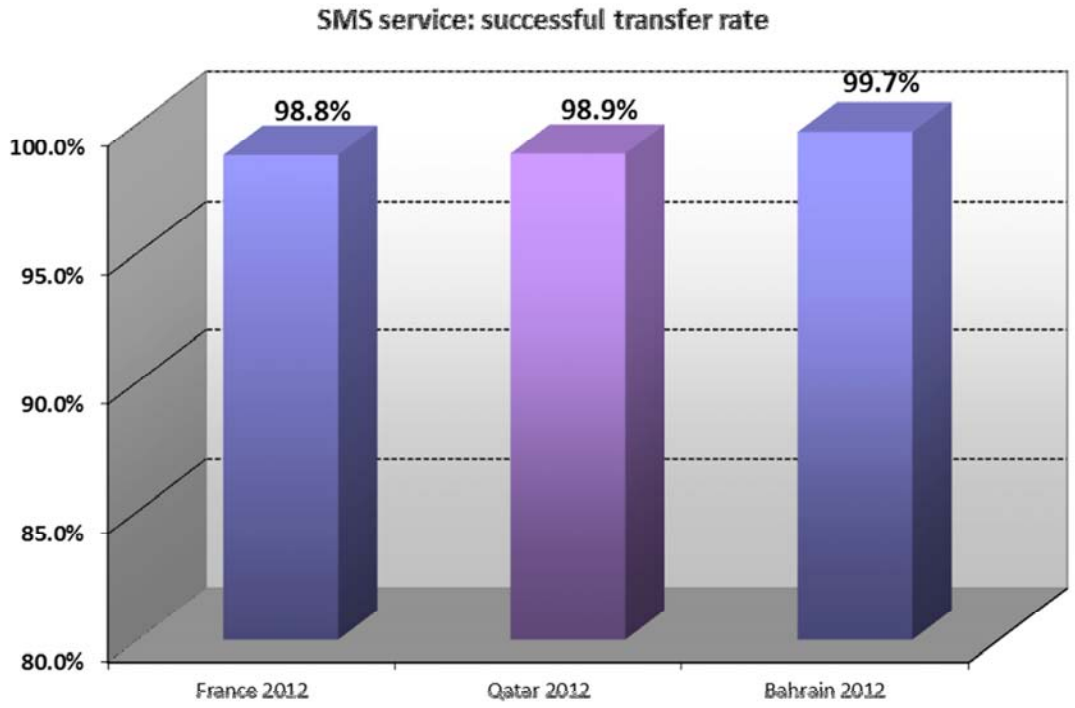


Note: only the failure and drop calls rate can be compared.The voice quality of the calls is assessed, in some countries, with automatic tools, like Swissqual. Therefore, the quality of the conversation cannot be evaluated for these countries.

SMS Service

	Sample	*2 984*
Rate of received SMS within 2 minutes (RS2)		**98.8%**
	Statistical accuracy	*+/-0.4%*
Rate of received SMS within 30 seconds (RS30)		**98.3%**
	Statistical accuracy	*+/-0.5%*
Rate of received SMS within 15 seconds (RS15)		**96.7%**
	Statistical accuracy	*+/-0.6%*
Average time reception		**5.9 s**

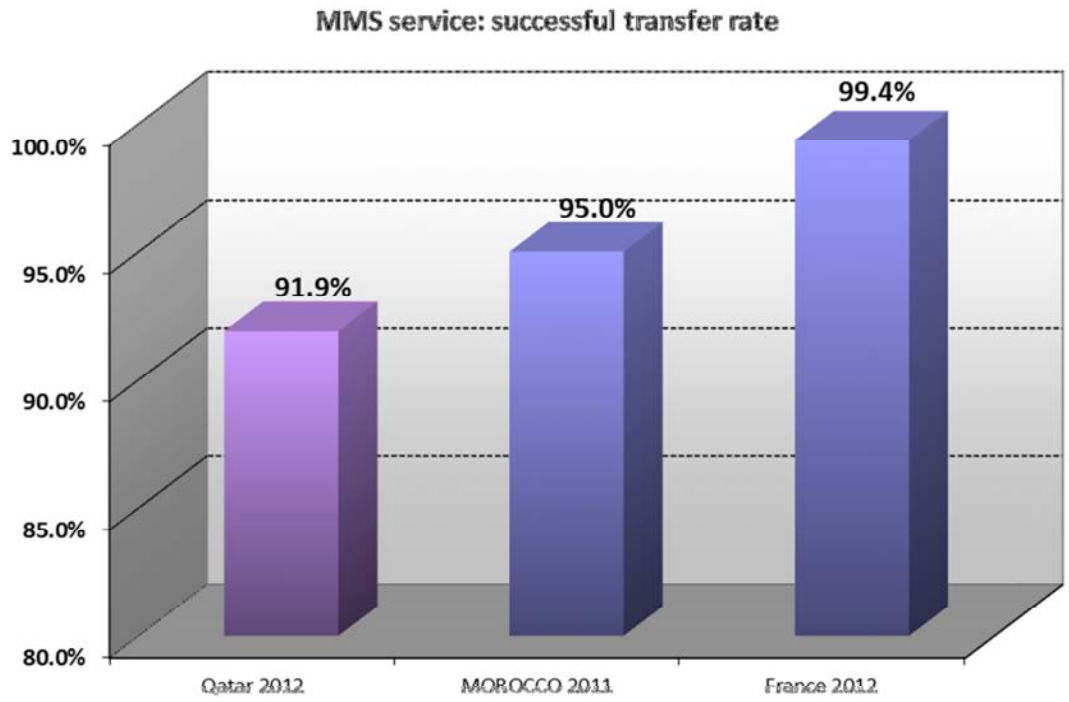
International benchmark:



MMS Service

	Sample	*2 989*
Rate of received MMS within 5 minutes (RM5)		**91.9%**
	Statistical accuracy	*+/-1.0%*
Rate of received MMS within 2 minutes (RM2)		**87.8%**
	Statistical accuracy	*+/-1.2%*
Average time reception		**46.0 s**

International benchmark:



BBM Service

	Sample	*1 492*
Rate of received SMS within 2 minutes (RS2)		**99.5%**
	Statistical accuracy	*+/-0.2%*
Rate of received SMS within 30 seconds (RS30)		**99.1%**
	Statistical accuracy	*+/-0.3%*
Rate of received SMS within 15 seconds (RS15)		**97.4%**
	Statistical accuracy	*+/-0.6%*
Average time reception		**5.8 s**

3.2.2 Video Streaming

Video Streaming

		Smartphone	Dongle
	Sample	*1 700*	*1 703*
END to END Quality rate		**93.1%**	**90.3%**
	Statistic accuracy	*+/-1.2%*	*+/-1.4%*
Rate of successful access to the video		94.5%	92.6%
	Statistic accuracy	*+/-1.1%*	*+/-1.2%*
Dropped sequences		0.1%	0.1%
	Statistic accuracy	*+/-0.1%*	*+/-0.1%*
Non Quality sequences		1.4%	2.2%
	Statistic accuracy	*+/-0.6%*	*+/-0.7%*

Results are similar between tests on Smartphone and tests on PC with dongle.

3.2.3 Computer Dongle Services

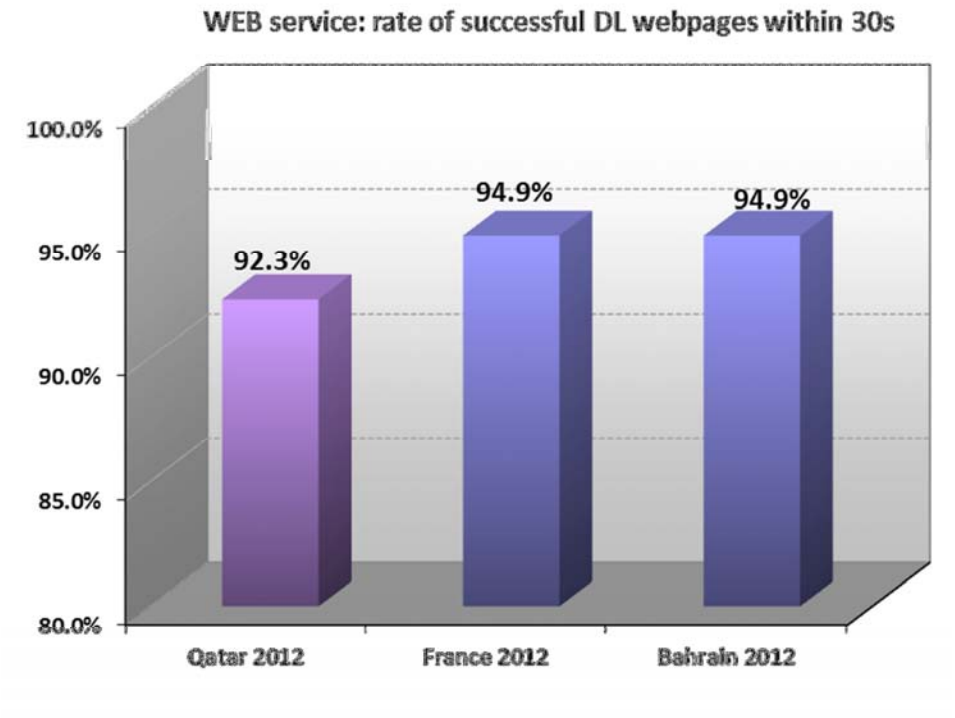
Radio Connection

	Sample	*6 805*
Rate of succesfull radio connections to network		**97.8%**
	Statistical accuracy	*+/-0.3%*
Rate of succesfull radio connections within 10 sec		**97.1%**
	Statistical accuracy	*+/-0.4%*

Web Browsing

	Sample	*16 274*
Rate of successful DL webpages within 30s		**92.3%**
	Statistical accuracy	*+/-0.4%*

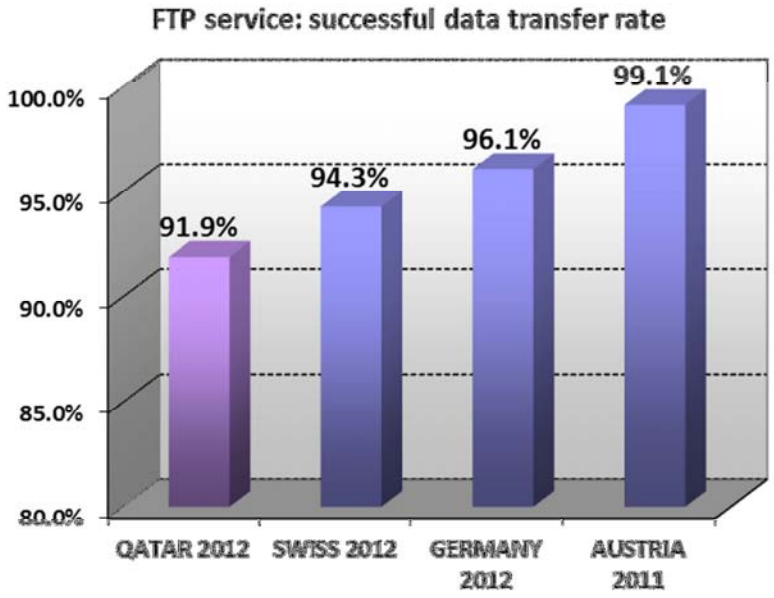
International benchmark:



FTP Download & Upload

	Global	Download	Upload
Sample	***6 805***	*3 404*	*3 401*
Rate of succesfull data transfers	**91.9%**	**94.6%**	**89.2%**
Statistical accuracy	*+/-0.6%*	*+/-0.8%*	*+/-1.0%*
Average Throughput		2091 kbps	850 kbps
Max Throughput		8484 kbps	2388 kbps

International Benchmark:



Mail

	SMTP	POP
Sample	*3 404*	*3 404*
Rate of succesfull data transfers	**90.6%**	**97.7%**
Statistical accuracy	*+/-1.0%*	*+/-0.6%*

3.2.4 Smartphone Services

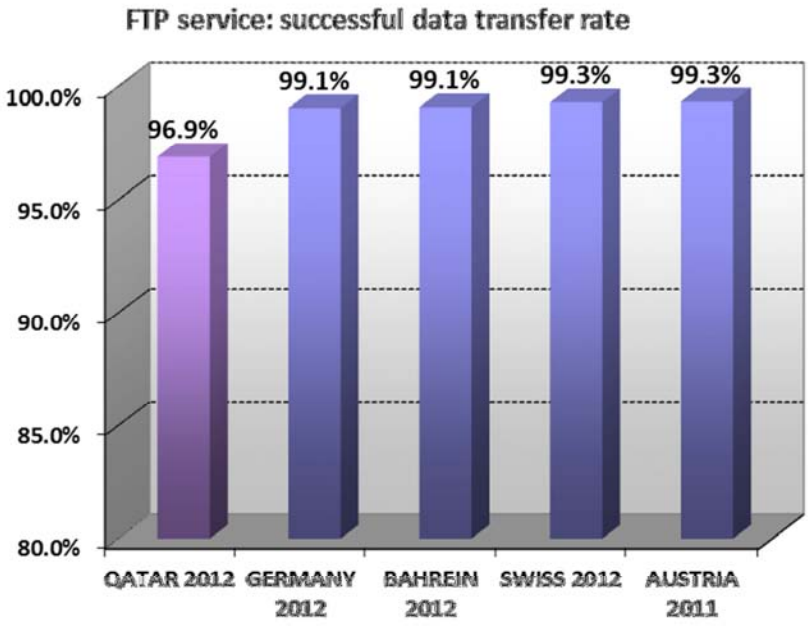
Web Browsing

	Sample	*16 795*
Rate of successful DL webpages within 30s		**93.7%**
	Statistical accuracy	*+/-0.4%*

FTP Download & Upload

		Global	Download	Upload
	Sample	***6 716***	*3 358*	*3 358*
Rate of succesfull data transfers		**96.9%**	**98.3%**	**95.5%**
	Statistical accuracy	*+/-0.4%*	*+/-0.4%*	*+/-0.7%*
Average Throughput			2008 kbps	981 kbps
Max Throughput			5857 kbps	2491 kbps

International benchmark:



HTTP Download & Upload

	Global	Download	Upload
Sample	***6 716***	*3 358*	*3 358*
Rate of succesfull data transfers	**95.9%**	**97.1%**	**94.7%**
Statistical accuracy	*+/-0.5%*	*+/-0.6%*	*+/-0.8%*
Average Throughput		2341 kbps	1202 kbps
Max Throughput		11390 kbps	3648 kbps

4 AUDIT RESULTS

4.1 QTEL Results

4.1.1 Global Voice Results (Towns & Roads)

Global Voice Service		***Qtel***
		4 967 mes
Rate of calls set-up and held for 2 min		**98.5%**
	Statistical accuracy	*± 0.3%*
and marked	**4-perfect (PQR)**	**97.9%**
	Statistical accuracy	*± 0.4%*
	4-perfect or 3-fair (CQR)	**98.3%**
	Statistical accuracy	*± 0.8%*

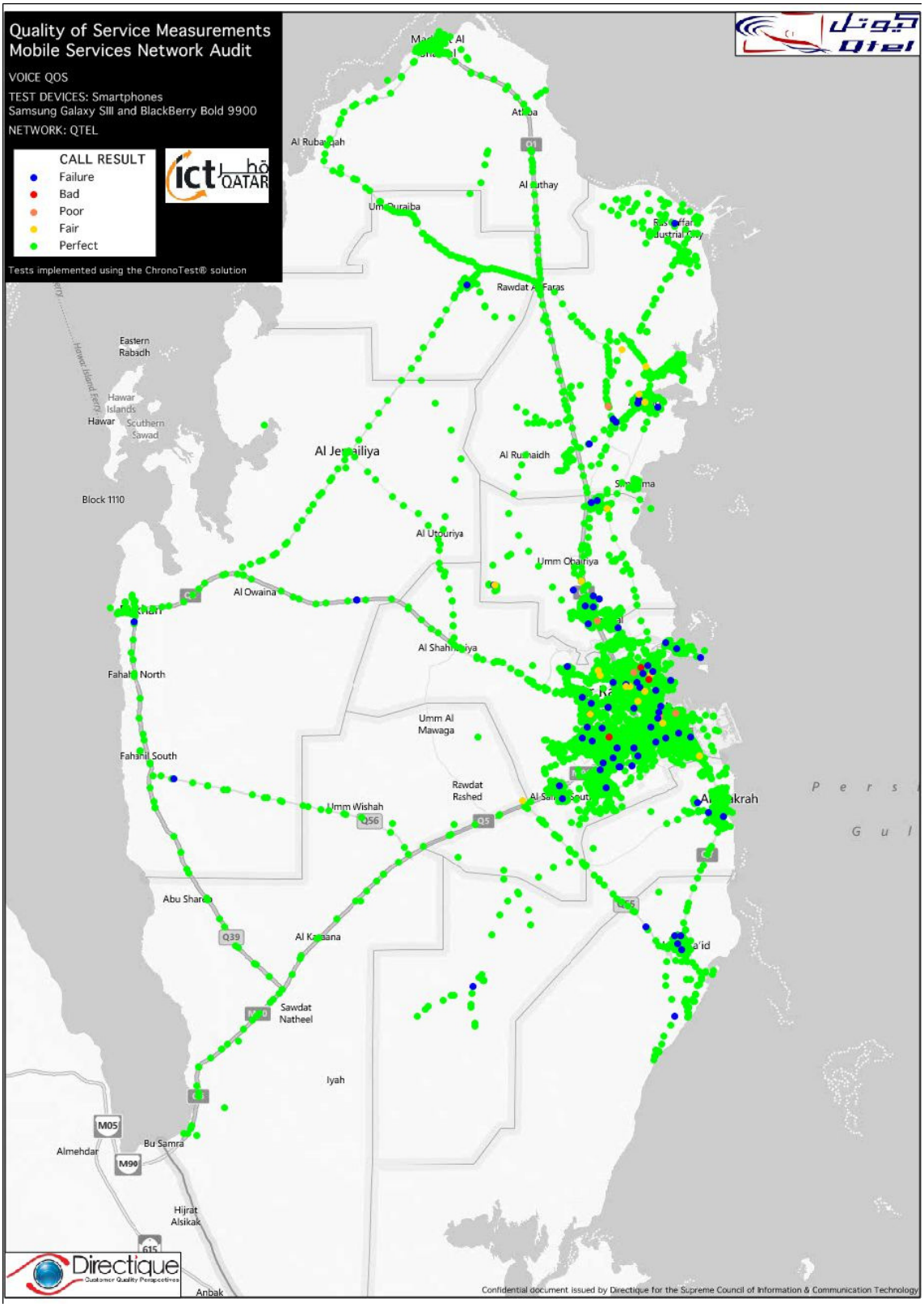
4.1.1.1 Cities Voice Results (In car-Indoor-Outdoor)

CITIES VOICE SERVICE		***Qtel***
		4 435 mes
Rate of calls set-up and held for 2 min		**98.5%**
	Statistical accuracy	*± 0.3%*
and marked	**4-perfect (PQR)**	**97.9%**
	Statistical accuracy	*± 0.4%*
	4-perfect or 3-fair (CQR)	**98.3%**
	Statistical accuracy	*± 0.8%*

Cities INCAR Voice Service		***Qtel***
		1 439 mes
Rate of calls set-up and held for 2 min		**98.1%**
	Statistical accuracy	*± 0.3%*
and marked	**4-perfect (PQR)**	**97.4%**
	Statistical accuracy	*± 0.4%*
	4-perfect or 3-fair (CQR)	**98.0%**
	Statistical accuracy	*± 0.8%*

4.1.1.2 Roads Links Voice Results

Road Links Voice Service		*Qtel*
		532 mes
Rate of calls set-up and held for 2 min		**98.1%**
	Statistical accuracy	*± 0.3%*
and marked	**4-perfect (PQR)**	**97.9%**
	Statistical accuracy	*± 0.4%*
	4-perfect or 3-fair (CQR)	**98.1%**
	Statistical accuracy	*± 0.8%*



Map – Voice Call Results

4.1.2 Services Results

4.1.2.1 SMS Results

SMS Service	Qtel
Sample	*1 492 mes*
Rate of received SMS within 2 minutes (RS2)	**98.7%**
Statistical accuracy	*+/-0.6%*
Rate of received SMS within 30 seconds (RS30)	**98.3%**
Statistical accuracy	*+/-0.7%*
Average time reception	**5.7 s**

4.1.2.2 BBM Results

BBM Service	Qtel
Sample	*746 mes*
Rate of received BBM within 2 minutes (RS2)	**99.7%**
Statistical accuracy	*+/-0.4%*
Rate of received BBM within 30 seconds (RS30)	**99.3%**
Statistical accuracy	*+/-0.6%*
Average time reception	**5.7 s**

4.1.2.3 MMS Results

MMS Service	Qtel
Sample	*1 495 mes*
Rate of received MMS within 5 minutes (RM5)	**91.1%**
Statistical accuracy	*+/-1.4%*
Rate of received MMS within 2 minutes (RM2)	**85.4%**
Statistical accuracy	*+/-1.8%*
Average time reception	**49.1 s**

4.1.3 Data Dongle Results

4.1.3.1 Data Accessibility Results

Radio Connection	Qtel
Sample	*3 412 mes*
Rate of succesfull radio connections to network (within 60 seconds)	**99.4%**
Statistical accuracy	*+/-0.3%*
Rate of succesfull radio connections within 10 sec	**99.1%**
Statistical accuracy	*+/-0.3%*

4.1.3.2 WEB Service Results

WEB BROWSING	Qtel
Sample	*8 290 mes*
Rate of succesfull downloaded webpages (within 30 seconds)	**96.5%**
Average download time once connected	**7.9 s**
Min download time once connected	2.5 s
Max download time once connected	29.9 s
Standard deviation of download time once connected	4.7 s

4.1.3.3 FTP Results

Download FTP	Qtel		
Sample	*1 706 mes*		
Rate of succesfull data transfers	**97.7%**		
Statistical accuracy	*+/-0.7%*	**gprs.qtel**	**web.qtel**
Average Throughput	**2250 kbps**	**2300 kbps**	**2208 kbps**
THROUGHPUT - min	243 kbps	364 kbps	243 kbps
THROUGHPUT - max	8484 kbps	4993 kbps	8484 kbps
THROUGHPUT - standard deviation	876 kbps	774 kbps	978 kbps

Upload FTP	Qtel		
Sample	*1 706 mes*		
Rate of succesfull data transfers	**95.8%**		
Statistical accuracy	*+/-0.9%*	**gprs.qtel**	**web.qtel**
Average Throughput	**831 kbps**	**849 kbps**	**816 kbps**
THROUGHPUT - min	75 kbps	75 kbps	76 kbps
THROUGHPUT - max	2342 kbps	2220 kbps	2342 kbps
THROUGHPUT - standard deviation	451 kbps	458 kbps	444 kbps

4.1.3.4 Mail Results

	Email 100Kb		*Email 1Mb*	
Mail Service **QTEL**	**SMTP**	**POP**	**SMTP**	**POP**
Sample	*1 692 mes*	*1 628 mes*	*1 695 mes*	*1 489 mes*
Rate of succesful data transfer	**93.6%**	**98.1%**	**87.0%**	**99.1%**
Statistical accuracy	*+/-0.9%*	*+/-0.7%*	*+/-0.9%*	*+/-0.5%*
Average Sending/Receiving Time once connected	**13.8 s**	**2.8 s**	**25.6 s**	**7.5 s**
Min Sending/Receiving Time once connected	5.9 s	1.1 s	12.5 s	2.7 s
Max Sending/Receiving Time once connected	58.9 s	32.6 s	59.6 s	47.5 s
Standard deviation Sending/Receiving Time once connected	8.0 s	2.4 s	10.2 s	4.1 s

4.1.4 Smartphone Results

4.1.4.1 WEB Service Results

WEB BROWSING	Qtel
Sample	*8 360 mes*
Rate of succesfull downloaded webpages (within 30 seconds)	**96.5%**
Average download time once connected	**6.2 s**
Min download time once connected	0.6 s
Max download time once connected	28.7 s
Standard deviation of download time once connected	4.4 s

4.1.4.2 FTP Results

Download FTP	Qtel
Sample	*1 671 mes*
Rate of succesfull data transfers	**99.0%**
Statistical accuracy	*+/-0.5%*
Average Throughput	**1911 kbps**
THROUGHPUT - min	151 kbps
THROUGHPUT - max	5636 kbps
THROUGHPUT - standard deviation	938 kbps

Upload FTP	Qtel
Sample	*1 671 mes*
Rate of succesfull data transfers	**96.5%**
Statistical accuracy	*+/-0.9%*
Average Throughput	**981 kbps**
THROUGHPUT - min	69 kbps
THROUGHPUT - max	2491 kbps
THROUGHPUT - standard deviation	513 kbps

4.1.4.3 HTTP Results

Download HTTP	Qtel
Sample	*1 671 mes*
Rate of succesfull data transfers	**98.9%**
Statistical accuracy	*+/-0.5%*
Average Throughput	**2483 kbps**
THROUGHPUT - min	144 kbps
THROUGHPUT - max	6250 kbps
THROUGHPUT - standard deviation	1420 kbps

Upload HTTP	Qtel
Sample	*1 671 mes*
Rate of succesfull data transfers	**95.5%**
Statistical accuracy	*+/-1.0%*
Average Throughput	**1163 kbps**
THROUGHPUT - min	70 kbps
THROUGHPUT - max	2583 kbps
THROUGHPUT - standard deviation	578 kbps

4.1.5 Video Streaming Results

VIDEO STREAMING	Qtel	
	Smartphone	**Dongle**
Sample	*850 mes*	*852 mes*
END to END non-Quality rate	**3.6%**	**4.0%**
Statistic accuracy	*+/-1.3%*	*+/-1.3%*
TNQ - Acess to the video	3.4%	2.1%
Youtube sequences dropped	0.0%	0.0%
Youtube sequences with quality defaults	0.2%	1.9%
(more than 2 major defaults and/or more than 6 minor defaults)		

4.2 VODAFONE Results

4.2.1Global Voice Results (Towns & Roads)

Global Voice Service		***Vodafone***
		4 967 mes
Rate of calls set-up and held for 2 min		**97.9%**
	Statistical accuracy	*± 0.4%*
and marked	**4-perfect (PQR)**	**97.4%**
	Statistical accuracy	*± 0.4%*
	4-perfect or 3-fair (CQR)	**97.6%**
	Statistical accuracy	*± 0.4%*

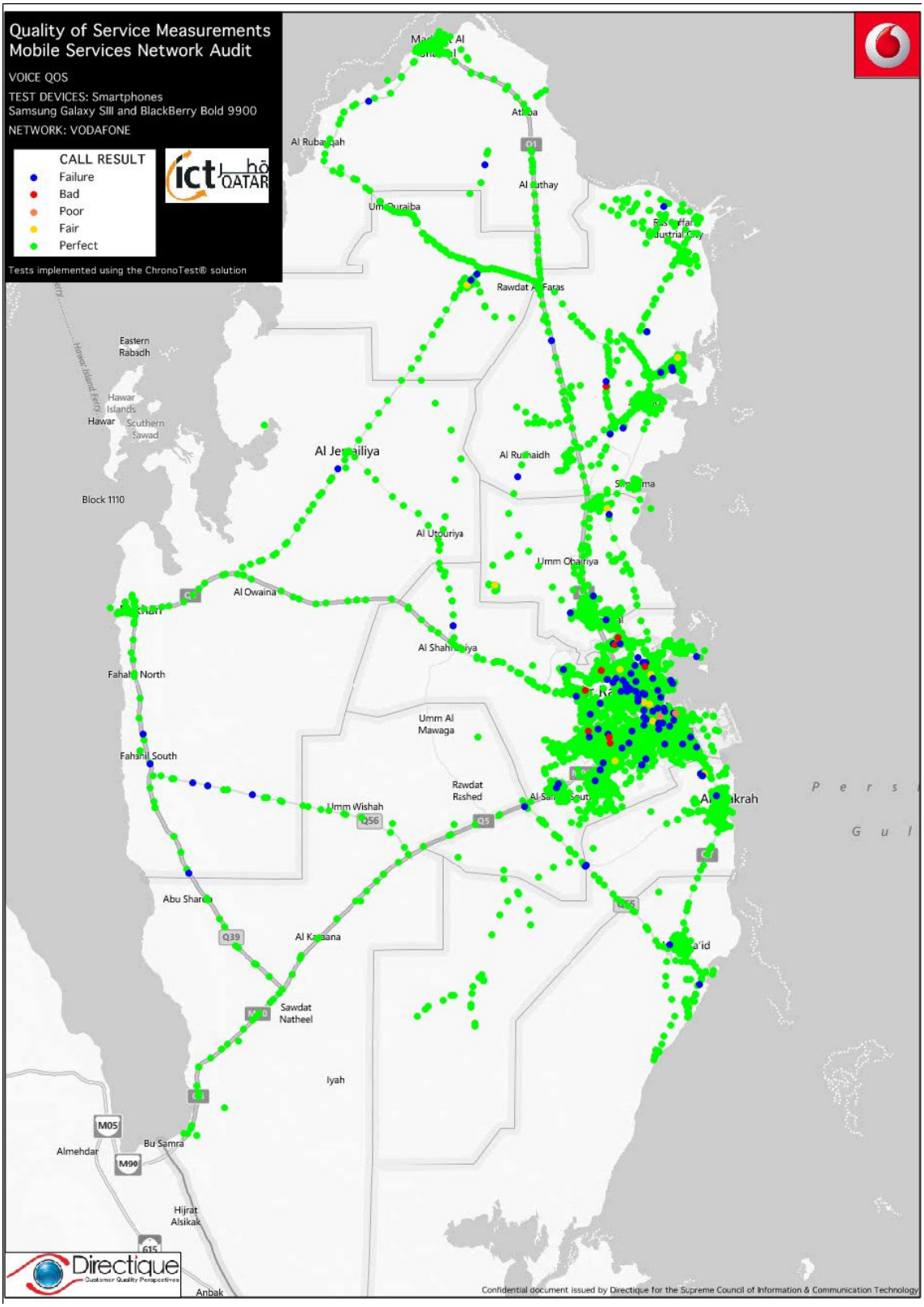
4.2.1.1 Towns Voice Results (In car-Indoor-Outdoor)

CITIES VOICE SERVICE		***Vodafone***
		4 435 mes
Rate of calls set-up and held for 2 min		**98.0%**
	Statistical accuracy	*± 0.3%*
and marked	**4-perfect (PQR)**	**97.5%**
	Statistical accuracy	*± 0.4%*
	4-perfect or 3-fair (CQR)	**97.7%**
	Statistical accuracy	*± 0.8%*

Cities INCAR Voice Service		***Vodafone***
		1 439 mes
Rate of calls set-up and held for 2 min		**97.4%**
	Statistical accuracy	*± 0.3%*
and marked	**4-perfect (PQR)**	**97.1%**
	Statistical accuracy	*± 0.4%*
	4-perfect or 3-fair (CQR)	**97.3%**
	Statistical accuracy	*± 0.8%*

4.2.1.2 Roads Links Voice Results

Road Links Voice Service		***Vodafone***
		532 mes
Rate of calls set-up and held for 2 min		**97.0%**
	Statistical accuracy	*± 0.3%*
and marked	**4-perfect (PQR)**	**96.8%**
	Statistical accuracy	*± 0.4%*
	4-perfect or 3-fair (CQR)	**97.0%**
	Statistical accuracy	*± 0.8%*



Map - Voice Call Results

4.2.2Service Results

4.2.2.1 SMS Results

SMS Service	Vodafone
Sample	*1 492 mes*
Rate of received SMS within 2 minutes (RS2)	**99.0%**
Statistical accuracy	*+/-0.5%*
Rate of received SMS within 30 seconds (RS30)	**98.3%**
Statistical accuracy	*+/-0.7%*
Average time reception	**6.0 s**

4.2.2.2 BBM Results

BBM Service	Vodafone
Sample	*746 mes*
Rate of received BBM within 2 minutes (RS2)	**99.3%**
Statistical accuracy	*+/-0.6%*
Rate of received BBM within 30 seconds (RS30)	**98.8%**
Statistical accuracy	*+/-0.8%*
Average time reception	**5.8 s**

4.2.2.3 MMS Results

MMS Service	Vodafone
Sample	*1 494 mes*
Rate of received MMS within 5 minutes (RM5)	**92.7%**
Statistical accuracy	*+/-1.3%*
Rate of received MMS within 2 minutes (RM2)	**90.1%**
Statistical accuracy	*+/-1.5%*
Average time reception	**43.0 s**

4.2.3Data Dongle Results

4.2.3.1 Data Accessibility Results

Radio Connection	Vodafone
Sample	*3 393 mes*
Rate of succesfull radio connections to network (within 60 seconds)	**96.2%**
Statistical accuracy	*+/-0.6%*
Rate of succesfull radio connections within 10 sec	**95.1%**
Statistical accuracy	*+/-0.7%*

4.2.3.2 WEB Service Results

WEB BROWSING	Vodafone
Sample	*7 984 mes*
Rate of succesfull downloaded webpages (within 30 seconds)	**88.0%**
Average download time once connected	**9.5 s**
Min download time once connected	2.5 s
Max download time once connected	30.0 s
Standard deviation of download time once connected	5.9 s

4.2.3.3 FTP Results

Download FTP	Vodafone
Sample	*1 698 mes*
Rate of succesfull data transfers	**91.5%**
Statistical accuracy	*+/-1.3%*
Average Throughput	**1931 kbps**
THROUGHPUT - min	206 kbps
THROUGHPUT - max	5301 kbps
THROUGHPUT - standard deviation	907 kbps

Upload FTP	Vodafone
Sample	*1 695 mes*
Rate of succesfull data transfers	**82.5%**
Statistical accuracy	*+/-1.8%*
Average Throughput	**868 kbps**
THROUGHPUT - min	76 kbps
THROUGHPUT - max	2388 kbps
THROUGHPUT - standard deviation	434 kbps

4.2.3.4 Mail Results

	Email 100Kb		*Email 1Mb*	
Mail Service **VODAFONE**	**SMTP**	**POP**	**SMTP**	**POP**
Sample	*1 576 mes*	*1 480 mes*	*1 583 mes*	*1 448 mes*
Rate of succesful data transfer	**98.2%**	**95.9%**	**83.6%**	**97.7%**
Statistical accuracy	*+/-1.8%*	*+/-1.0%*	*+/-1.8%*	*+/-0.8%*
Average Sending/Receiving Time once connected	**16.9 s**	**4.1 s**	**25.5 s**	**9.6 s**
Min Sending/Receiving Time once connected	8.3 s	1.4 s	15.1 s	3.9 s
Max Sending/Receiving Time once connected	59.2 s	52.6 s	59.9 s	49.6 s
Standard deviation Sending/Receiving Time once connected	9.5 s	4.8 s	7.8 s	5.4 s

4.2.4 Smartphone Results

4.2.4.1 WEB Results

WEB BROWSING	Vodafone
Sample	*8 435 mes*
Rate of succesfull downloaded webpages (within 30 seconds)	**90.9%**
Average download time once connected	**4.2 s**
Min download time once connected	0.1 s
Max download time once connected	28.9 s
Standard deviation of download time once connected	3.7 s

4.2.4.2 FTP Results

Download FTP	Vodafone
Sample	*1 687 mes*
Rate of succesfull data transfers	**97.6%**
Statistical accuracy	*+/-0.7%*
Average Throughput	**2105 kbps**
THROUGHPUT - min	136 kbps
THROUGHPUT - max	5857 kbps
THROUGHPUT - standard deviation	1076 kbps

Upload FTP	Vodafone
Sample	*1 687 mes*
Rate of succesfull data transfers	**94.5%**
Statistical accuracy	*+/-1.1%*
Average Throughput	**980 kbps**
THROUGHPUT - min	71 kbps
THROUGHPUT - max	2355 kbps
THROUGHPUT - standard deviation	367 kbps

4.2.4.3 HTTP Results

Download HTTP	Vodafone
Sample	*1 687 mes*
Rate of succesfull data transfers	**95.4%**
Statistical accuracy	*+/-1.0%*
Average Throughput	**2200 kbps**
THROUGHPUT - min	136 kbps
THROUGHPUT - max	11390 kbps
THROUGHPUT - standard deviation	1608 kbps

Upload HTTP	Vodafone
Sample	*1 687 mes*
Rate of succesfull data transfers	**93.9%**
Statistical accuracy	*+/-1.1%*
Average Throughput	**1240 kbps**
THROUGHPUT - min	68 kbps
THROUGHPUT - max	3648 kbps
THROUGHPUT - standard deviation	584 kbps

4.2.5 Video Streaming Results

VIDEO STREAMING	Vodafone	
	Smartphone	**Dongle**
Sample	*850 mes*	*851 mes*
END to END non-Quality rate	**10.2%**	**17.9%**
Statistic accuracy	*+/-2.0%*	*+/-2.6%*
TNQ - Acess to the video	7.5%	12.7%
Youtube sequences dropped	0.1%	0.2%
Youtube sequences with quality defaults	2.6%	4.9%
(more than 2 major defaults and/or more than 6 minor defaults)		

5 Conclusions

KPI's synthesis. Objectives for the next 2 years will be defined after public consultation

Protocol	KPI	Operator	Rate
VOICE	Rate of calls set-up and held for 2 min (SHC)	***Qtel***	98.5%
		Vodafone	97.9%
SMS	Rate of received SMS within 2 minutes (RS2)	***Qtel***	98.7%
		Vodafone	99.0%
BBM	Rate of received BBM within 2 minutes (RS2)	***Qtel***	99.7%
		Vodafone	99.3%
MMS	Rate of received MMS within 5 minutes (RM5)	***Qtel***	91.1%
		Vodafone	92.7%
DATA			
STREAMING VIDEO	END to END non-Quality rate	***Qtel***	3.8%
		Vodafone	14.1%
WEB Dongle	Rate of successfully downloaded webpages	***Qtel***	96.3%
		Vodafone	88.0%
WEB Smartphone	Rate of successfully downloaded webpages	***Qtel***	96.5%
		Vodafone	90.9%
FTP Dongle	Rate of successful data transfers	***Qtel***	96.7%
		Vodafone	87.0%
FTP Smartphone	Rate of successful data transfers	***Qtel***	97.7%
		Vodafone	96.1%
HTTP Smartphone	Rate of successful data transfers	***Qtel***	97.2%
		Vodafone	94.6%
MAIL SMTP Dongle	Rate of successfully sent messages	***Qtel***	90.3%
		Vodafone	90.9%
MAIL POP Dongle	Rate of successfully received messages	***Qtel***	98.6%
		Vodafone	96.8%

6 Appendix: Compliance with Annexure E of Operator's Licence

As stated in the annexure E of their licenses (here below), stating the obligations relating to provision and QoS to retail customer, operators have an obligation on the network call set-up success rate CSSR and the network dropped call rate DCR.

- **CSSR** : Call set-up on first attempt. Rate is based on the total sample.
- **DCR** : Rate of calls dropped before 2 minutes. Rate is based on the total sample.

Those KPI are, as stated in the license methodology, considering busy hours of the networks (17pm – 21pm)

The drive test done in the state of Qatar as part of the audit are only indicative but not sufficient to assess this parameter.

QoS Voice - busy Hours		Qtel	Vodafone
		2 018 mes	**2 017 mes**
CSSR : Call set-up Success Rate		**98.9%**	**97.8%**
	Statistical accuracy	*+/-0.5%*	*+/-0.6%*
DCR : Dropped Call Rate		**0.4%**	**0.7%**
	Statistical accuracy	*+/-0.3%*	*+/-0.4%*

Annexure E of Operator's License:

Parameter	Measure	Measurement Method	Obligation during First Year following the Effective Date	Obligation during Second Year following the Effective Date	Ongoing obligation after Second Year following the Effective Date
Network call set-up success rate	These measures the call set up success rate over the busiest part of the network. The call setup success rate is defined as (successful seizures for TCH/ seizure attempts for TCH) multiplied by (successful SDCCH requests for call set-up / SDCCH requests for call set-up).	The 10% of cells which have the highest levels of carried traffic during their busy hour during the measurement period are identified. The call set up success rate is calculated for each cell during the identified busy hour[1]. The network call set up success rate is the average across the individual success rates for each cell.	≥ 95%	≥ 97%	≥ 98%
Network dropped call rate	This measures the dropped call rate over the busiest part of the network. The network dropped call rate is defined as the proportion of calls successfully set up which terminate for any reason other than termination by either the calling or called parties.	The dropped call rate is calculated during the busy hour[1] for each of the 10% of busiest cells (as for the call success rate). The network dropped call rate is the average over the dropped call rates for each cell.	≤ 3.5%	≤ 2.0%	≤ 1.5%

7 ANNEXURES

a. Annexure 1 - Voice Results by Municipality

QTEL:

SHC (Set-up and held for 2 min calls) — *Qtel*

ID	Municipality	Sample	SHC
1	AL DAAYEN MUNICIPALITY	254	97.2%
2	UMM SLAL MUNICIPALITY	139	97.1%
3	AL WAKRA MUNICIPALITY	427	97.7%
4	AL RAYYAN MUNICIPALITY	1393	98.1%
5	DOHA MUNICIPALITY	1913	98.8%
6	AL KHOR MUNICIPALITY	644	98.9%
7	AL SHAMAL MUNICIPALITY	197	100.0%
	TOTAL	**4 967**	**98.5%**

VODAFONE:

SHC (Set-up and held for 2 min calls) — *Vodafone*

ID	Municipality	Sample	SHC
1	AL DAAYEN MUNICIPALITY	254	97.2%
2	UMM SLAL MUNICIPALITY	139	99.3%
3	AL WAKRA MUNICIPALITY	427	98.8%
4	AL RAYYAN MUNICIPALITY	1393	97.8%
5	DOHA MUNICIPALITY	1913	97.4%
6	AL KHOR MUNICIPALITY	644	98.4%
7	AL SHAMAL MUNICIPALITY	197	99.0%
	TOTAL	**4 967**	**97.9%**

b. Annexure 2 - Voice Results by Zones

SHC (Set-up and held for 2 min calls) — *Qtel*

ID	Municipality	Sample	SHC
1	AL JASRA	5	100.0%
2	AL BIDDA	3	100.0%
3	FEREEJ MOHAMMED BIN JASIM / MUSHAIREB	3	100.0%
4	MUSHAIREB	9	100.0%
5	AL NAJADA / BRAHAT AL JUFAIRY / FEREEJ AL ASMAKH	2	100.0%
6	OLD AL GHANIM	13	100.0%
7	AL SOUQ	33	100.0%
10	WADI AL SAIL	4	100.0%
11	RUMAILA	4	100.0%
12	AL BIDDA	11	90.9%
13	MUSHAIREB	13	100.0%
14	FEREEJ ABDEL AZIZ	13	100.0%
15	AL DOHA AL JADEEDA	6	100.0%
16	OLD AL GHANIM	9	100.0%
17	AL RUFAA / OLD AL HITMI	17	100.0%
18	SLATA / AL MIRQAB	21	100.0%
19	DOHA PORT	5	100.0%
20	WADI AL SAIL	12	100.0%
21	RUMAILA	10	100.0%
22	FEREEJ BIN MAHMOUD	29	96.6%
23	FEREEJ BIN MAHMOUD	56	98.2%
24	RAWDAT AL KHAIL	41	100.0%
25	AL MANSOURA / FEREEJ BIN DIRHAM	44	100.0%
26	NAJMA	16	100.0%
27	UMM GHUWAILINA	34	100.0%
28	AL KHULAIFAT / RAS BU ABBOUD	9	100.0%
29	RAS BU ABBOUD	2	100.0%
30	DUHAIL	21	100.0%
31	UMM LEKHBA	54	100.0%
32	MADINAT KHALIFA NORTH / DAHL AL HAMAM	35	94.3%
33	AL MARKHIYA	33	97.0%
34	MADINAT KHALIFA SOUTH	107	100.0%
35	FEREEJ KULAIB	39	100.0%
36	AL MESSILA	36	97.2%
37	FEREEJ BIN OMRAN / NEW AL HITMI / HAMAD MEDICA	81	100.0%
38	AL SADD	77	100.0%
39	AL SADD / NEW AL MIRQAB / FEREEJ AL NASR	127	99.2%
40	NEW SLATA	63	100.0%
41	NUAIJA	12	91.7%
42	AL HILAL	52	98.1%
43	NUAIJA	16	93.8%
44	NUAIJA	28	100.0%
45	OLD AIRPORT	65	98.5%
46	AL THUMAMA	14	100.0%
47	AL THUMAMA	37	100.0%

SHC (Set-up and held for 2 min calls)

Qtel

ID	Municipality	Sample	SHC
48	DOHA INTERNATIONAL AIRPORT	18	100.0%
49	DOHA INTERNATIONAL AIRPORT	10	100.0%
51	AL GHARRAFA / GHARRAFAT AL RAYYAN / IZGHAWA /	151	98.7%
52	AL LUQTA / LEBDAY / OLD AL RAYYAN / AL SHAGUB / FI	74	98.6%
53	NEW AL RAYYAN / AL WAJBA / MUAITHER	152	97.4%
54	FEREEJ AL AMIR / LUAIB / MURAIKH / BAAYA / MEHAIR	93	98.9%
55	FEREEJ AL SOUDAN / AL WAAB / AL AZIZIYA / NEW FER	395	98.7%
56	FEREEJ AL ASIRI / NEW FEREEJ AL KHULAIFAT / BU SAM	263	97.0%
57	INDUSTRIAL AREA	206	99.0%
60	AL DAFNA	15	100.0%
61	AL DAFNA / AL QASSAR	45	97.8%
62	LEKHWAIR	28	96.4%
63	ONAIZA	19	100.0%
64	LEJBAILAT	12	100.0%
65	ONAIZA	15	93.3%
66	ONAIZA / LEQTAIFIYA / AL QASSAR	112	97.3%
67	HAZM AL MARKHIYA	35	94.3%
68	JELAIAH / AL TARFA / JERYAN NEJAIMA	37	100.0%
69	JABAL THUAILEB / AL KHARAYEJ / LUSAIL / AL EGLA / W	7	100.0%
70	LEABAIB / AL EBB / JERYAN JENAIHAT / AL KHEESA / RA	221	97.3%
71	AL KHARAITIYAT / IZGHAWA / UMM SLAL MOHAMMED	139	97.1%
72	AL UTOURIYA	33	100.0%
73	LIJMILIYA	19	100.0%
74	SIMAISMA / AL JERYAN / AL KHOR	286	97.9%
75	AL THAKHIRA/RASS LAFFAN/UMM BIRKA	239	99.6%
76	AL GHUWAIRIYA	152	99.3%
77	FUWAIRIT/AIN SINAN/MADINAT AL KAABAN	19	100.0%
78	ABU DHALOUF/AL ZUBARA	56	100.0%
79	AL RUWAIS/MADINAT AL SHAMAL	122	100.0%
80	AL SHEEHANIYA	30	100.0%
81	MEBAIREEK	67	98.5%
82	RAWDAT RASHED	13	100.0%
83	AL KARAANA	21	100.0%
84	UMM BAB	29	96.6%
85	AL NASRANIYA	9	77.8%
86	DUKHAN	48	97.9%
90	AL WAKRA	192	99.0%
91	AL THUMAMA / AL WUKAIR/AL MASHAF	61	98.4%
92	MESAIEED	86	95.3%
93	MESAIEED INDUSTRIAL AREA	50	98.0%
94	SHAGRA	13	92.3%
95	AL KHARRARA	25	96.0%
96	ABU SAMRA	29	100.0%
97	SAWDA NATHEEL		
98	AL ADAID		

SHC (Set-up and held for 2 min calls)

Vodafone

ID	Municipality	Sample	SHC
1	AL JASRA	5	100.0%
2	AL BIDDA	3	100.0%
3	FEREEJ MOHAMMED BIN JASIM / MUSHAIREB	3	100.0%
4	MUSHAIREB	9	100.0%
5	AL NAJADA / BRAHAT AL JUFAIRY / FEREEJ AL ASMAKH	2	100.0%
6	OLD AL GHANIM	13	100.0%
7	AL SOUQ	33	90.9%
10	WADI AL SAIL	4	100.0%
11	RUMAILA	4	75.0%
12	AL BIDDA	11	81.8%
13	MUSHAIREB	13	100.0%
14	FEREEJ ABDEL AZIZ	13	92.3%
15	AL DOHA AL JADEEDA	6	100.0%
16	OLD AL GHANIM	9	88.9%
17	AL RUFAA / OLD AL HITMI	17	100.0%
18	SLATA / AL MIRQAB	21	100.0%
19	DOHA PORT	5	100.0%
20	WADI AL SAIL	12	91.7%
21	RUMAILA	10	90.0%
22	FEREEJ BIN MAHMOUD	29	100.0%
23	FEREEJ BIN MAHMOUD	56	100.0%
24	RAWDAT AL KHAIL	41	92.7%
25	AL MANSOURA / FEREEJ BIN DIRHAM	44	97.7%
26	NAJMA	16	100.0%
27	UMM GHUWAILINA	34	100.0%
28	AL KHULAIFAT / RAS BU ABBOUD	9	100.0%
29	RAS BU ABBOUD	2	100.0%
30	DUHAIL	21	100.0%
31	UMM LEKHBA	54	98.1%
32	MADINAT KHALIFA NORTH / DAHL AL HAMAM	35	88.6%
33	AL MARKHIYA	33	100.0%
34	MADINAT KHALIFA SOUTH	107	95.3%
35	FEREEJ KULAIB	39	94.9%
36	AL MESSILA	36	97.2%
37	FEREEJ BIN OMRAN / NEW AL HITMI / HAMAD MEDICA	81	100.0%
38	AL SADD	77	94.8%
39	AL SADD / NEW AL MIRQAB / FEREEJ AL NASR	127	99.2%
40	NEW SLATA	63	100.0%
41	NUAIJA	12	100.0%
42	AL HILAL	52	100.0%
43	NUAIJA	16	93.8%
44	NUAIJA	28	100.0%
45	OLD AIRPORT	65	95.4%
46	AL THUMAMA	14	100.0%
47	AL THUMAMA	37	100.0%

SHC (Set-up and held for 2 min calls)

Vodafone

ID	Municipality	Sample	SHC
48	DOHA INTERNATIONAL AIRPORT	18	100.0%
49	DOHA INTERNATIONAL AIRPORT	10	100.0%
51	AL GHARRAFA / GHARRAFAT AL RAYYAN / IZGHAWA /	151	97.4%
52	AL LUQTA / LEBDAY / OLD AL RAYYAN / AL SHAGUB / FI	74	97.3%
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54	FEREEJ AL AMIR / LUAIB / MURAIKH / BAAYA / MEHAIR	93	97.8%
55	FEREEJ AL SOUDAN / AL WAAB / AL AZIZIYA / NEW FER	395	98.5%
56	FEREEJ AL ASIRI / NEW FEREEJ AL KHULAIFAT / BU SAM	263	98.5%
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62	LEKHWAIR	28	96.4%
63	ONAIZA	19	100.0%
64	LEJBAILAT	12	100.0%
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66	ONAIZA / LEQTAIFIYA / AL QASSAR	112	99.1%
67	HAZM AL MARKHIYA	35	97.1%
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69	JABAL THUAILEB / AL KHARAYEJ / LUSAIL / AL EGLA / W	7	100.0%
70	LEABAIB / AL EBB / JERYAN JENAIHAT / AL KHEESA / RA	221	97.7%
71	AL KHARAITIYAT / IZGHAWA / UMM SLAL MOHAMMED	139	99.3%
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79	AL RUWAIS/MADINAT AL SHAMAL	122	100.0%
80	AL SHEEHANIYA	30	96.7%
81	MEBAIREEK	67	95.5%
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83	AL KARAANA	21	100.0%
84	UMM BAB	29	79.3%
85	AL NASRANIYA	9	100.0%
86	DUKHAN	48	100.0%
90	AL WAKRA	192	99.5%
91	AL THUMAMA / AL WUKAIR/AL MASHAF	61	96.7%
92	MESAIEED	86	98.8%
93	MESAIEED INDUSTRIAL AREA	50	98.0%
94	SHAGRA	13	100.0%
95	AL KHARRARA	25	100.0%
96	ABU SAMRA	29	100.0%
97	SAWDA NATHEEL		
98	AL ADAID		

المجلس الأعلى للإتصالات و تكنولوجيا المعلومات
Supreme Council of Information & Communication Technology

Quality of Service Measurements- Mobile Services Network Audit 2012

COVERAGE REPORT

TABLE OF CONTENTS

1 Executive Summary

Mobile Operators are under a coverage obligation as a condition of their mobile license, and it is the responsibility of ictQATAR to verify and validate that each operator is meeting its obligation.

Verification of Coverage and Technology Commitment:

- Qtel and Vodafone are to provide 2G to 100% of the State of Qatar. Vodafone is however obliged to provide 3G and 3.5G services to 90% of Qatar's population.
- Although Qtel has no technology commitments mentioned in its license, the test developed to verify Vodafone Qatar's compliance with technology roll-out shall be carried out for both operators.
- Public Mobile Telecommunications Services are considered to be available in a geographic area if a voice call can be successfully commenced and completed and the minimum signal strength obligations are met.
- The minimum signal strength required to qualify for achieving coverage is -85 dBm at ≥ 95% of the locations within any outdoor area of 100m x100m at a height of 1.5m above ground level. (Please see Annexure G of the licenses)
- 100% of the State of Qatar is defined as the primary physical landmass of the State of Qatar. For the avoidance of doubt, this does not include Qatari territorial waters or offshore islands.
- Population coverage shall be defined as the percentage of the total number of inhabitants of the State of Qatar who permanently reside, in accordance with the then most recent official statistics available from The General Secretariat of the Planning Council for the State of Qatar (http://www.qsa.gov.qa) in the area where the Public Mobile Telecommunications Services are available at the minimum signal strength.

Coverage Obligation:

- Geography: 100% of the State of Qatar for **both** service providers.
- Population: 100% of the population for Vodafone. No obligation for Qtel

Vodafone Technology Commitments:

Mobile Technology	Population Coverage
2G (GSM)	100%
2.5G (GPRS/EDGE)	100%
3G (UMTS)	90%
3.5G (HSDPA)	90%

It is important to point out that several areas were not accessible to the test team, being either private land or reserved for government, which explains why the maps do not show any measurements in some area of the Country. However those areas are not open to general public.
Directique was also required to compare Mobile Operators coverage prediction maps with the actual coverage measured. The maps included in this report contain two layers: a first layer showing the coverage predictions provided by the operators themselves, and a second layer illustrating the results of the coverage measurements.

2 Objective

The objective of this audit was to:

- Measure the outdoor coverage of the 2 Mobile Operators QTEL and Vodafone, on both 2G and 3G technologies with mobiles in IDLE recording the signal strength.
- With mobiles launching Accessibility tests every 30 seconds, establish for each operator a direct correlation between the number of households covered and the percentage of the population, resulting directly from such coverage.
- Validate the coverage maps of each Mobile Operator against the outdoor coverage measured during the audit.
- Conduct a DATA coverage audit with Smartphones.

3 Methodology

The audit was conducted between December 17th 2012 and February 22nd 2013 and across the entire State of Qatar.

Coverage results have been weighted by the population percentage living in each Zone. The tables presented in Annex show the detailed coverage as measured for each operator.

Measurements have been performed in two ways, a set of mobile equipment set in 2G only and a set of mobile equipment set in 3G only.

Coverage, from a end-user perspective, cannot be measured with a scanner or by tracing reception level. A scanner cannot discern the difference between the live cells and the other emitting cells and would give an over optimistic coverage measurement. Further, measuring reception levels would also not be appropriate as having a signal is not a guarantee that a call would be successful.

For example in the case of an unbalanced cell between receive and transmit signal levels, it is possible for a mobile phone to receive a good signal but be unable to support a call due to the distance to the base station. Furthermore, such tools would measure reception levels in dB, and this cannot be interpreted or even understood by the end user.

It is for these reasons that the coverage has been audited using tools which are fully representative of how a subscriber would access a mobile service – the audit therefore if fully representive of the subscriber experience.

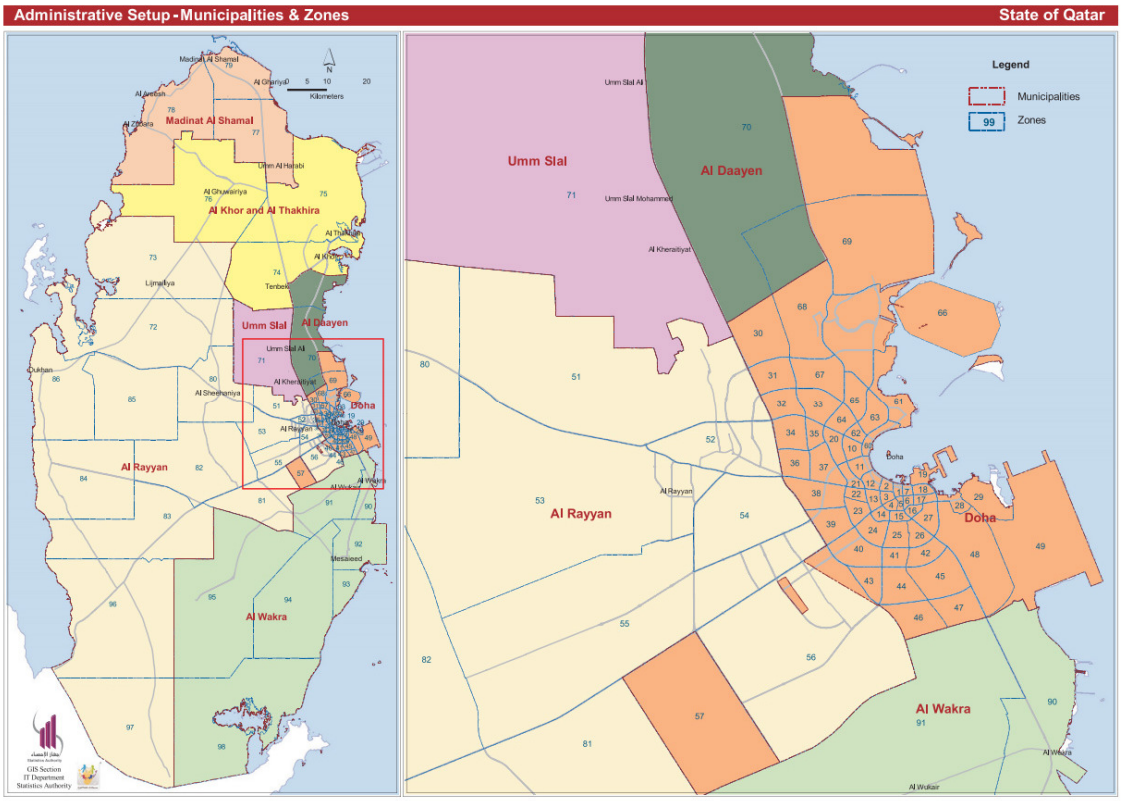
A vehicle equipped with standard mobile phones an placing calls following an automatic test script driven by a software called *MobiTrace***,** was used perform tests on all streets (paved roads of Qatar along a length of approximately 6600km approx.), pedestrian areas and through desert (off) roads (a length of approximately 500 km).

Accessibility measurements : The software performed repeated call attempts to pre-defined number (111), until a ring-back tone or a specific audio recording (voicemail message) was received. The software also performed a measure of the field strength for every call.

IDLE measurements : a full radio trace is recorded every second, indicating the signal strengh in 2G (RxLev) and 3G (RSCP). Then, in order to establish a coverage KPI corresponding to the license's obligation, a specific method of calculation has been set:

- The state of Qatar has been divided into 100m*100m areas
- For each 100m*100m area, the rate of locations where signal strength is greater than -85dBM is calculated
- The KPI shows the proportion of areas where this rate is over 95%

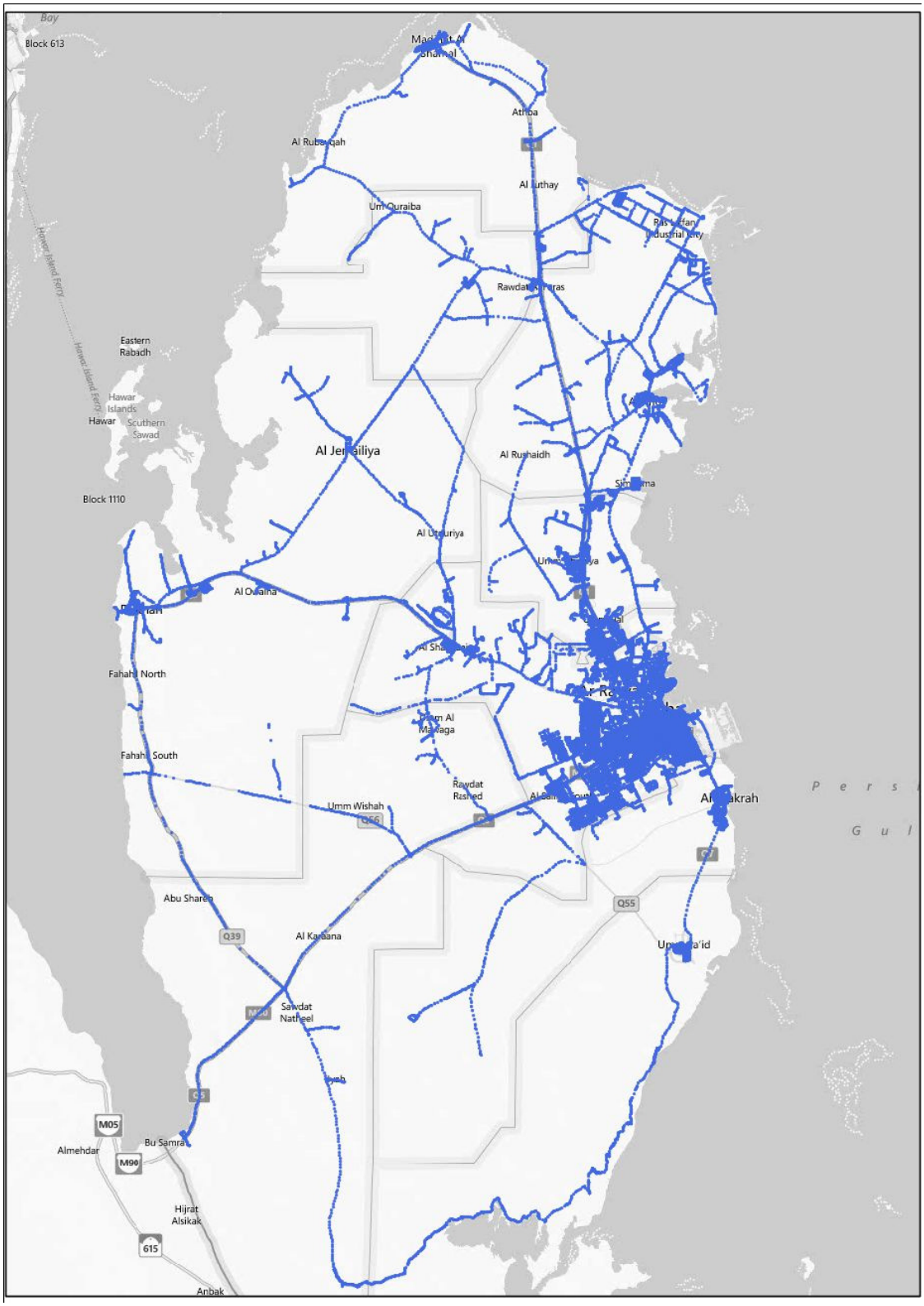
Administrative Divisions



Qatar is divided into 7 Municipalities, including 90 administrative zones.

3.1 Drive Test

Routes followed by the vehicle performing measurements, including off roads.



3.2 Equipment

Audit measurements were performed using standard mobile phones.

The make and model of the mobile phone used is Samsung GT-S8530.

For each type of tests (accessibility and Idle), two mobile phones were used per network. One was locked in 2G mode and the other one was locked in 3G mode.

Rooftop Box and Mobile Phones

For outdoor test conditions mobile phones were positioned in a plastic rooftop box. The rooftop box was tested by measuring a reference signal, both outside and inside the rooftop box, this is to validate the absence of significant radio signal attenuation. Similarly the test platform was calibrated using a reference signal to identify and correct any significant difference between mobile phones sensibility.

Inside the rooftop box, mobile phones were positioned vertically on a stable, specifically adapted base, to provide the best possible radio conditions. Electrical supply of each mobile phone was continuously guaranteed to ensure autonomy of the device and optimal radio conditions.

The platform was connected to a computer based software running the automated test script and recording test results. The set-up was completed with a GPS receiver, one for each Mobile Operator, which recorded the exact location of each test.

3.3 Data Coverage

Accessibility Data tests are fully automated with the following method:

- A latency measurement of a 32-byte file download.

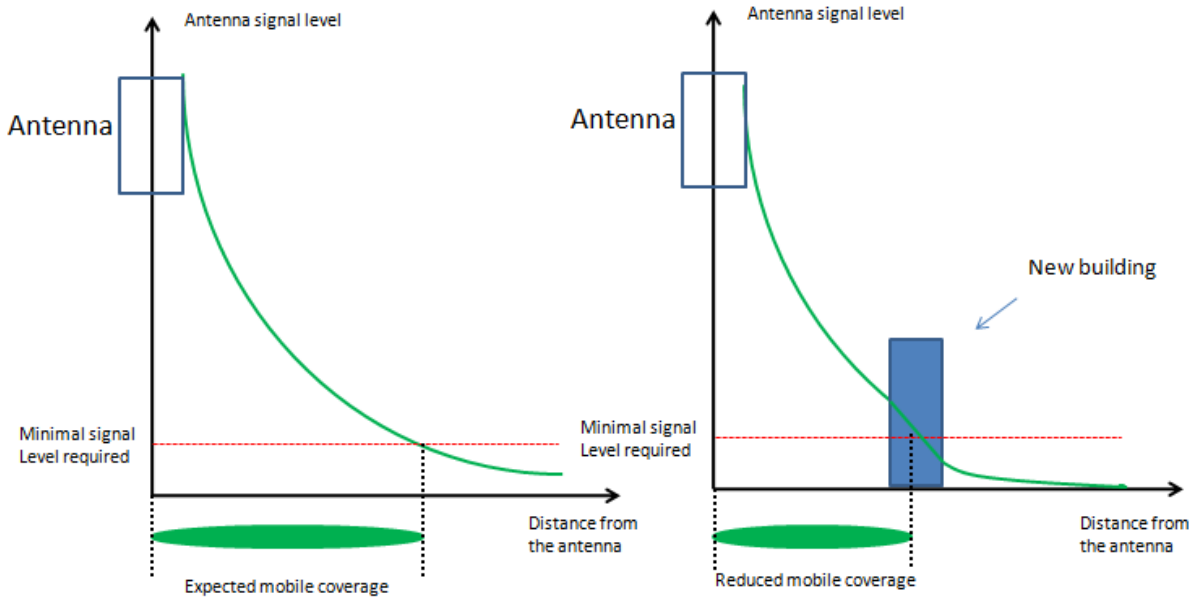
This enables the detection of networks, their availability and their technology.

Data coverage measurements are carried out using android smartphones and Directique's tool Mobispeed. Smartphones are installed inside the vehicle used for Voice measurements and tests are reiterated every minute automatically. This method makes it possible to carry out 10 000 measurements each week.

3.4 Additional Elements

It is important to understand that outdoor coverage is usually better than indoor coverage, because the base station providing the mobile signal is usually located outside, typically on a building roof or a telecommunications mast.

The mobile signal is attenuated when it penetrates a building structure, affected by the thickness of concrete wall and metallic elements used in the construction, thus resulting in lower signal strength inside the building.



Coverage Evolution Following a New Construction

Readers shall understand that mobile coverage can also vary with the evolution of the landscape, the diagram above showing the impact of a new building in a previously fully covered area, and illustrate the need for Mobile Operators to continuously monitor the coverage of their mobile network and take action when necessary to maintain the appropriate coverage level.

4 Results

4.1 Geographical Coverage: (IDLE Measurements)

The minimum signal strength required to qualify for achieving coverage is -85 dBm at ≥ 95% of the locations within any outdoor area of 100m x100m at a height of 1.5m above ground level. (Please see Annexure G of the licenses).

	QTEL 2G	QTEL 3G
Total areas	45 811	45 965
% of areas where at least 95% of IDLE measurements signal is -85dBm or higher	99.5%	85.1%
Statistical accuracy	*+/-0.1%*	*+/-0.3%*

	VODAFONE 2G	VODAFONE 3G
Total areas	45 965	46 819
% of areas where at least 95% of IDLE measurements signal is -85dBm or higher	95.3%	78.2%
Statistical accuracy	*+/-0.2%*	*+/-0.4%*

Geographical Coverage by Municipality:

	QTEL 2G		QTEL 3G	
Municipality	**Sample**	**Coverage**	**Sample**	**Coverage**
AL DAAYEN MUNICIPALITY	2589	99.2%	2215	79.5%
UMM SLAL MUNICIPALITY	2436	99.7%	2451	76.2%
AL WAKRA MUNICIPALITY	4657	97.3%	4327	82.8%
AL RAYYAN MUNICIPALITY	18965	99.7%	19397	87.0%
DOHA MUNICIPALITY	8661	99.9%	8762	86.6%
AL KHOR MUNICIPALITY	6214	99.6%	6338	82.8%
AL SHAMAL MUNICIPALITY	2289	99.9%	2308	89.7%
TOTAL	**45 811**	**99.5%**	**45 798**	**85.1%**

	VODA 2G		VODA 3G	
Municipality	**Sample**	**Coverage**	**Sample**	**Coverage**
AL DAAYEN MUNICIPALITY	2571	92.8%	2589	80.9%
UMM SLAL MUNICIPALITY	2496	94.2%	2500	86.4%
AL WAKRA MUNICIPALITY	4600	90.5%	4696	72.2%
AL RAYYAN MUNICIPALITY	18879	94.9%	19513	73.0%
DOHA MUNICIPALITY	8796	97.8%	8871	90.7%
AL KHOR MUNICIPALITY	6314	96.4%	6341	73.8%
AL SHAMAL MUNICIPALITY	2309	98.9%	2309	86.1%
TOTAL	**45 965**	**95.3%**	**46 819**	**78.2%**

Comment: for all the tables regarding IDLE measurements: the sample represents the total number of 100mX100m areas where measurements have been conducted

Geographical Coverage by Zone:

		QTEL 2G		QTEL 3G	
ID	Zone	Sample	Coverage	Sample	Coverage
1	AL JASRA	18	100.0%	18	83.3%
2	AL BIDDA	13	100.0%	12	91.7%
3	FEREEJ MOHAMMED BIN JASIM / MUSHAIREB	6	100.0%	5	100.0%
4	MUSHAIREB	38	100.0%	37	97.3%
5	AL NAJADA / BRAHAT AL JUFAIRY / FEREEJ AL ASMAKH	13	100.0%	13	100.0%
6	OLD AL GHANIM	18	100.0%	18	100.0%
7	AL SOUQ	18	100.0%	19	100.0%
10	WADI AL SAIL	11	100.0%	11	81.8%
11	RUMAILA	53	100.0%	27	92.6%
12	AL BIDDA	39	100.0%	34	97.1%
13	MUSHAIREB	55	100.0%	54	100.0%
14	FEREEJ ABDEL AZIZ	59	100.0%	58	100.0%
15	AL DOHA AL JADEEDA	62	100.0%	61	95.1%
16	OLD AL GHANIM	46	100.0%	46	97.8%
17	AL RUFAA / OLD AL HITMI	35	100.0%	35	100.0%
18	SLATA / AL MIRQAB	36	100.0%	38	97.4%
19	DOHA PORT	16	100.0%	16	100.0%
20	WADI AL SAIL	49	98.0%	50	76.0%
21	RUMAILA	94	100.0%	101	91.1%
22	FEREEJ BIN MAHMOUD	68	100.0%	71	81.7%
23	FEREEJ BIN MAHMOUD	82	100.0%	82	84.1%
24	RAWDAT AL KHAIL	145	100.0%	145	97.9%
25	AL MANSOURA / FEREEJ BIN DIRHAM	149	100.0%	149	93.3%
26	NAJMA	110	100.0%	110	87.3%
27	UMM GHUWAILINA	128	100.0%	126	98.4%
28	AL KHULAIFAT / RAS BU ABBOUD	48	97.9%	46	84.8%
29	RAS BU ABBOUD	20	100.0%	18	100.0%
30	DUHAIL	185	100.0%	166	73.5%
31	UMM LEKHBA	200	100.0%	200	70.5%
32	MADINAT KHALIFA NORTH / DAHL AL HAMAM	135	100.0%	135	88.1%
33	AL MARKHIYA	63	100.0%	63	69.8%
34	MADINAT KHALIFA SOUTH	106	100.0%	105	80.0%
35	FEREEJ KULAIB	51	100.0%	51	82.4%
36	AL MESSILA	75	100.0%	75	74.7%
37	FEREEJ BIN OMRAN / NEW AL HITMI / HAMAD MEDICA	139	100.0%	139	88.5%
38	AL SADD	188	100.0%	188	89.9%
39	AL SADD / NEW AL MIRQAB / FEREEJ AL NASR	254	100.0%	254	95.7%
40	NEW SLATA	311	100.0%	311	91.3%
41	NUAIJA	107	100.0%	107	94.4%
42	AL HILAL	179	100.0%	174	94.8%
43	NUAIJA	167	100.0%	167	93.4%
44	NUAIJA	288	100.0%	283	91.5%
45	OLD AIRPORT	447	100.0%	428	90.2%

		QTEL 2G		QTEL 3G	
ID	Zone	Sample	Coverage	Sample	Coverage
46	AL THUMAMA	264	100.0%	264	77.3%
47	AL THUMAMA	304	100.0%	297	91.6%
48	DOHA INTERNATIONAL AIRPORT	115	99.1%	112	96.4%
49	DOHA INTERNATIONAL AIRPORT	44	100.0%	38	100.0%
51	AL GHARRAFA / GHARRAFAT AL RAYYAN / IZGHAWA /	1563	99.3%	1560	84.2%
52	AL LUQTA / LEBDAY / OLD AL RAYYAN / AL SHAGUB / FI	353	100.0%	352	78.7%
53	NEW AL RAYYAN / AL WAJBA / MUAITHER	778	100.0%	782	77.6%
54	FEREEJ AL AMIR / LUAIB / MURAIKH / BAAYA / MEHAIR	733	100.0%	658	89.2%
55	FEREEJ AL SOUDAN / AL WAAB / AL AZIZIYA / NEW FER	3332	99.7%	3378	90.5%
56	FEREEJ AL ASIRI / NEW FEREEJ AL KHULAIFAT / BU SAM	2497	100.0%	3116	84.1%
57	INDUSTRIAL AREA	1321	100.0%	1318	89.8%
60	AL DAFNA	84	96.4%	83	69.9%
61	AL DAFNA / AL QASSAR	175	100.0%	174	75.3%
62	LEKHWAIR	12	100.0%	12	91.7%
63	ONAIZA	116	99.1%	116	72.4%
64	LEJBAILAT	94	100.0%	94	63.8%
65	ONAIZA	102	99.0%	104	74.0%
66	ONAIZA / LEQTAIFIYA / AL QASSAR	535	99.4%	535	75.9%
67	HAZM AL MARKHIYA	159	100.0%	159	63.5%
68	JELAIAH / AL TARFA / JERYAN NEJAIMA	275	100.0%	274	70.1%
69	JABAL THUAILEB / AL KHARAYEJ / LUSAIL / AL EGLA / W	126	100.0%	126	93.7%
70	LEABAIB / AL EBB / JERYAN JENAIHAT / AL KHEESA / RA	1930	99.1%	1573	81.2%
71	AL KHARAITIYAT / IZGHAWA / UMM SLAL MOHAMMED	2442	99.7%	2456	76.3%
72	AL UTOURIYA	865	99.9%	875	82.6%
73	LIJMILIYA	833	100.0%	836	89.8%
74	SIMAISMA / AL JERYAN / AL KHOR	2683	99.4%	2702	75.5%
75	AL THAKHIRA/RASS LAFFAN/UMM BIRKA	2903	99.7%	3004	89.7%
76	AL GHUWAIRIYA	1387	99.9%	1391	78.8%
77	FUWAIRIT/AIN SINAN/MADINAT AL KAABAN	644	99.7%	645	84.0%
78	ABU DHALOUF/AL ZUBARA	682	99.9%	699	94.8%
79	AL RUWAIS/MADINAT AL SHAMAL	990	99.9%	995	89.6%
80	AL SHEEHANIYA	1829	100.0%	1827	88.5%
81	MEBAIREEK	1472	100.0%	1470	83.6%
82	RAWDAT RASHED	615	100.0%	611	93.9%
83	AL KARAANA	635	100.0%	658	90.7%
84	UMM BAB	716	98.6%	716	92.3%
85	AL NASRANIYA	379	100.0%	379	94.2%
86	DUKHAN	1368	98.9%	1368	93.3%
90	AL WAKRA	1125	99.8%	775	92.5%
91	AL THUMAMA / AL WUKAIR/AL MASHAF	1221	99.6%	1212	94.1%
92	MESAIEED	817	100.0%	817	90.8%
93	MESAIEED INDUSTRIAL AREA	155	100.0%	155	64.5%
94	SHAGRA	255	89.0%	260	64.6%
95	AL KHARRARA	674	99.6%	680	83.7%
96	ABU SAMRA	1046	99.9%	1048	83.0%
97	SAWDA NATHEEL	275	97.8%	275	86.9%
98	AL ADAID	564	84.2%	573	48.9%
	TOTAL	**45 811**	**99.5%**	**45 798**	**85.1%**

		VODA 2G		VODA 3G	
ID	Zone	Sample	Coverage	Sample	Coverage
1	AL JASRA	18	100.0%	18	100.0%
2	AL BIDDA	13	100.0%	13	84.6%
3	FEREEJ MOHAMMED BIN JASIM / MUSHAIREB	6	100.0%	6	100.0%
4	MUSHAIREB	38	100.0%	38	100.0%
5	AL NAJADA / BRAHAT AL JUFAIRY / FEREEJ AL ASMAKH	13	100.0%	13	100.0%
6	OLD AL GHANIM	18	100.0%	18	88.9%
7	AL SOUQ	18	100.0%	22	90.9%
10	WADI AL SAIL	11	100.0%	11	54.5%
11	RUMAILA	53	100.0%	53	86.8%
12	AL BIDDA	39	100.0%	40	97.5%
13	MUSHAIREB	55	100.0%	55	98.2%
14	FEREEJ ABDEL AZIZ	59	100.0%	59	96.6%
15	AL DOHA AL JADEEDA	61	100.0%	62	95.2%
16	OLD AL GHANIM	46	97.8%	46	89.1%
17	AL RUFAA / OLD AL HITMI	35	97.1%	35	97.1%
18	SLATA / AL MIRQAB	36	100.0%	38	81.6%
19	DOHA PORT	16	100.0%	16	100.0%
20	WADI AL SAIL	49	100.0%	50	92.0%
21	RUMAILA	94	98.9%	94	91.5%
22	FEREEJ BIN MAHMOUD	68	100.0%	68	88.2%
23	FEREEJ BIN MAHMOUD	82	100.0%	82	93.9%
24	RAWDAT AL KHAIL	145	97.9%	145	91.0%
25	AL MANSOURA / FEREEJ BIN DIRHAM	149	98.7%	149	96.6%
26	NAJMA	110	97.3%	110	93.6%
27	UMM GHUWAILINA	124	98.4%	130	94.6%
28	AL KHULAIFAT / RAS BU ABBOUD	46	87.0%	48	87.5%
29	RAS BU ABBOUD	18	100.0%	20	90.0%
30	DUHAIL	183	96.7%	185	85.9%
31	UMM LEKHBA	200	94.0%	200	83.0%
32	MADINAT KHALIFA NORTH / DAHL AL HAMAM	135	96.3%	135	92.6%
33	AL MARKHIYA	63	93.7%	63	90.5%
34	MADINAT KHALIFA SOUTH	106	88.7%	106	81.1%
35	FEREEJ KULAIB	51	92.2%	51	82.4%
36	AL MESSILA	75	92.0%	75	88.0%
37	FEREEJ BIN OMRAN / NEW AL HITMI / HAMAD MEDICA	139	95.7%	139	95.7%
38	AL SADD	188	94.1%	188	91.0%
39	AL SADD / NEW AL MIRQAB / FEREEJ AL NASR	254	98.8%	254	96.9%
40	NEW SLATA	311	99.7%	311	97.1%
41	NUAIJA	107	100.0%	107	100.0%
42	AL HILAL	177	99.4%	179	97.2%
43	NUAIJA	167	100.0%	167	94.0%
44	NUAIJA	288	97.9%	288	95.1%
45	OLD AIRPORT	417	97.4%	447	93.3%

		VODA 2G		VODA 3G	
ID	Zone	Sample	Coverage	Sample	Coverage
46	AL THUMAMA	264	93.2%	264	92.8%
47	AL THUMAMA	297	97.3%	304	95.1%
48	DOHA INTERNATIONAL AIRPORT	111	100.0%	115	98.3%
49	DOHA INTERNATIONAL AIRPORT	44	100.0%	44	100.0%
51	AL GHARRAFA / GHARRAFAT AL RAYYAN / IZGHAWA /	1559	94.0%	1563	84.9%
52	AL LUQTA / LEBDAY / OLD AL RAYYAN / AL SHAGUB / FI	353	97.2%	353	86.4%
53	NEW AL RAYYAN / AL WAJBA / MUAITHER	777	92.1%	782	64.8%
54	FEREEJ AL AMIR / LUAIB / MURAIKH / BAAYA / MEHAIR	733	98.8%	733	94.1%
55	FEREEJ AL SOUDAN / AL WAAB / AL AZIZIYA / NEW FER	3385	92.2%	3388	67.4%
56	FEREEJ AL ASIRI / NEW FEREEJ AL KHULAIFAT / BU SAM	2559	98.2%	3122	89.4%
57	INDUSTRIAL AREA	1325	98.8%	1325	80.5%
60	AL DAFNA	83	98.8%	84	83.3%
61	AL DAFNA / AL QASSAR	175	99.4%	177	82.5%
62	LEKHWAIR	12	75.0%	12	58.3%
63	ONAIZA	116	100.0%	117	87.2%
64	LEJBAILAT	94	92.6%	94	97.9%
65	ONAIZA	102	89.2%	104	92.3%
66	ONAIZA / LEQTAIFIYA / AL QASSAR	537	98.3%	535	92.5%
67	HAZM AL MARKHIYA	159	99.4%	159	82.4%
68	JELAIAH / AL TARFA / JERYAN NEJAIMA	271	97.8%	275	85.5%
69	JABAL THUAILEB / AL KHARAYEJ / LUSAIL / AL EGLA / W	126	100.0%	126	99.2%
70	LEABAIB / AL EBB / JERYAN JENAIHAT / AL KHEESA / RA	1914	92.1%	1930	84.2%
71	AL KHARAITIYAT / IZGHAWA / UMM SLAL MOHAMMED	2502	94.5%	2506	86.6%
72	AL UTOURIYA	871	98.3%	875	70.9%
73	LIJMILIYA	833	100.0%	836	87.7%
74	SIMAISMA / AL JERYAN / AL KHOR	2701	93.5%	2704	61.4%
75	AL THAKHIRA/RASS LAFFAN/UMM BIRKA	2981	97.9%	3005	80.9%
76	AL GHUWAIRIYA	1391	98.3%	1391	82.0%
77	FUWAIRIT/AIN SINAN/MADINAT AL KAABAN	647	100.0%	646	94.9%
78	ABU DHALOUF/AL ZUBARA	698	97.7%	699	74.8%
79	AL RUWAIS/MADINAT AL SHAMAL	994	97.8%	995	84.9%
80	AL SHEEHANIYA	1813	97.4%	1833	85.7%
81	MEBAIREEK	1465	89.0%	1483	65.1%
82	RAWDAT RASHED	615	86.2%	615	41.1%
83	AL KARAANA	646	98.5%	658	64.1%
84	UMM BAB	716	98.3%	716	19.0%
85	AL NASRANIYA	379	98.4%	379	68.6%
86	DUKHAN	1367	95.8%	1368	82.0%
90	AL WAKRA	1125	96.3%	1125	91.2%
91	AL THUMAMA / AL WUKAIR/AL MASHAF	1130	98.7%	1222	91.6%
92	MESAIEED	817	98.8%	817	99.3%
93	MESAIEED INDUSTRIAL AREA	155	100.0%	155	100.0%
94	SHAGRA	261	69.3%	260	48.8%
95	AL KHARRARA	681	88.8%	684	25.4%
96	ABU SAMRA	1046	98.2%	1048	57.8%
97	SAWDA NATHEEL	275	76.7%	275	80.4%
98	AL ADAID	579	64.2%	584	16.3%
	TOTAL	**45 965**	**95.3%**	**46 819**	**78.2%**

4.2 Population Coverage: (IDLE Measurements)

Population coverage is then calculated by weighting results with the population percentage living in each Zone, using most recent official statistics available from The General Secretariat of the Planning Council for the State of Qatar.

% of measurements with radio signal is -85dBm or higher		QTEL 2G	QTEL 3G
	Sample	45 811	45 798
By Municipality		99.6%	85.4%
	Statistical accuracy	*+/-0.1%*	*+/-0.3%*
By Zone		99.8%	87.1%
	Statistical accuracy	*+/-0.0%*	*+/-0.3%*

% of measurements with radio signal is -85dBm or higher		VODAFONE 2G	VODAFONE 3G
	Sample	45 965	46 819
By Municipality		96.0%	82.1%
	Statistical accuracy	*+/-0.2%*	*+/-0.3%*
By Zone		96.3%	83.3%
	Statistical accuracy	*+/-0.2%*	*+/-0.3%*

Population Coverage by municipality:

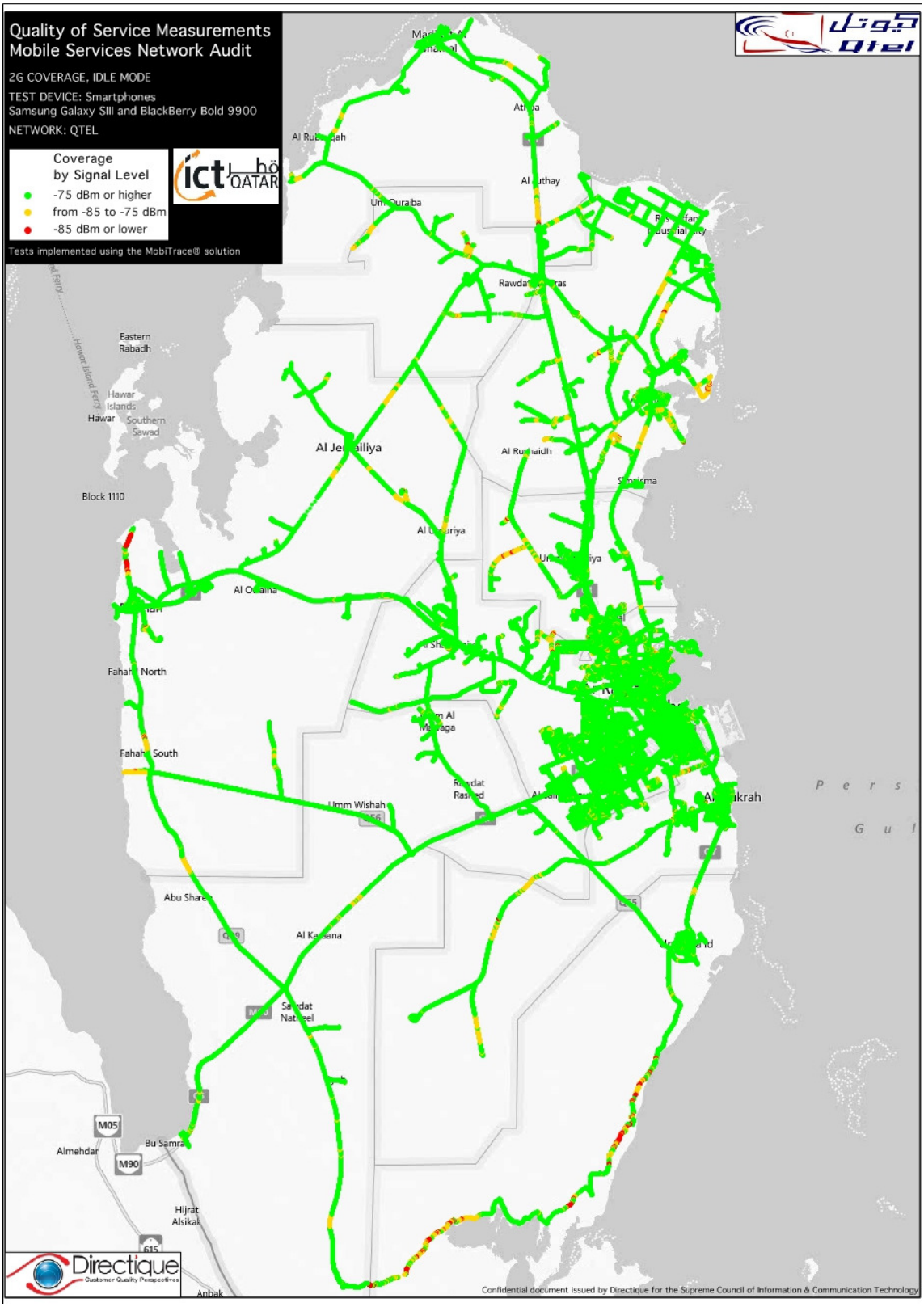
			QTEL 2G		QTEL 3G	
Municipality	**Pop.**	**% POP**	**Sample**	**Coverage**	**Sample**	**Coverage**
AL DAAYEN MUNICIPALITY	43 176	2.5%	2589	99.2%	2215	79.5%
UMM SLAL MUNICIPALITY	60 509	3.6%	2436	99.7%	2451	76.2%
AL WAKRA MUNICIPALITY	141 222	8.3%	4657	97.3%	4327	82.8%
AL RAYYAN MUNICIPALITY	455 623	26.8%	18965	99.7%	19397	87.0%
DOHA MUNICIPALITY	796 947	46.9%	8661	99.9%	8762	86.6%
AL KHOR MUNICIPALITY	193 983	11.4%	6214	99.6%	6338	82.8%
AL SHAMAL MUNICIPALITY	7 975	0.5%	2289	99.9%	2308	89.7%
TOTAL	**1 699 435**		**45 811**	**99.6%**	**45 798**	**85.4%**

			VODA 2G		VODA 3G	
Municipality	**Pop.**	**% POP**	**Sample**	**Coverage**	**Sample**	**Coverage**
AL DAAYEN MUNICIPALITY	43 176	2.5%	2571	92.8%	2589	80.9%
UMM SLAL MUNICIPALITY	60 509	3.6%	2496	94.2%	2500	86.4%
AL WAKRA MUNICIPALITY	141 222	8.3%	4600	90.5%	4696	72.2%
AL RAYYAN MUNICIPALITY	455 623	26.8%	18879	94.9%	19513	73.0%
DOHA MUNICIPALITY	796 947	46.9%	8796	97.8%	8871	90.7%
AL KHOR MUNICIPALITY	193 983	11.4%	6314	96.4%	6341	73.8%
AL SHAMAL MUNICIPALITY	7 975	0.5%	2309	98.9%	2309	86.1%
TOTAL	**1 699 435**		**45 965**	**96.0%**	**46 819**	**82.1%**

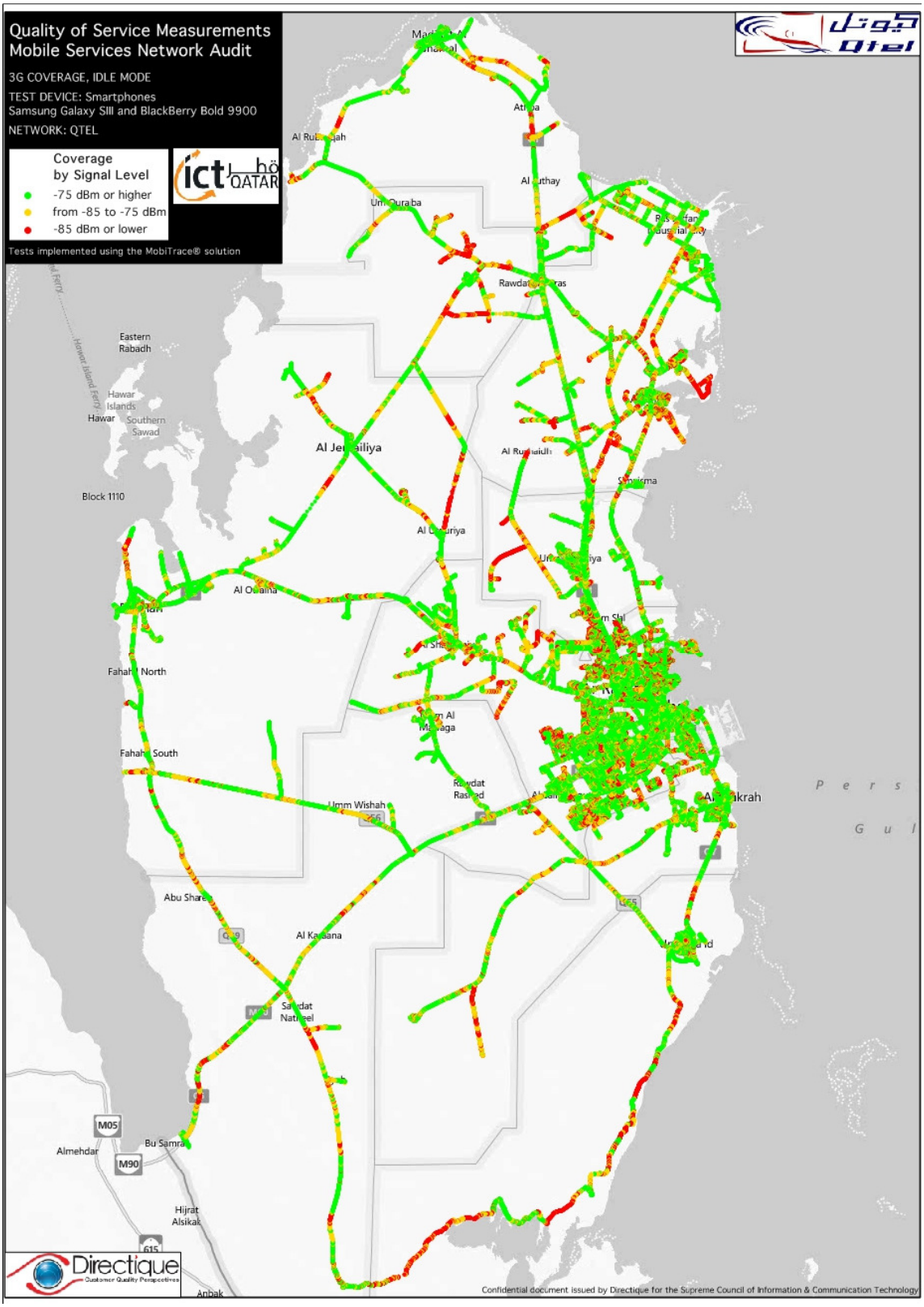
Population Coverage by Zone in annexure 1

4.3 Idle Coverage Maps

QTEL 2G



QTEL 3G


Quality of Service Measurements
Mobile Services Network Audit
3G COVERAGE, IDLE MODE
TEST DEVICE: Smartphones
Samsung Galaxy SIII and BlackBerry Bold 9900
NETWORK: QTEL
Coverage by Signal Level
-75 dBm or higher
from -85 to -75 dBm
-85 dBm or lower
Tests implemented using the MobiTrace® solution
Qtel
Eastern Rabadh
Hawar Islands
Hawar
Southern Sawad
Block 1110
Umm Wishah
Abu Shara
Almehdar
Bu Samra
Hijrat Alsikak
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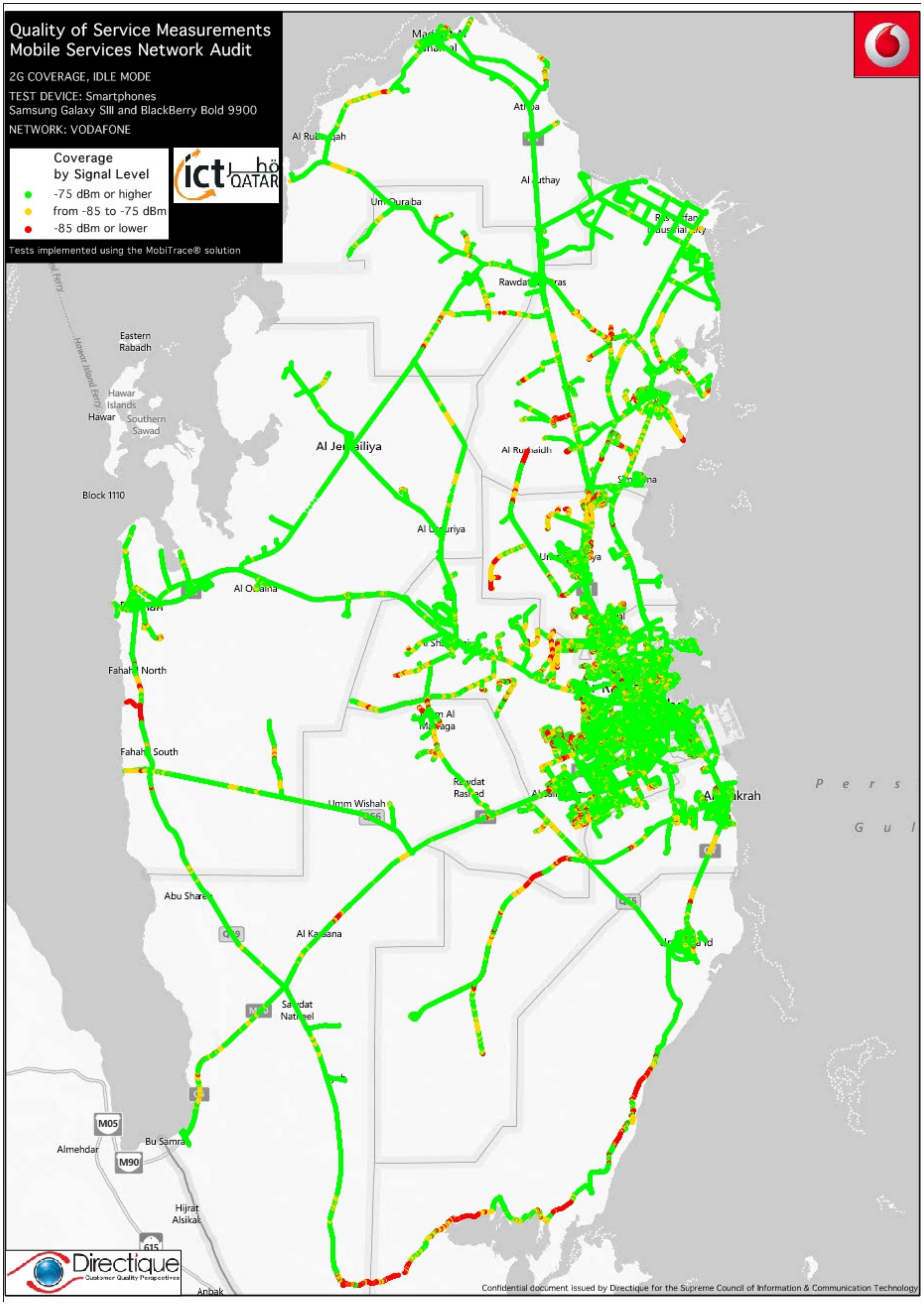
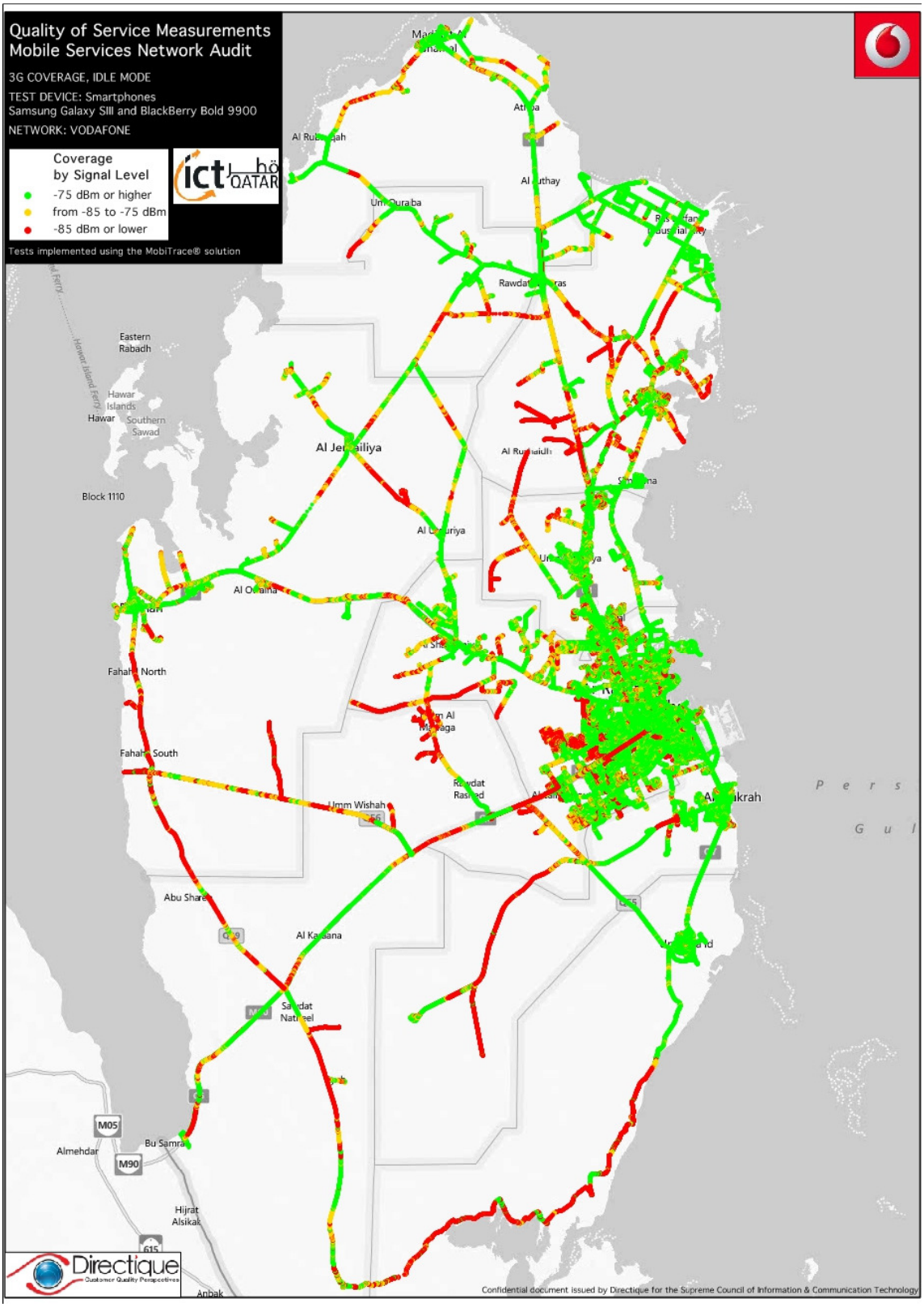
VODAFONE 2G


Quality of Service Measurements
Mobile Services Network Audit
2G COVERAGE, IDLE MODE
TEST DEVICE: Smartphones
Samsung Galaxy SIII and BlackBerry Bold 9900
NETWORK: VODAFONE
Coverage by Signal Level
-75 dBm or higher
from -85 to -75 dBm
-85 dBm or lower
Tests implemented using the MobiTrace® solution
Eastern Rabadh
Hawar Islands
Hawar
Southern Sawad
Block 1110
Al Duriya
M05
Almehdar
M90
Bu Samra
615
Anbak
Directique
Confidential document issued by Directique for the Supreme Council of Information & Communication Technology

VODAFONE 3G


Quality of Service Measurements
Mobile Services Network Audit
3G COVERAGE, IDLE MODE
TEST DEVICE: Smartphones
Samsung Galaxy SIII and BlackBerry Bold 9900
NETWORK: VODAFONE
Coverage by Signal Level
-75 dBm or higher
from -85 to -75 dBm
-85 dBm or lower
Tests implemented using the MobiTrace® solution
Eastern Rabadh
Hawar Islands
Hawar
Southern Sawad
Block 1110
Fahaheel North
Fahaheel South
Umm Wishah
Abu Shara
Almehdar
Bu Samra
Hijrat Alsikak
Anbak
M05
M90
615
Directique
Customer Quality Perspectives
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4.4 Data Coverage

- **Latency Success Rate**: Number of successful latency tests divided by the number of attempts.

		QTEL	VODAFONE
	Sample	*43 556*	*54 475*
Latency Success Rate		**99.1%**	**98.5%**
	Statistic accuracy	*+/-0.1%*	*+/-0.1%*
Average Latency time		**2545 ms**	**497 ms**

- **Technology Distribution (Successful Latency Tests)**:

		QTEL	VODAFONE
GPRS		**0.0%**	**0.0%**
	Statistic accuracy	*+/-0.0%*	*+/-0.0%*
EDGE		**0.7%**	**3.1%**
	Statistic accuracy	*+/-0.1%*	*+/-0.1%*
UMTS		**2.5%**	**0.1%**
	Statistic accuracy	*+/-0.1%*	*+/-0.0%*
HSDPA		**96.8%**	**96.8%**
	Statistic accuracy	*+/-0.2%*	*+/-0.1%*

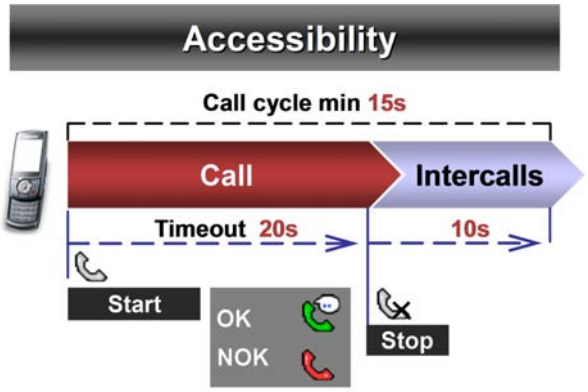
This table provides the technology breakdown used by Mobile Operators as recorded during all measurements. Every minute, the mobile is recording the observed technology. They are shown as contextual information at the time of the audit.

4.5 Accessibility Test

Accessibility Test Scenario

The vehicle equiped with the on board test platform was following pre-defined routes across the state. The computer based software automaticaly initiated tests and recorded results following a pre-defined test cycle based on the following parameters:

- An individual test duration set to a minimum of 15 seconds and up to a maximum of 30 seconds - “Call cycle”
- A test window of up to 20 seconds - “Timeout”
- A minimum time before a new call takes place set to 10 seconds - “Intercall”



Accessibility Test Scenario

Coverage measurement for the 2 Mobile Operators’ networks was launched at the same time, the software triggering the start of a call cycle for the 2 Operators simultaneously.

The timeout was set to 20 seconds to allow for different dial delay scenario.

The Inter call time was set to 10 seconds.

Calls failed due to genuine network problems as identified by mobile protocol and not related to network coverage, such as for example network congestion, were extracted and not taken into consideration in the final results.

Accessibility Test

The geographical coverage rate is computed using the number of successful accessibility tests divided by the number of test attempts, after removal of congestion attempts, if any.

$$\text{Coverage rate} = \frac{\sum OK}{\sum OK+NOK}$$

Population coverage is then calculated by weighting these results with the population percentage living in each Zone, using most recent official statistics available from The General Secretariat of the Planning Council for the State of Qatar.

Accessibility Rate

The accessibility rate is computed using the number of successful accessibility tests divided by the number of test attempts, after removal of congestion attempts, if any

	QTEL 2G	QTEL 3G
Sample	*33 844*	*38 695*
Accessibility Rate	**98.2%**	**98.4%**
Statistic accuracy	*+/-0.1%*	*+/-0.1%*

	VODA 2G	VODA 3G
Sample	*33 117*	*38 682*
Accessibility Rate	**88.9%**	**97.2%**
Statistic accuracy	*+/-0.3%*	*+/-0.2%*

Accessibility Rate by Municipality:

Geographical Coverage	*QTEL 2G*		*QTEL 3G*	
Municipality	**Sample**	**Accessibility**	**Sample**	**Accessibility**
AL DAAYEN MUNICIPALITY	1525	97.3%	1723	97.6%
UMM SLAL MUNICIPALITY	1338	96.9%	1650	97.4%
AL WAKRA MUNICIPALITY	2775	99.1%	3208	99.3%
AL RAYYAN MUNICIPALITY	13388	98.3%	14980	98.2%
DOHA MUNICIPALITY	11595	98.4%	13771	98.7%
AL KHOR MUNICIPALITY	2417	97.2%	2644	97.8%
AL SHAMAL MUNICIPALITY	806	99.8%	719	99.7%
TOTAL	**33 844**	**98.2%**	**38 695**	**98.4%**

	VODA 2G		*VODA 3G*	
Municipality	**Sample**	**Accessibility**	**Sample**	**Accessibility**
AL DAAYEN MUNICIPALITY	1525	91.8%	1723	99.8%
UMM SLAL MUNICIPALITY	1332	86.6%	1649	99.7%
AL WAKRA MUNICIPALITY	2776	94.6%	3211	88.7%
AL RAYYAN MUNICIPALITY	12831	87.5%	14981	94.6%
DOHA MUNICIPALITY	11627	88.0%	13756	99.2%
AL KHOR MUNICIPALITY	2220	95.0%	2645	99.6%
AL SHAMAL MUNICIPALITY	806	86.6%	717	100.0%
TOTAL	**33 117**	**88.9%**	**38 682**	**97.2%**

Results show that accessibility coverage is similar in 2G and 3G, in every municipality, around 98%. An objective could be to get closer to 100%.

5 Conclusion

1 Geographical Coverage:

	QTEL 2G	QTEL 3G
Total areas	45 811	45 965
% of areas where at least 95% of IDLE measurements signal is -85dBm or higher	99.5%	85.1%
Statistical accuracy	*+/-0.1%*	*+/-0.3%*

	VODAFONE 2G	VODAFONE 3G
Total areas	45 965	46 819
% of areas where at least 95% of IDLE measurements signal is -85dBm or higher	95.3%	78.2%
Statistical accuracy	*+/-0.2%*	*+/-0.4%*

Qtel and Vodafone are not in compliance with the annexure G of their license (100%)

*A**nnexure G**: the minimum signal strength required to qualify for achieving coverage is -85 dBm at ≥ 95% of the locations within any outdoor area of 100m x100m at a height of 1.5m above ground level.

2 Population Coverage:

% of measurements with radio signal is -85dBm or higher	VODAFONE 2G	VODAFONE 3G
Sample	45 965	46 819
By Municipality	96.0%	82.1%
Statistical accuracy	*+/-0.2%*	*+/-0.3%*
By Zone	96.3%	83.3%
Statistical accuracy	*+/-0.2%*	*+/-0.3%*

VODAFONE is not in compliance with the annexure G of its license, where 100% of the population should be covered.

Note: Qtel has no obligation coverage in its license.

3 Data Coverage:

		VODAFONE	License's obligation
EDGE		**100.0%**	100.0%
	Statistic accuracy	*+/-0.1%*	
UMTS		**96.9%**	90.0%
	Statistic accuracy	*+/-0.2%*	
HSDPA		**96.8%**	90.0%
	Statistic accuracy	*+/-0.2%*	

Vodafone is in compliance with the technology commitment mentioned in the Annexure G of the Vodafone license

Note: Qtel has no technology commitments mentioned in its license>.

6 ANNEXURES

a. Annexure 1 - Population Coverage by Zone

Population Coverage

				QTEL 2G		QTEL 3G	
ID	Zone	Pop.	% POP	Sample	Coverage	Sample	Coverage
1	AL JASRA	240	0.0%	18	100.0%	18	83.3%
2	AL BIDDA	35	0.0%	13	100.0%	12	91.7%
3	FEREEJ MOHAMMED BIN JASIM / MUSHAIREB	4 886	0.3%	6	100.0%	5	100.0%
4	MUSHAIREB	14 063	0.8%	38	100.0%	37	97.3%
5	AL NAJADA / BRAHAT AL JUFAIRY / FEREEJ AL ASMAKH	4 138	0.2%	13	100.0%	13	100.0%
6	OLD AL GHANIM	3 462	0.2%	18	100.0%	18	100.0%
7	AL SOUQ	679	0.0%	18	100.0%	19	100.0%
10	WADI AL SAIL	8	0.0%	11	100.0%	11	81.8%
11	RUMAILA	63	0.0%	53	100.0%	27	92.6%
12	AL BIDDA	1 067	0.1%	39	100.0%	34	97.1%
13	MUSHAIREB	8 648	0.5%	55	100.0%	54	100.0%
14	FEREEJ ABDEL AZIZ	10 808	0.6%	59	100.0%	58	100.0%
15	AL DOHA AL JADEEDA	13 059	0.8%	62	100.0%	61	95.1%
16	OLD AL GHANIM	14 230	0.8%	46	100.0%	46	97.8%
17	AL RUFAA / OLD AL HITMI	7 125	0.4%	35	100.0%	35	100.0%
18	SLATA / AL MIRQAB	741	0.0%	36	100.0%	38	97.4%
19	DOHA PORT	6	0.0%	16	100.0%	16	100.0%
20	WADI AL SAIL	539	0.0%	49	98.0%	50	76.0%
21	RUMAILA	1 532	0.1%	94	100.0%	101	91.1%
22	FEREEJ BIN MAHMOUD	10 590	0.6%	68	100.0%	71	81.7%
23	FEREEJ BIN MAHMOUD	13 582	0.8%	82	100.0%	82	84.1%
24	RAWDAT AL KHAIL	17 219	1.0%	145	100.0%	145	97.9%
25	AL MANSOURA / FEREEJ BIN DIRHAM	31 573	1.9%	149	100.0%	149	93.3%
26	NAJMA	24 763	1.5%	110	100.0%	110	87.3%
27	UMM GHUWAILINA	26 069	1.5%	128	100.0%	126	98.4%
28	AL KHULAIFAT / RAS BU ABBOUD	1 868	0.1%	48	97.9%	46	84.8%
29	RAS BU ABBOUD	0	0.0%	20	100.0%	18	100.0%
30	DUHAIL	7 059	0.4%	185	100.0%	166	73.5%
31	UMM LEKHBA	9 871	0.6%	200	100.0%	200	70.5%
32	MADINAT KHALIFA NORTH / DAHL AL HAMAM	14 725	0.9%	135	100.0%	135	88.1%
33	AL MARKHIYA	5 197	0.3%	63	100.0%	63	69.8%
34	MADINAT KHALIFA SOUTH	35 125	2.1%	106	100.0%	105	80.0%
35	FEREEJ KULAIB	7 702	0.5%	51	100.0%	51	82.4%
36	AL MESSILA	4 716	0.3%	75	100.0%	75	74.7%
37	FEREEJ BIN OMRAN / NEW AL HITMI / HAMAD MEDICA	21 066	1.2%	139	100.0%	139	88.5%
38	AL SADD	14 113	0.8%	188	100.0%	188	89.9%
39	AL SADD / NEW AL MIRQAB / FEREEJ AL NASR	15 184	0.9%	254	100.0%	254	95.7%
40	NEW SLATA	15 114	0.9%	311	100.0%	311	91.3%
41	NUAIJA	5 604	0.3%	107	100.0%	107	94.4%
42	AL HILAL	11 257	0.7%	179	100.0%	174	94.8%
43	NUAIJA	10 742	0.6%	167	100.0%	167	93.4%
44	NUAIJA	13 357	0.8%	288	100.0%	283	91.5%
45	OLD AIRPORT	44 275	2.6%	447	100.0%	428	90.2%

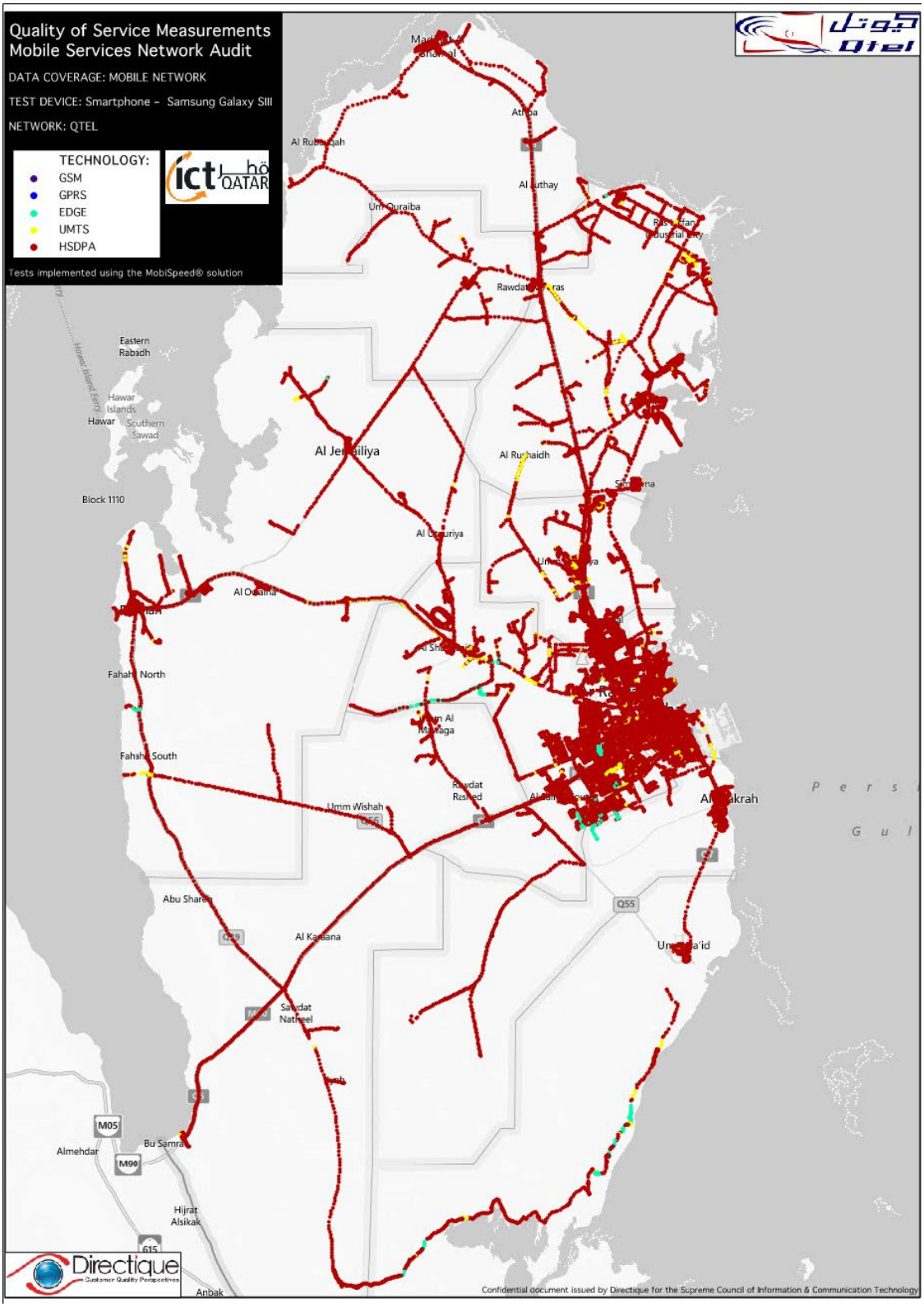
				QTEL 2G		QTEL 3G	
ID	Zone	Pop.	% POP	Sample	Coverage	Sample	Coverage
46	AL THUMAMA	4 417	0.3%	264	100.0%	264	77.3%
47	AL THUMAMA	12 179	0.7%	304	100.0%	297	91.6%
48	DOHA INTERNATIONAL AIRPORT	1 354	0.1%	115	99.1%	112	96.4%
49	DOHA INTERNATIONAL AIRPORT	0	0.0%	44	100.0%	38	100.0%
51	AL GHARRAFA / GHARRAFAT AL RAYYAN / IZGHAWA /	46 976	2.8%	1563	99.3%	1560	84.2%
52	AL LUQTA / LEBDAY / OLD AL RAYYAN / AL SHAGUB / FE	20 416	1.2%	353	100.0%	352	78.7%
53	NEW AL RAYYAN / AL WAJBA / MUAITHER	76 966	4.5%	778	100.0%	782	77.6%
54	FEREEJ AL AMIR / LUAIB / MURAIKH / BAAYA / MEHAIR	23 591	1.4%	733	100.0%	658	89.2%
55	FEREEJ AL SOUDAN / AL WAAB / AL AZIZIYA / NEW FER	138 573	8.2%	3332	99.7%	3378	90.5%
56	FEREEJ AL ASIRI / NEW FEREEJ AL KHULAIFAT / BU SAM	85 906	5.1%	2497	100.0%	3116	84.1%
57	INDUSTRIAL AREA	260 726	15.3%	1321	100.0%	1318	89.8%
60	AL DAFNA	19	0.0%	84	96.4%	83	69.9%
61	AL DAFNA / AL QASSAR	2 782	0.2%	175	100.0%	174	75.3%
62	LEKHWAIR	3	0.0%	12	100.0%	12	91.7%
63	ONAIZA	5 170	0.3%	116	99.1%	116	72.4%
64	LEJBAILAT	4 024	0.2%	94	100.0%	94	63.8%
65	ONAIZA	7 710	0.5%	102	99.0%	104	74.0%
66	ONAIZA / LEQTAIFIYA / AL QASSAR	22 168	1.3%	535	99.4%	535	75.9%
67	HAZM AL MARKHIYA	8 586	0.5%	159	100.0%	159	63.5%
68	JELAIAH / AL TARFA / JERYAN NEJAIMA	5 558	0.3%	275	100.0%	274	70.1%
69	JABAL THUAILEB / AL KHARAYEJ / LUSAIL / AL EGLA / W	1 213	0.1%	126	100.0%	126	93.7%
70	LEABAIB / AL EBB / JERYAN JENAIHAT / AL KHEESA / RA	24 722	1.5%	1930	99.1%	1573	81.2%
71	AL KHARAITIYAT / IZGHAWA / UMM SLAL MOHAMMED	60 509	3.6%	2442	99.7%	2456	76.3%
72	AL UTOURIYA	1 060	0.1%	865	99.9%	875	82.6%
73	LIJMILIYA	1 706	0.1%	833	100.0%	836	89.8%
74	SIMAISMA / AL JERYAN / AL KHOR	80 220	4.7%	2683	99.4%	2702	75.5%
75	AL THAKHIRA/RASS LAFFAN/UMM BIRKA	128 574	7.6%	2903	99.7%	3004	89.7%
76	AL GHUWAIRIYA	4 834	0.3%	1387	99.9%	1391	78.8%
77	FUWAIRIT/AIN SINAN/MADINAT AL KAABAN	1 970	0.1%	644	99.7%	645	84.0%
78	ABU DHALOUF/AL ZUBARA	1 009	0.1%	682	99.9%	699	94.8%
79	AL RUWAIS/MADINAT AL SHAMAL	4 996	0.3%	990	99.9%	995	89.6%
80	AL SHEEHANIYA	35 393	2.1%	1829	100.0%	1827	88.5%
81	MEBAIREEK	11 333	0.7%	1472	100.0%	1470	83.6%
82	RAWDAT RASHED	6 046	0.4%	615	100.0%	611	93.9%
83	AL KARAANA	1 567	0.1%	635	100.0%	658	90.7%
84	UMM BAB	6 194	0.4%	716	98.6%	716	92.3%
85	AL NASRANIYA	1 043	0.1%	379	100.0%	379	94.2%
86	DUKHAN	11 520	0.7%	1368	98.9%	1368	93.3%
90	AL WAKRA	79 457	4.7%	1125	99.8%	775	92.5%
91	AL THUMAMA / AL WUKAIR/AL MASHAF	22 459	1.3%	1221	99.6%	1212	94.1%
92	MESAIEED	35 150	2.1%	817	100.0%	817	90.8%
93	MESAIEED INDUSTRIAL AREA	123	0.0%	155	100.0%	155	64.5%
94	SHAGRA	3 874	0.2%	255	89.0%	260	64.6%
95	AL KHARRARA	117	0.0%	674	99.6%	680	83.7%
96	ABU SAMRA	1 065	0.1%	1046	99.9%	1048	83.0%
97	SAWDA NATHEEL	15	0.0%	275	97.8%	275	86.9%
98	AL ADAID	42	0.0%	564	84.2%	573	48.9%
	TOTAL	**1 699 435**		**45 811**	**99.8%**	**29 408**	**87.1%**

				VODA 2G		VODA 3G	
ID	Zone	Pop.	% POP	Sample	Coverage	Sample	Coverage
1	AL JASRA	240	0.0%	18	100.0%	18	100.0%
2	AL BIDDA	35	0.0%	13	100.0%	13	84.6%
3	FEREEJ MOHAMMED BIN JASIM / MUSHAIREB	4 886	0.3%	6	100.0%	6	100.0%
4	MUSHAIREB	14 063	0.8%	38	100.0%	38	100.0%
5	AL NAJADA / BRAHAT AL JUFAIRY / FEREEJ AL ASMAKH	4 138	0.2%	13	100.0%	13	100.0%
6	OLD AL GHANIM	3 462	0.2%	18	100.0%	18	88.9%
7	AL SOUQ	679	0.0%	18	100.0%	22	90.9%
10	WADI AL SAIL	8	0.0%	11	100.0%	11	54.5%
11	RUMAILA	63	0.0%	53	100.0%	53	86.8%
12	AL BIDDA	1 067	0.1%	39	100.0%	40	97.5%
13	MUSHAIREB	8 648	0.5%	55	100.0%	55	98.2%
14	FEREEJ ABDEL AZIZ	10 808	0.6%	59	100.0%	59	96.6%
15	AL DOHA AL JADEEDA	13 059	0.8%	61	100.0%	62	95.2%
16	OLD AL GHANIM	14 230	0.8%	46	97.8%	46	89.1%
17	AL RUFAA / OLD AL HITMI	7 125	0.4%	35	97.1%	35	97.1%
18	SLATA / AL MIRQAB	741	0.0%	36	100.0%	38	81.6%
19	DOHA PORT	6	0.0%	16	100.0%	16	100.0%
20	WADI AL SAIL	539	0.0%	49	100.0%	50	92.0%
21	RUMAILA	1 532	0.1%	94	98.9%	94	91.5%
22	FEREEJ BIN MAHMOUD	10 590	0.6%	68	100.0%	68	88.2%
23	FEREEJ BIN MAHMOUD	13 582	0.8%	82	100.0%	82	93.9%
24	RAWDAT AL KHAIL	17 219	1.0%	145	97.9%	145	91.0%
25	AL MANSOURA / FEREEJ BIN DIRHAM	31 573	1.9%	149	98.7%	149	96.6%
26	NAJMA	24 763	1.5%	110	97.3%	110	93.6%
27	UMM GHUWAILINA	26 069	1.5%	124	98.4%	130	94.6%
28	AL KHULAIFAT / RAS BU ABBOUD	1 868	0.1%	46	87.0%	48	87.5%
29	RAS BU ABBOUD	0	0.0%	18	100.0%	20	90.0%
30	DUHAIL	7 059	0.4%	183	96.7%	185	85.9%
31	UMM LEKHBA	9 871	0.6%	200	94.0%	200	83.0%
32	MADINAT KHALIFA NORTH / DAHL AL HAMAM	14 725	0.9%	135	96.3%	135	92.6%
33	AL MARKHIYA	5 197	0.3%	63	93.7%	63	90.5%
34	MADINAT KHALIFA SOUTH	35 125	2.1%	106	88.7%	106	81.1%
35	FEREEJ KULAIB	7 702	0.5%	51	92.2%	51	82.4%
36	AL MESSILA	4 716	0.3%	75	92.0%	75	88.0%
37	FEREEJ BIN OMRAN / NEW AL HITMI / HAMAD MEDICA	21 066	1.2%	139	95.7%	139	95.7%
38	AL SADD	14 113	0.8%	188	94.1%	188	91.0%
39	AL SADD / NEW AL MIRQAB / FEREEJ AL NASR	15 184	0.9%	254	98.8%	254	96.9%
40	NEW SLATA	15 114	0.9%	311	99.7%	311	97.1%
41	NUAIJA	5 604	0.3%	107	100.0%	107	100.0%
42	AL HILAL	11 257	0.7%	177	99.4%	179	97.2%
43	NUAIJA	10 742	0.6%	167	100.0%	167	94.0%
44	NUAIJA	13 357	0.8%	288	97.9%	288	95.1%
45	OLD AIRPORT	44 275	2.6%	417	97.4%	447	93.3%

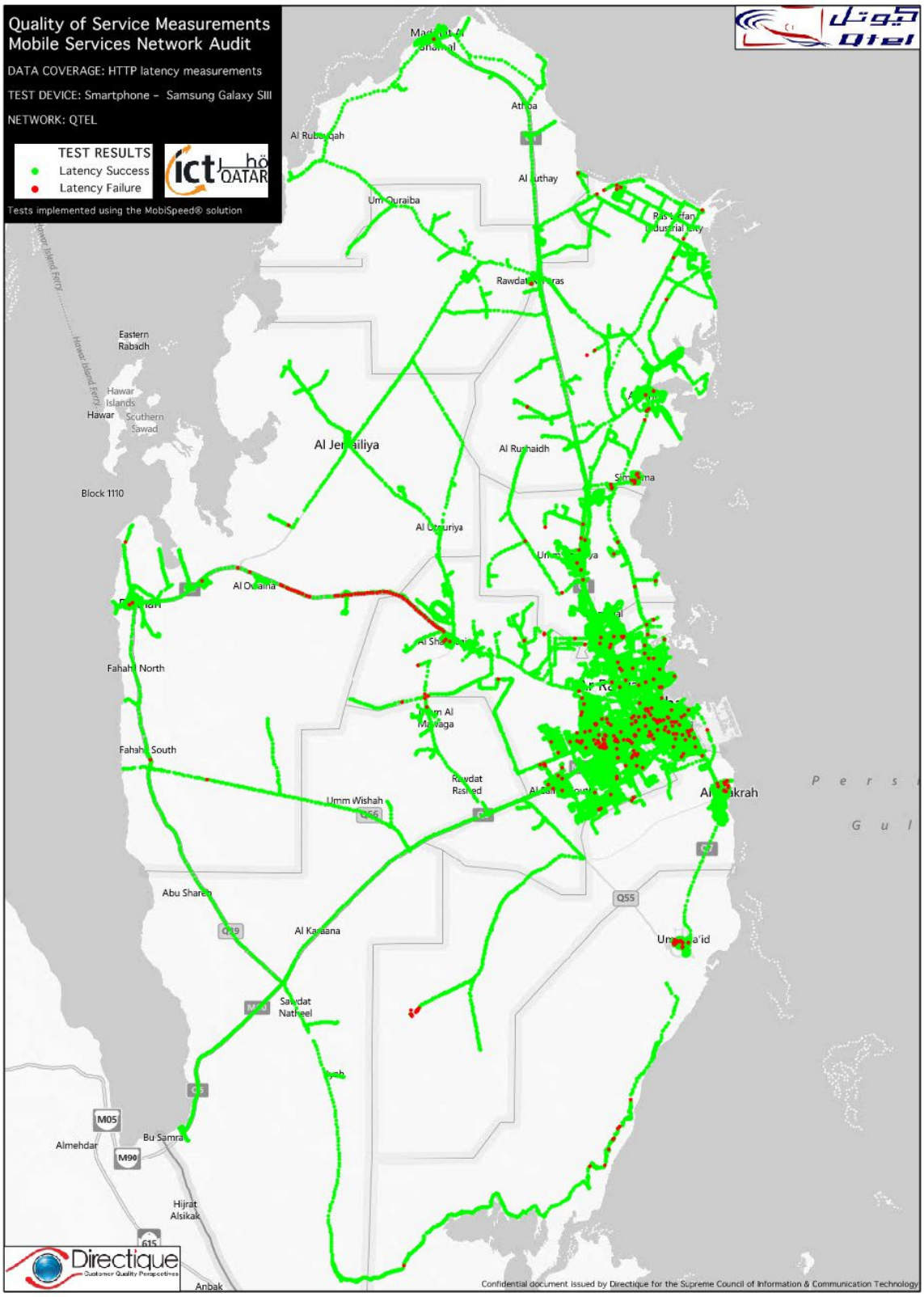
				VODA 2G		VODA 3G	
ID	Zone	Pop.	% POP	Sample	Coverage	Sample	Coverage
46	AL THUMAMA	4 417	0.3%	264	93.2%	264	92.8%
47	AL THUMAMA	12 179	0.7%	297	97.3%	304	95.1%
48	DOHA INTERNATIONAL AIRPORT	1 354	0.1%	111	100.0%	115	98.3%
49	DOHA INTERNATIONAL AIRPORT	0	0.0%	44	100.0%	44	100.0%
51	AL GHARRAFA / GHARRAFAT AL RAYYAN / IZGHAWA /	46 976	2.8%	1559	94.0%	1563	84.9%
52	AL LUQTA / LEBDAY / OLD AL RAYYAN / AL SHAGUB / FI	20 416	1.2%	353	97.2%	353	86.4%
53	NEW AL RAYYAN / AL WAJBA / MUAITHER	76 966	4.5%	777	92.1%	782	64.8%
54	FEREEJ AL AMIR / LUAIB / MURAIKH / BAAYA / MEHAIR	23 591	1.4%	733	98.8%	733	94.1%
55	FEREEJ AL SOUDAN / AL WAAB / AL AZIZIYA / NEW FER	138 573	8.2%	3385	92.2%	3388	67.4%
56	FEREEJ AL ASIRI / NEW FEREEJ AL KHULAIFAT / BU SAM	85 906	5.1%	2559	98.2%	3122	89.4%
57	INDUSTRIAL AREA	260 726	15.3%	1325	98.8%	1325	80.5%
60	AL DAFNA	19	0.0%	83	98.8%	84	83.3%
61	AL DAFNA / AL QASSAR	2 782	0.2%	175	99.4%	177	82.5%
62	LEKHWAIR	3	0.0%	12	75.0%	12	58.3%
63	ONAIZA	5 170	0.3%	116	100.0%	117	87.2%
64	LEJBAILAT	4 024	0.2%	94	92.6%	94	97.9%
65	ONAIZA	7 710	0.5%	102	89.2%	104	92.3%
66	ONAIZA / LEQTAIFIYA / AL QASSAR	22 168	1.3%	537	98.3%	535	92.5%
67	HAZM AL MARKHIYA	8 586	0.5%	159	99.4%	159	82.4%
68	JELAIAH / AL TARFA / JERYAN NEJAIMA	5 558	0.3%	271	97.8%	275	85.5%
69	JABAL THUAILEB / AL KHARAYEJ / LUSAIL / AL EGLA / W	1 213	0.1%	126	100.0%	126	99.2%
70	LEABAIB / AL EBB / JERYAN JENAIHAT / AL KHEESA / RA	24 722	1.5%	1914	92.1%	1930	84.2%
71	AL KHARAITIYAT / IZGHAWA / UMM SLAL MOHAMMED	60 509	3.6%	2502	94.5%	2506	86.6%
72	AL UTOURIYA	1 060	0.1%	871	98.3%	875	70.9%
73	LIJMILIYA	1 706	0.1%	833	100.0%	836	87.7%
74	SIMAISMA / AL JERYAN / AL KHOR	80 220	4.7%	2701	93.5%	2704	61.4%
75	AL THAKHIRA/RASS LAFFAN/UMM BIRKA	128 574	7.6%	2981	97.9%	3005	80.9%
76	AL GHUWAIRIYA	4 834	0.3%	1391	98.3%	1391	82.0%
77	FUWAIRIT/AIN SINAN/MADINAT AL KAABAN	1 970	0.1%	647	100.0%	646	94.9%
78	ABU DHALOUF/AL ZUBARA	1 009	0.1%	698	97.7%	699	74.8%
79	AL RUWAIS/MADINAT AL SHAMAL	4 996	0.3%	994	97.8%	995	84.9%
80	AL SHEEHANIYA	35 393	2.1%	1813	97.4%	1833	85.7%
81	MEBAIREEK	11 333	0.7%	1465	89.0%	1483	65.1%
82	RAWDAT RASHED	6 046	0.4%	615	86.2%	615	41.1%
83	AL KARAANA	1 567	0.1%	646	98.5%	658	64.1%
84	UMM BAB	6 194	0.4%	716	98.3%	716	19.0%
85	AL NASRANIYA	1 043	0.1%	379	98.4%	379	68.6%
86	DUKHAN	11 520	0.7%	1367	95.8%	1368	82.0%
90	AL WAKRA	79 457	4.7%	1125	96.3%	1125	91.2%
91	AL THUMAMA / AL WUKAIR/AL MASHAF	22 459	1.3%	1130	98.7%	1222	91.6%
92	MESAIEED	35 150	2.1%	817	98.8%	817	99.3%
93	MESAIEED INDUSTRIAL AREA	123	0.0%	155	100.0%	155	100.0%
94	SHAGRA	3 874	0.2%	261	69.3%	260	48.8%
95	AL KHARRARA	117	0.0%	681	88.8%	684	25.4%
96	ABU SAMRA	1 065	0.1%	1046	98.2%	1048	57.8%
97	SAWDA NATHEEL	15	0.0%	275	76.7%	275	80.4%
98	AL ADAID	42	0.0%	579	64.2%	584	16.3%
	TOTAL	**1 699 435**		**30 007**	**96.3%**	**30 219**	**83.3%**

b. Annexure 2 - Maps: Data Coverage

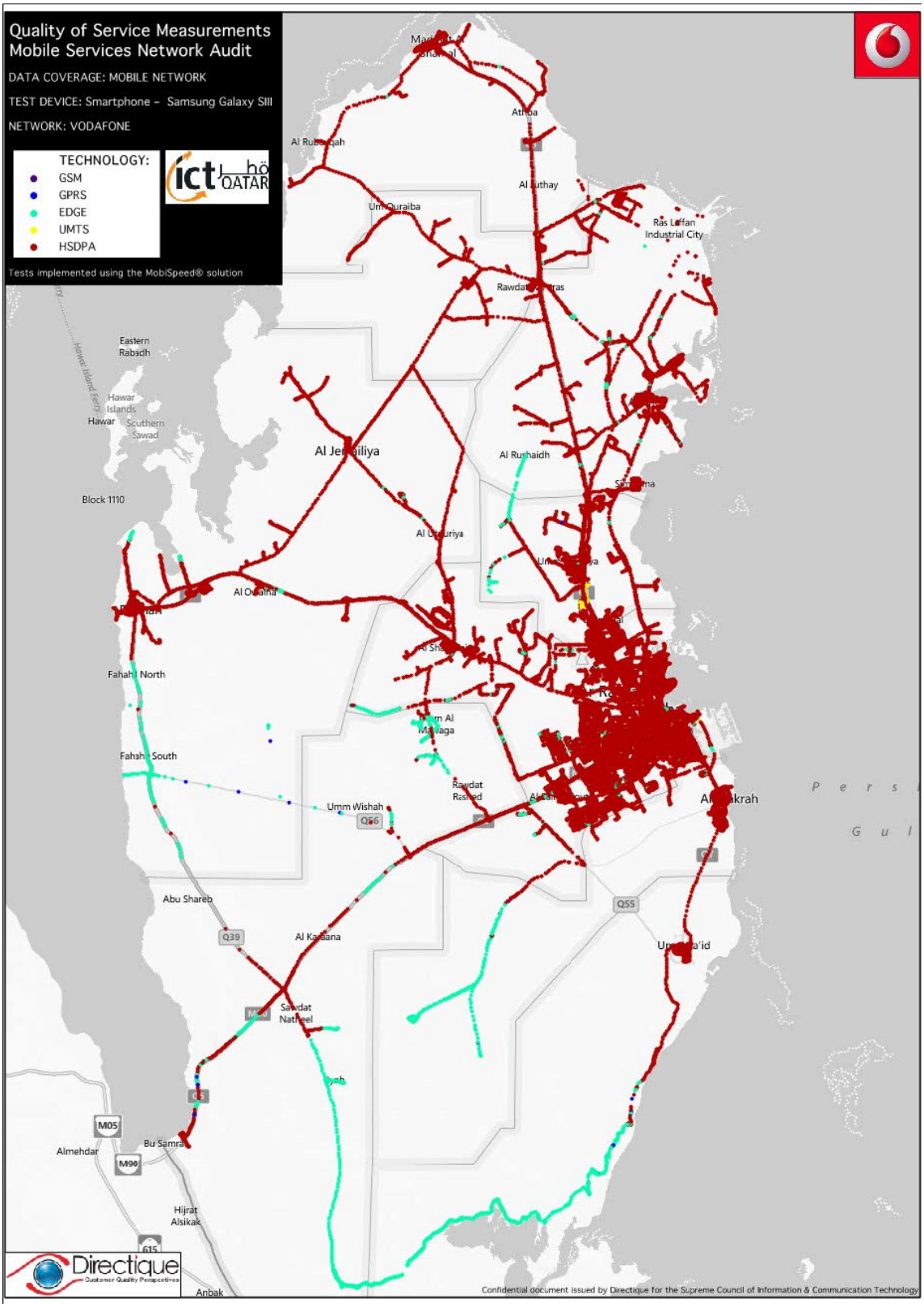
QTEL - Data Coverage



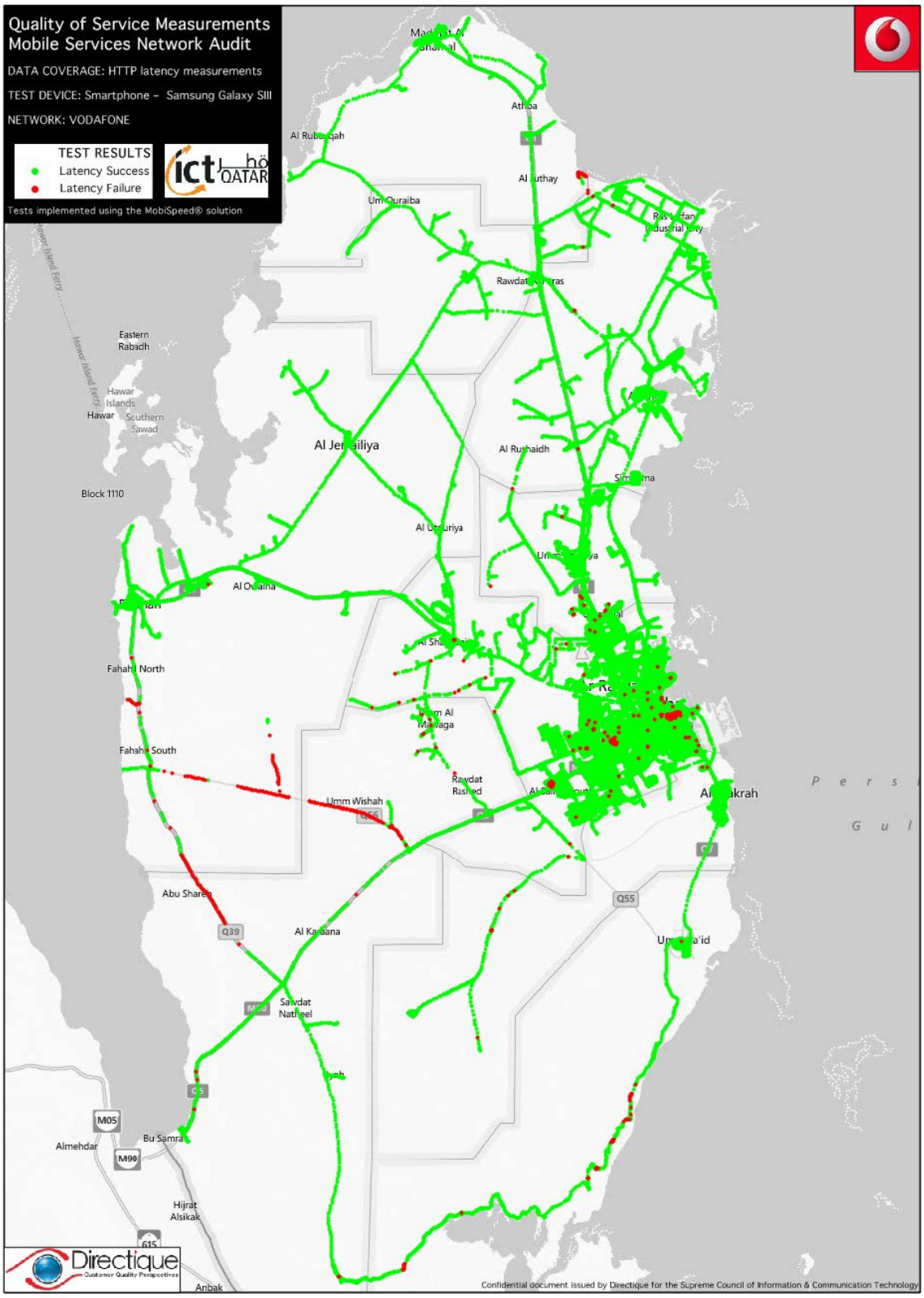
QTEL - Latency Test



VODAFONE - Data Coverage



VODAFONE - Latency Test



c. Annexure 3 - Comparison with Operator's Maps

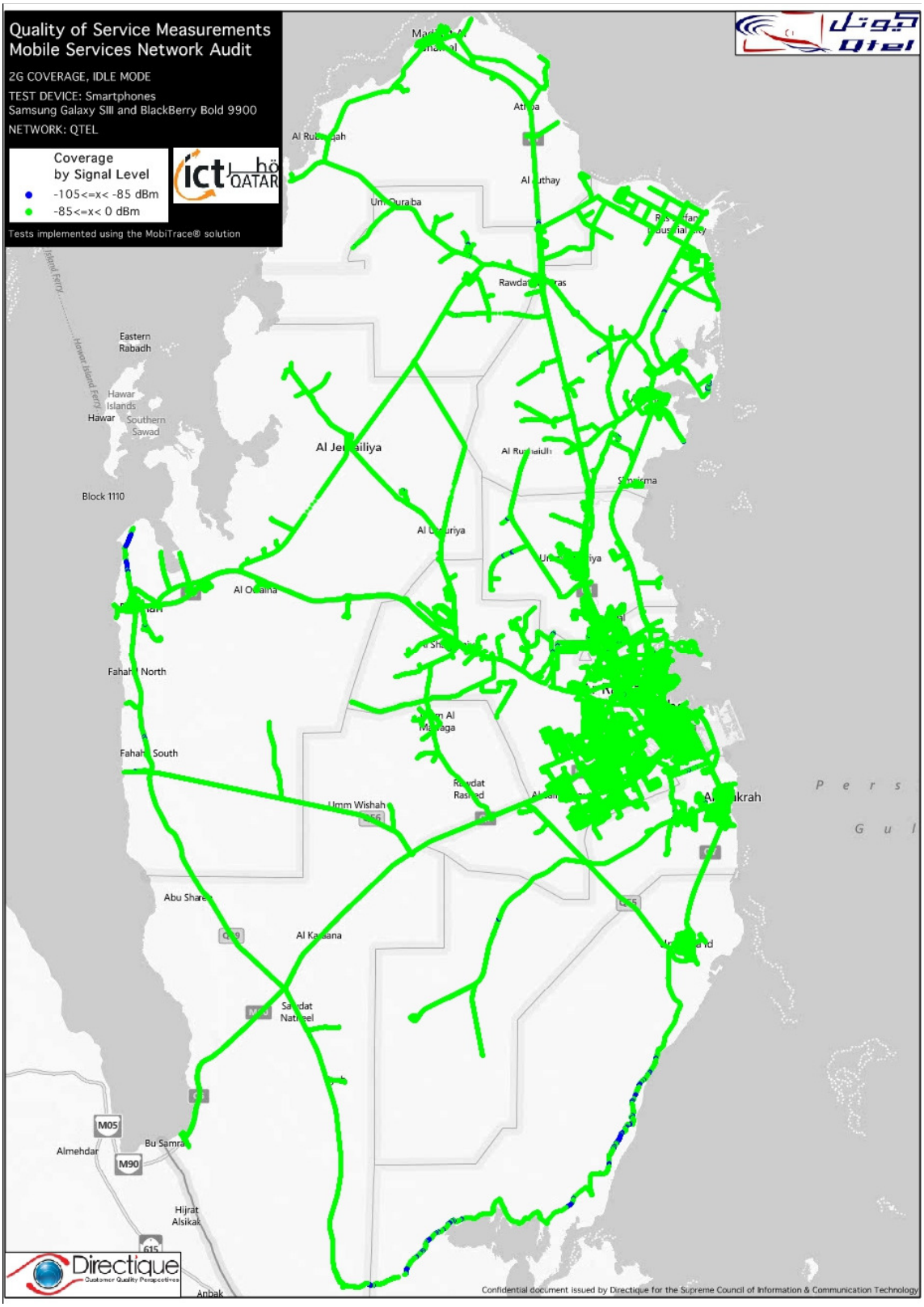
The idle coverage maps here after are showing the distribution of the signal strength of all the locations of the drive tests.

Also, they are compared to the coverage maps furnished by the operators themselves.

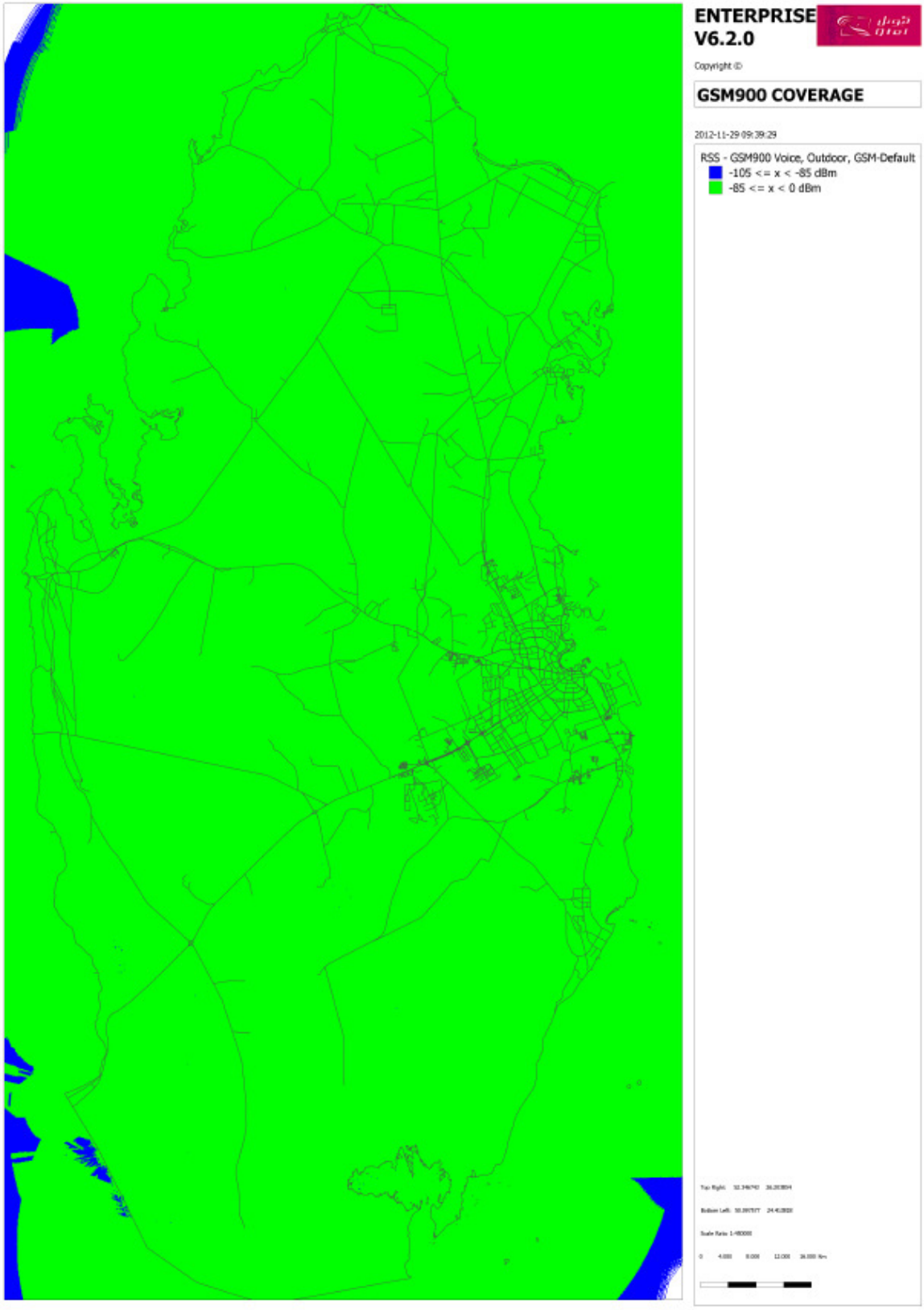
Compliance with operator's map:

OPERATOR	MAP COMPLIANCE	Comment
QTEL 2G	No	Locations with RxLev <-85dBm next to Dukhan and in the deep South East of the country.
QTEL 3G	Comparison not available	Qtel's map is U900 only and shows signal strength under and above -95dBm. (not -85dBm)
VODAFONE 2G	Yes	
VODAFONE 3G	Yes	

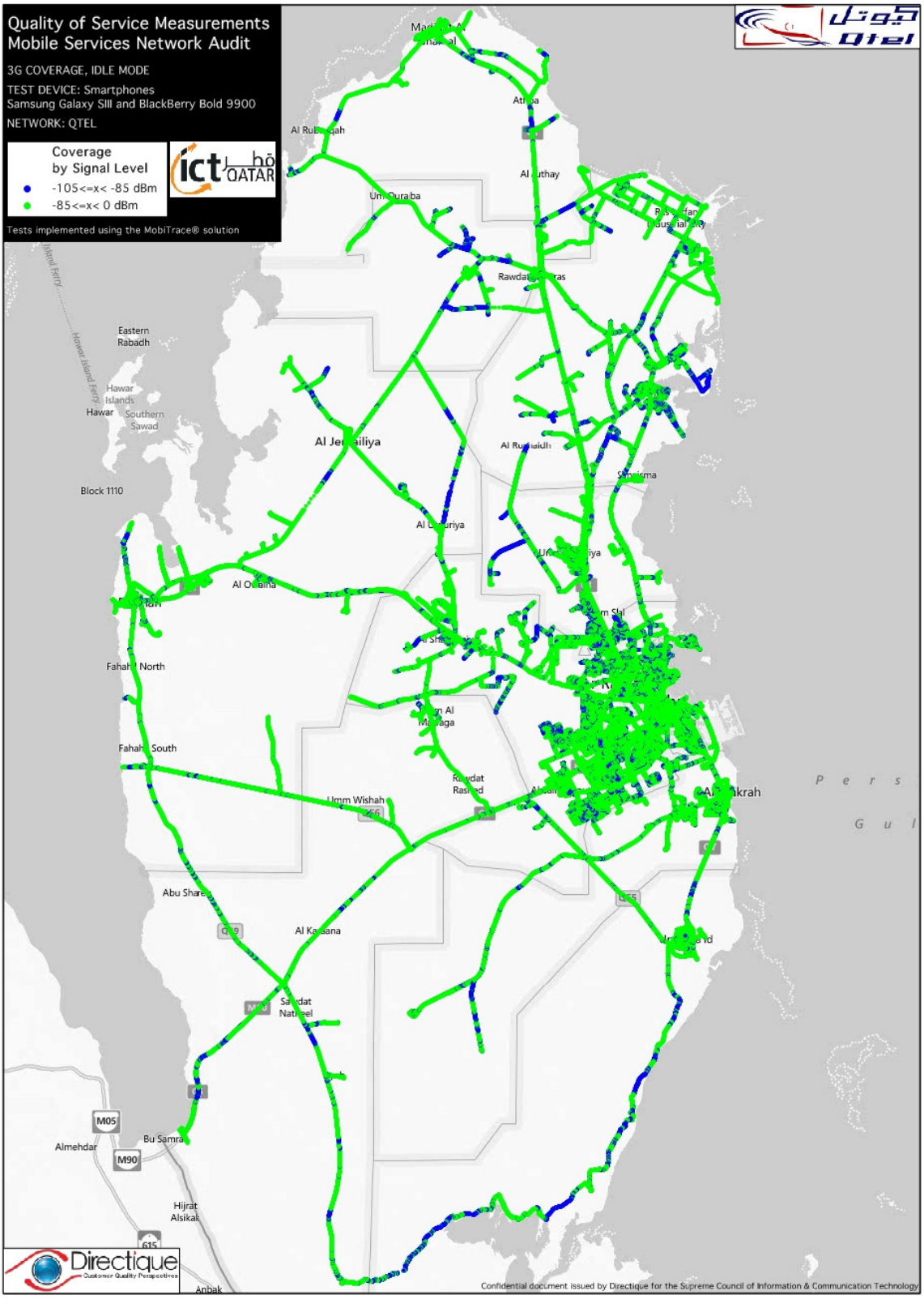
2G QTEL – Coverage Drive



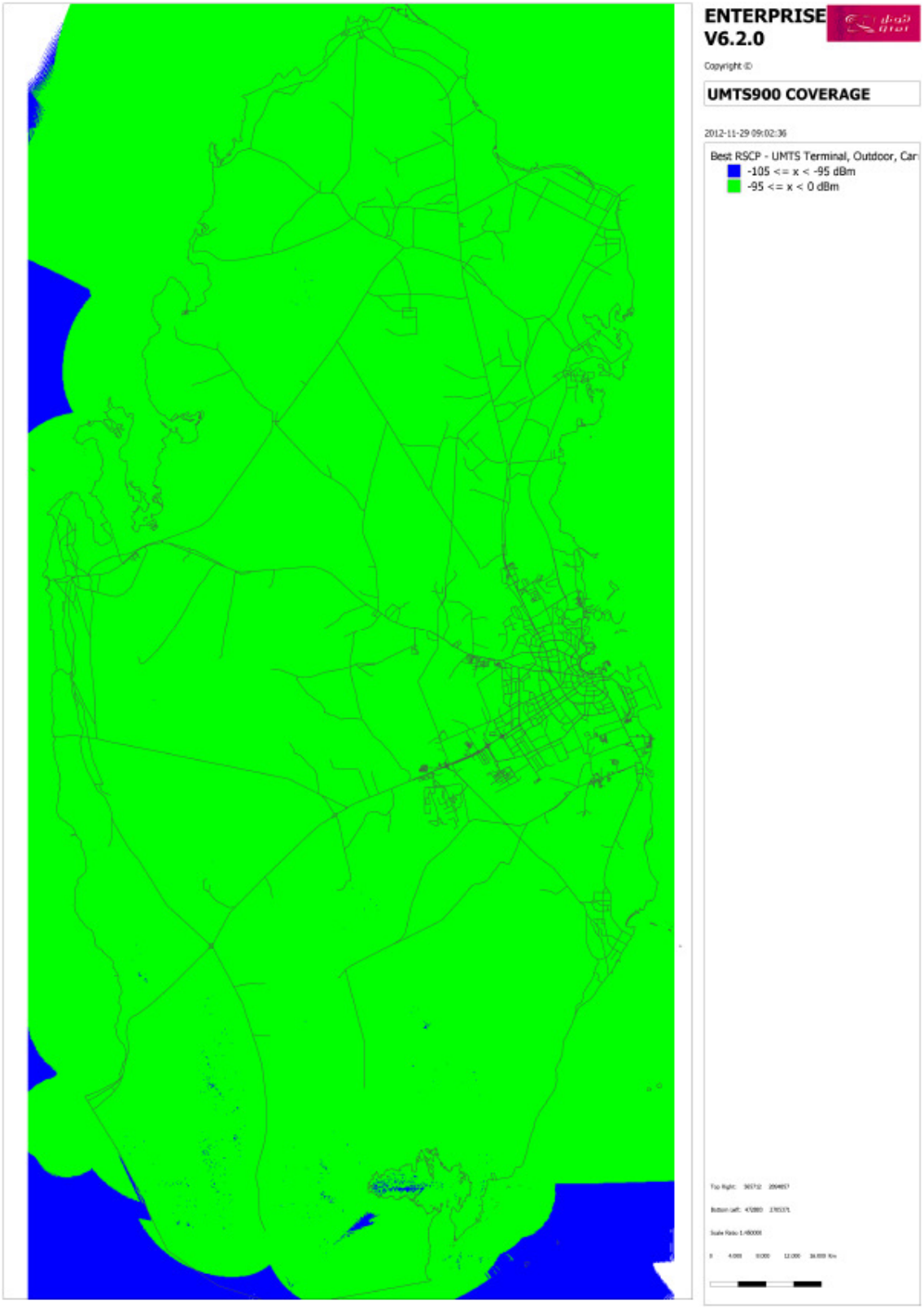
2G Coverage Map From QTEL



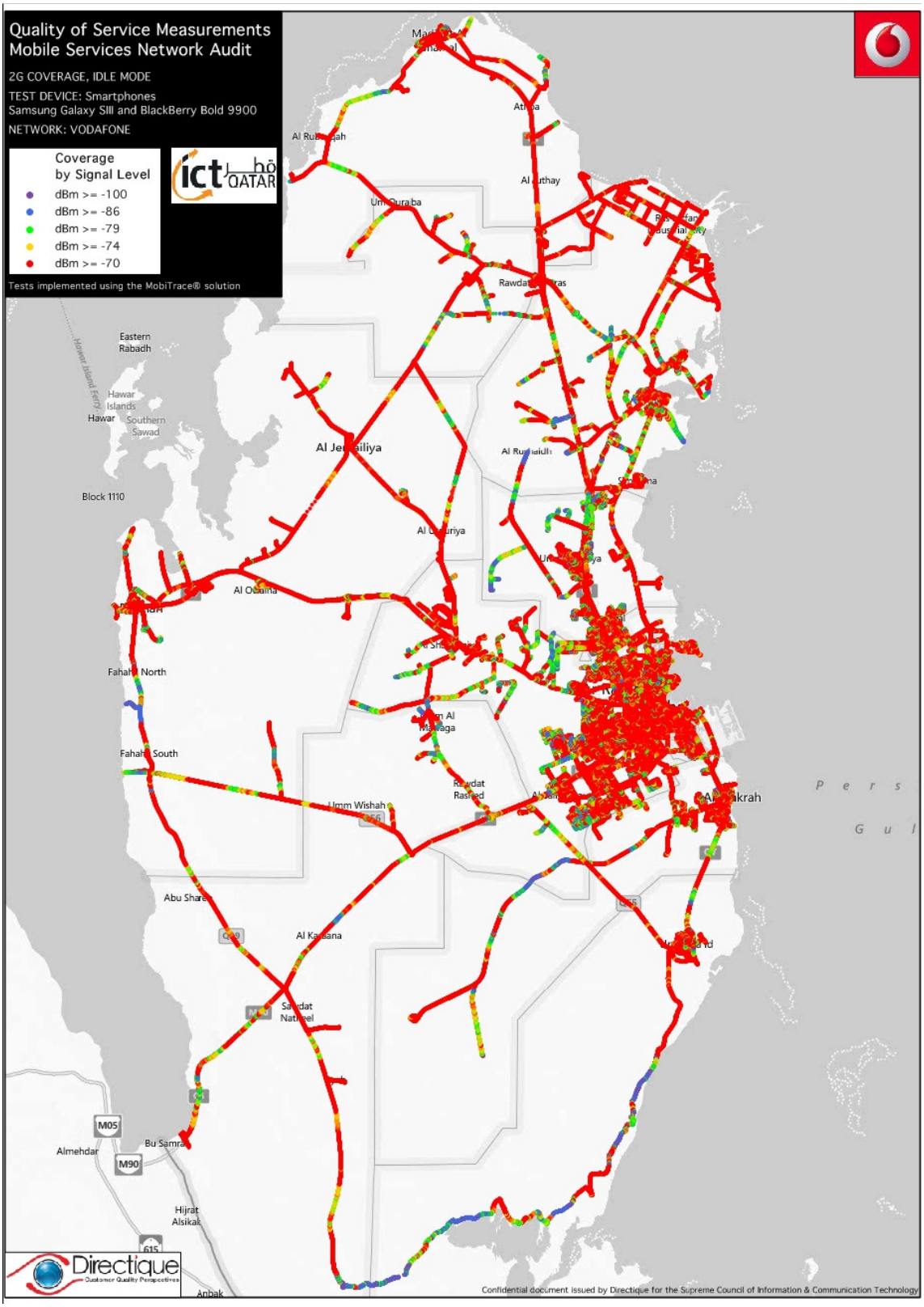
3G QTEL – Coverage Drive



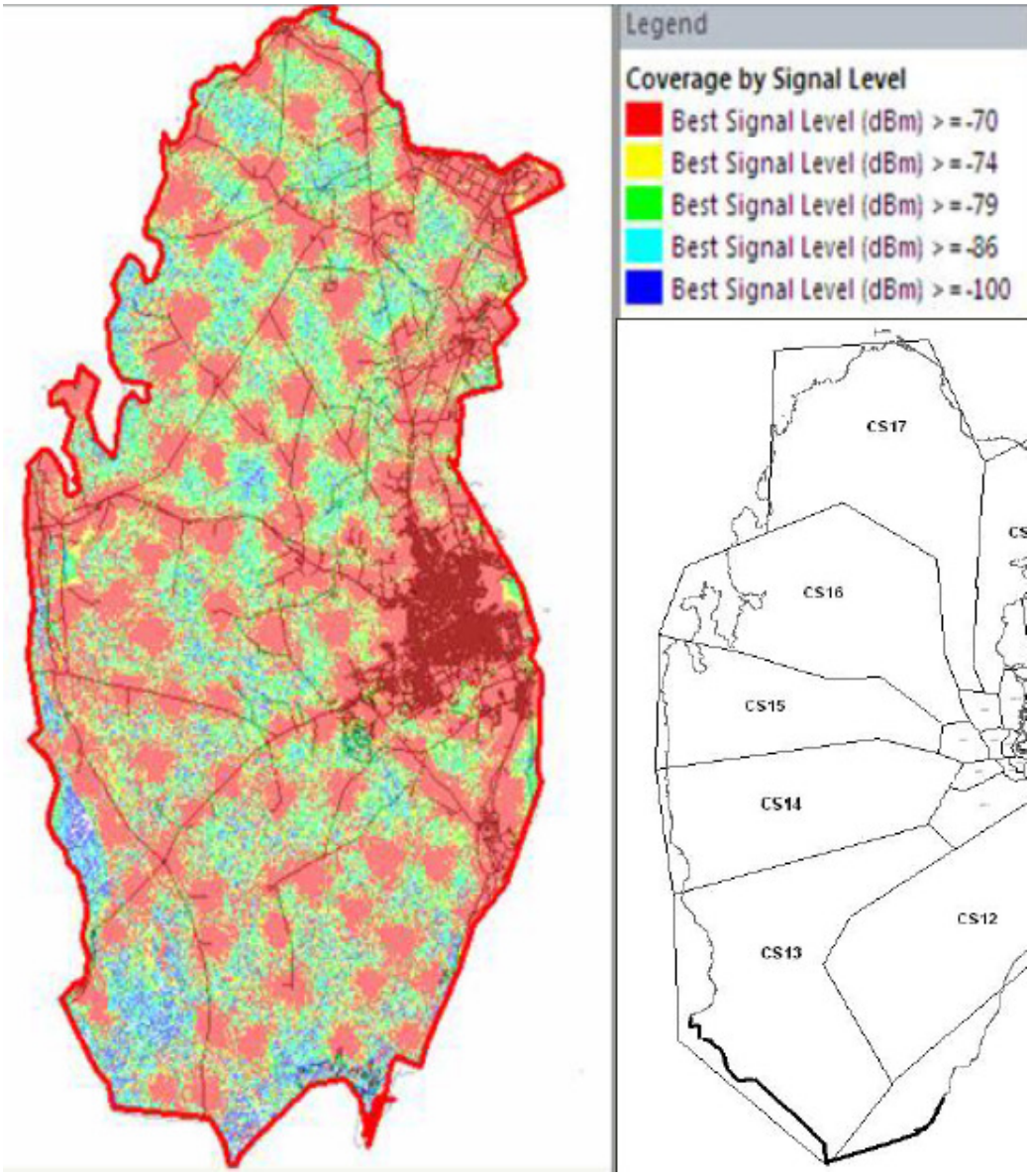
3G Coverage Map From QTEL



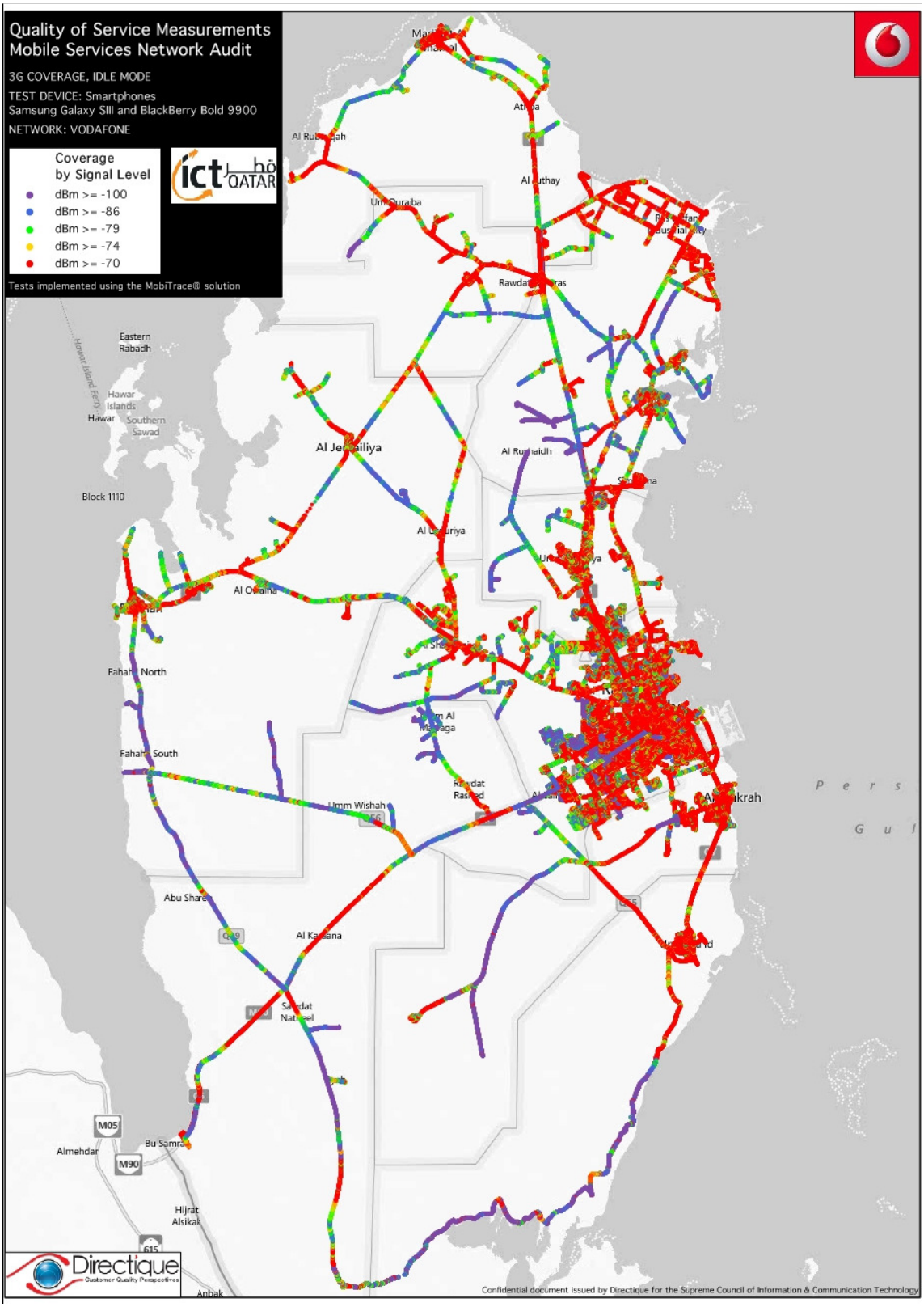
2G VODAFONE – Coverage Drive



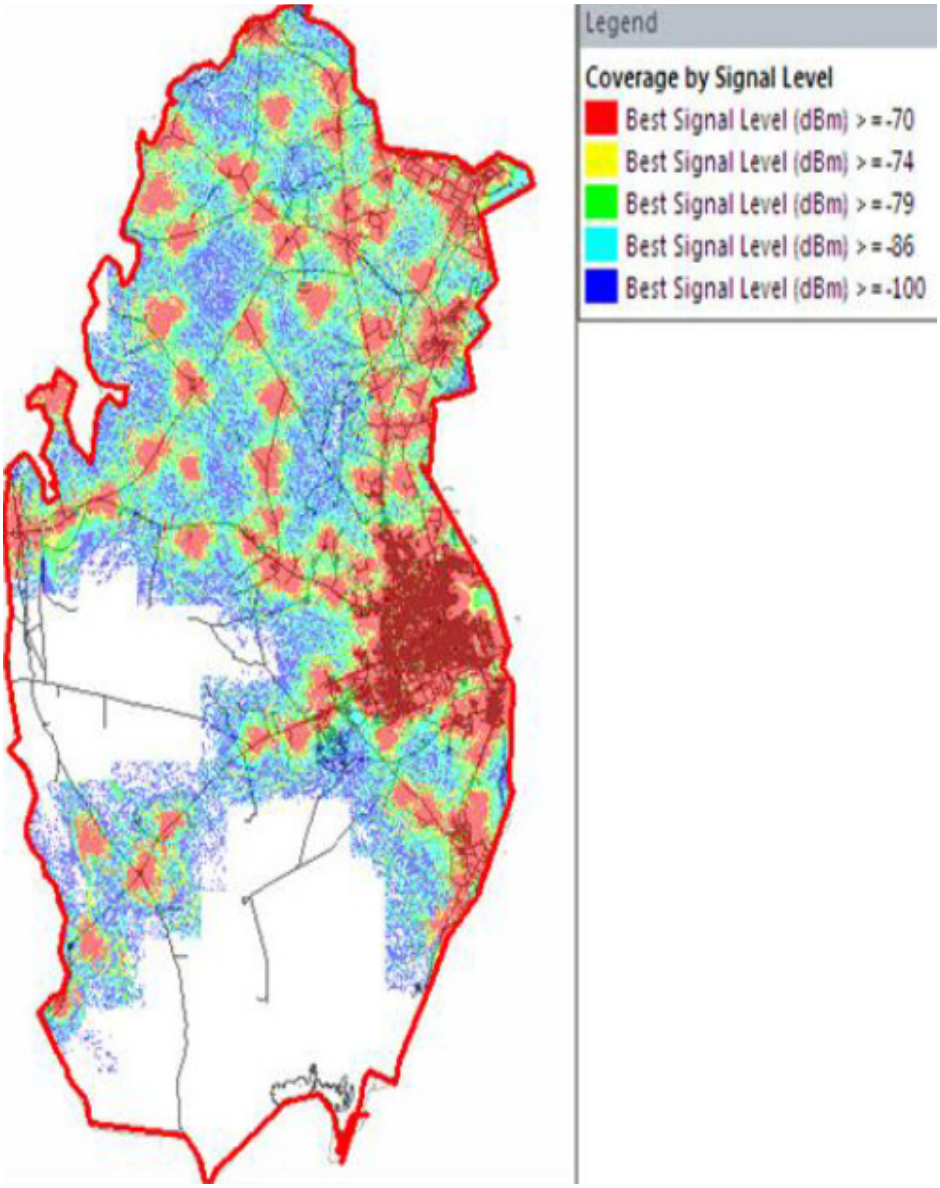
2G Coverage Map From VODAFONE



3G VODAFONE – Coverage Drive

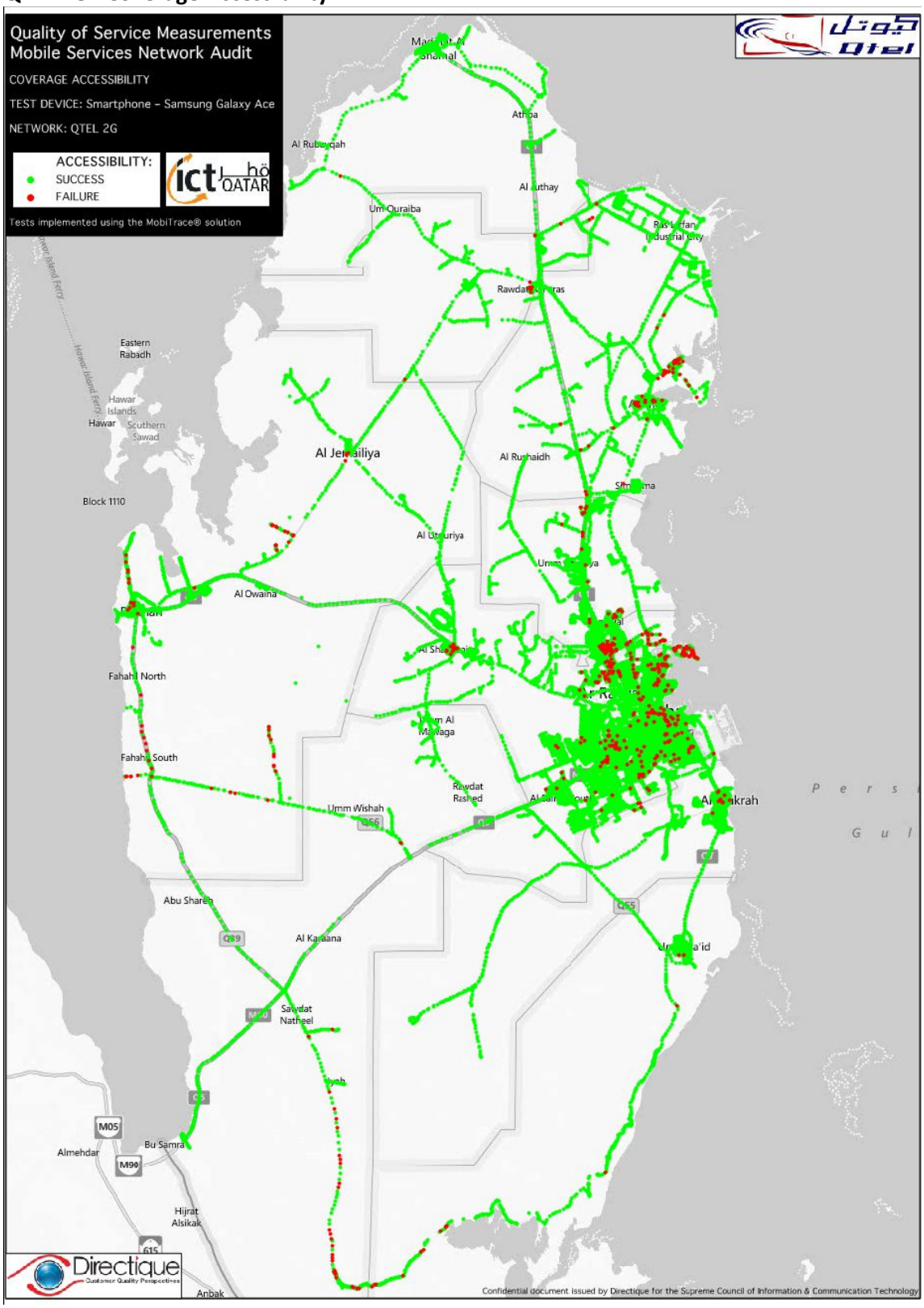


3G Coverage Map From VODAFONE

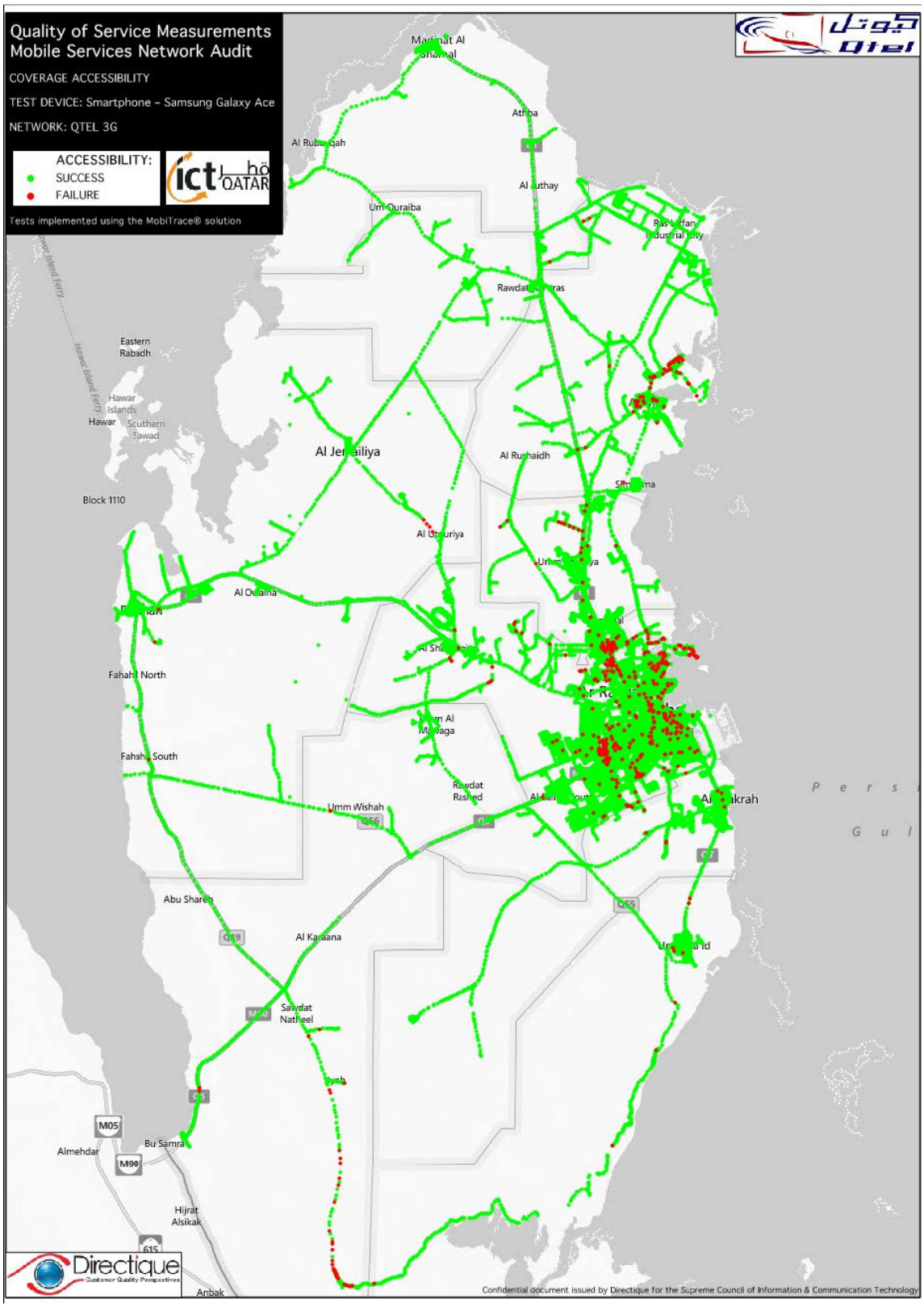


d. Annexure 4 - Maps: Coverage Accessibility

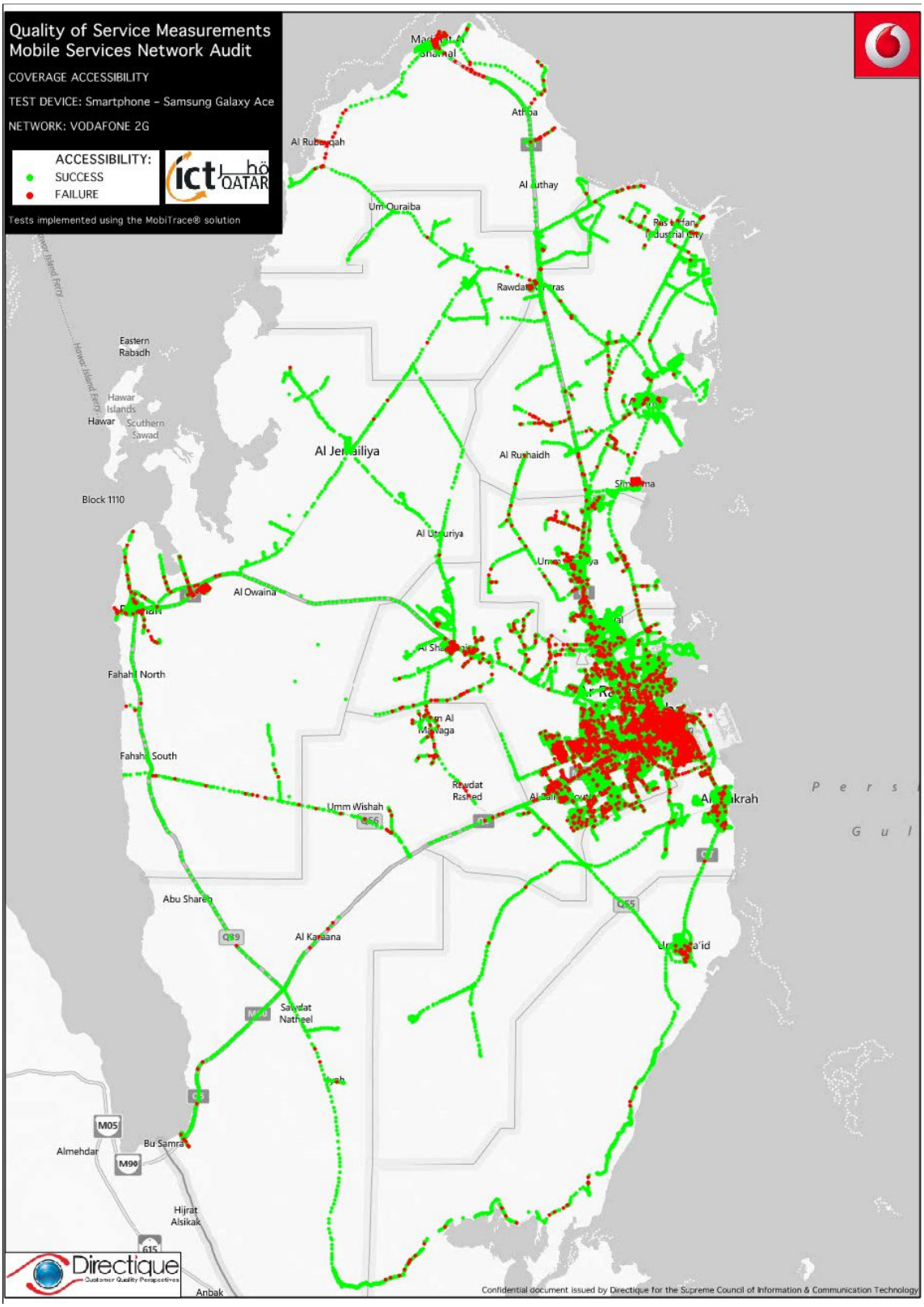
QTEL 2G - Coverage Accessibility



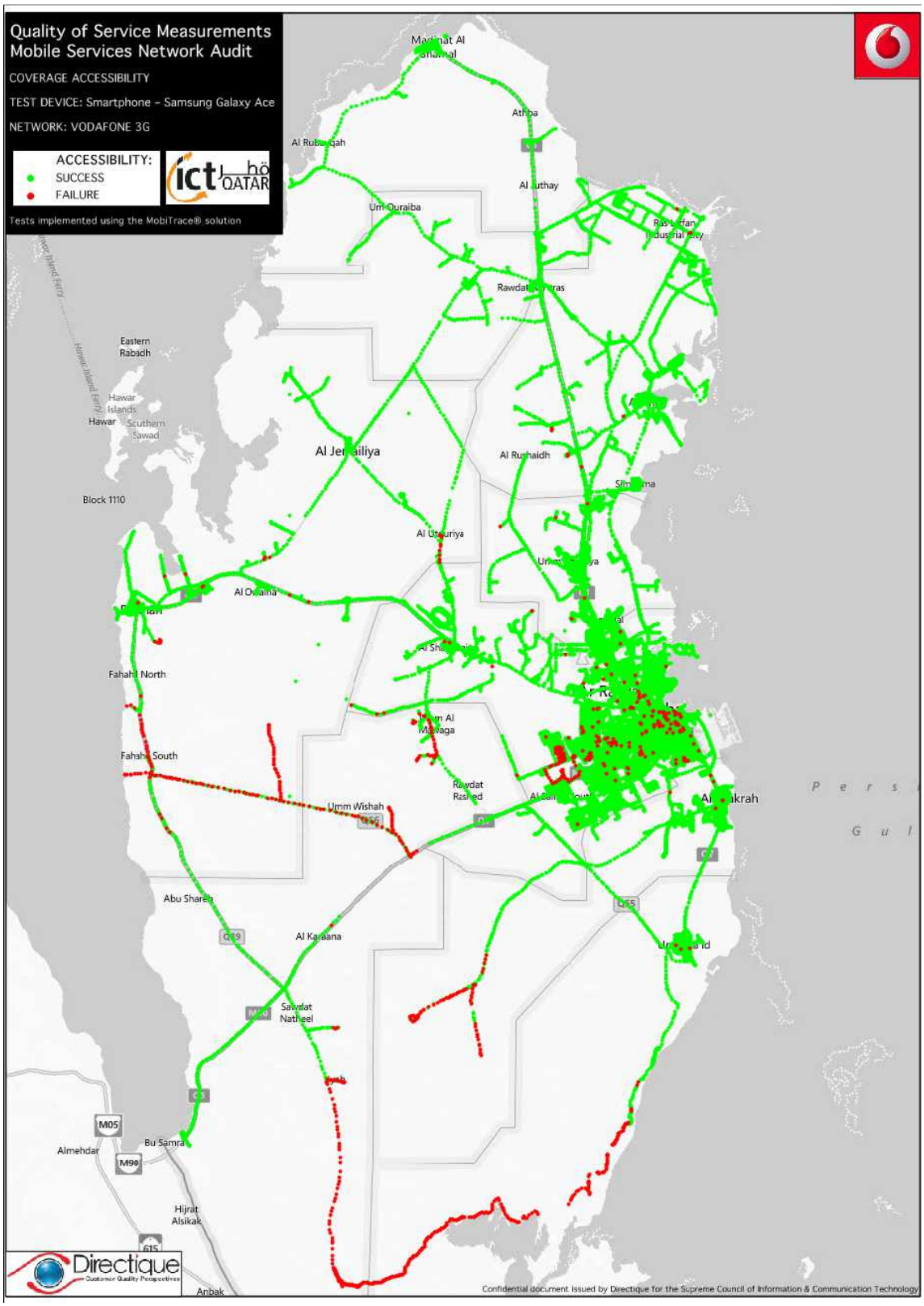
QTEL 3G - Coverage Accessibility



VODAFONE 2G - Coverage Accessibility



VODAFONE 3G - Coverage Accessibility



e. Annexure 5 - Raw Data

Excel Files