Directique
Customer Quality Perspectives

هيئة تنظيم الاتصالات
Telecommunications Regulatory Authority

Quality of Mobile Services

Kingdom of Bahrain - 2012

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This study is published in accordance with Articles 3(b)(1), 3(c)(2), 3(c)(4) and Article 54 of the Telecommunications Law. The purpose of the study is to evaluate and benchmark Quality Levels offered by Mobile Network Operators, Batelco, Viva and Zain, in the Kingdom of Bahrain. The independent study was conducted with an objective end-user perspective by Cabinet Directique and does not represent any views of the Authority.

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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 involves 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 END TO END AUDIT PERFORMANCE APPROACH

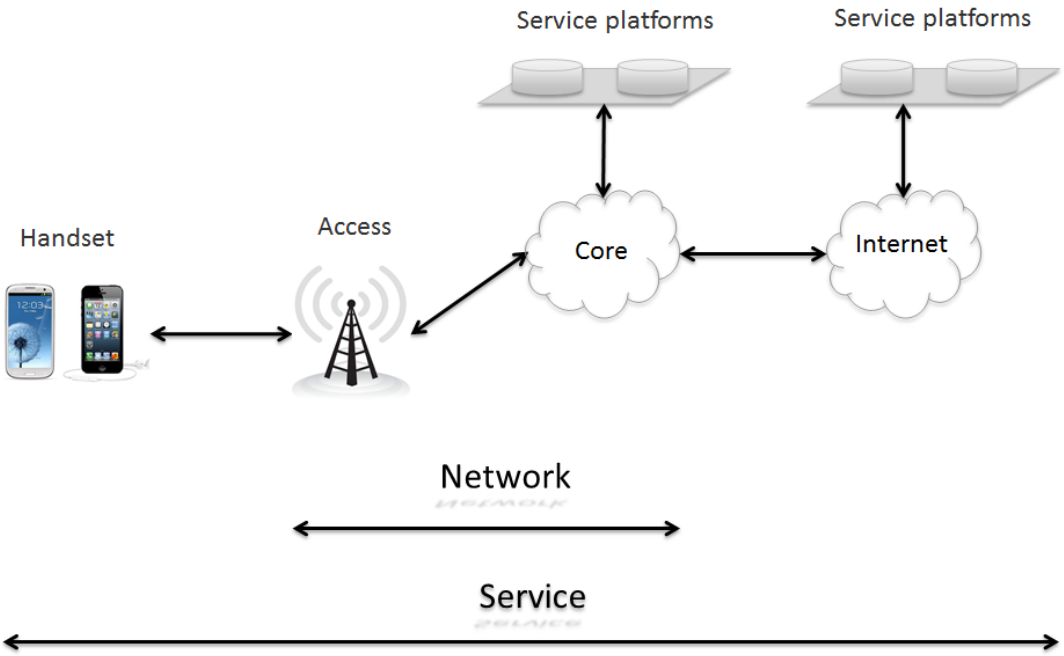
This audit is a benchmark focused on qualitative assessment of the end to end service provided from the user point of view.

This means that measurements are performed through an end to end user perspective, in order to gather a faithful record of the customer's quality experience.

The end to end perspective consists in verifying that the service offered by the service providers is accessible for their customers, and measuring probabilities of malfunction, depending on the customer location and types of usage.

To achieve this objective, verifying that a signal is received by the handset is not sufficient, in addition is confirmed that the radio link can be bilaterally established to support the tested service; And that this radio link, with the rest of the network, can be used to initiate calls and establish data communications; And, finally, assess this communication performance, once established (voice and data).

The diagram below show the end to end service path, from end user handsets to services platform located on or outside of the operator network.



End to end customer experience

The selected testing methodology reproduces a customer use of the range of mobile services, including:

- Handsets and subscriptions available to a large public. These are then selected from a list of current best sellers provided by the mobile operators. The results observed can therefore be subject to degradations induced by the device provided.
- A representative use of the market: incar, pedestrian inside and outside buildings, or under conditions that simulate correctly these uses.

3 EXECUTIVE SUMMARY

3.1 Introduction

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

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

- Voice
- Short Message Services (SMS)
- Smartphones data tests (Web surfing, FTP & HTTP file transfers)
- Dongle tests on hotspots (FTP & HTTP file transfers)
- Video streaming assessment using Smartphones

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 5 November 2012 to 6 December 2012 inclusive. Measurements were performed between 9:00 am and 10:00 pm every day except Saturdays and except during the day of Ashoora (25 November 2012)

The key highlights of this audit are that Mobile Operators have maintained a high level of quality of service for voice and SMS compared to previous years while data throughputs available are globally increasing.

Telecom services are going through an important evolution phase in the Kingdom, specifically in the mobile data arena. Since the audit was conducted, operators have performed significant networks modifications and upgrades; results should be understood in the specific context of the time of the study. To capture network changes and enhancement, it is TRA's intention to conduct a similar audit towards the end of 2013 and compare with the results of this audit in order to highlight any variation in service performance.

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

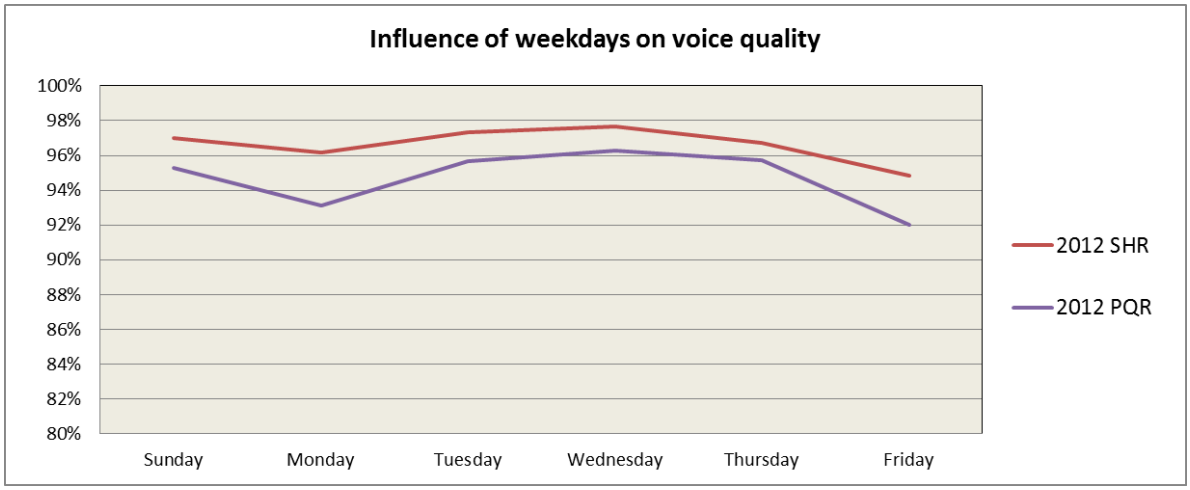
3.2 Industry results

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

3.2.1 Voice and messaging services

		2012	2011	2010
Global voice service		6 828 tests	6 822 tests	7 059 tests
Rate of calls set-up and held (SHR) for 2 min		**96.6%**	**98.2%**	**96.6%**
	statistical accuracy	0.4%	0.3%	0.4%
and marked	**4-perfect (PQR)**	**94.1%**	**94.5%**	**94.1%**
	statistical accuracy	0.6%	0.5%	0.5%
	4-perfect or 3-fair (CQR)	**96.2%**	**97.2%**	**95.7%**
	statistical accuracy	0.5%	0.4%	0.5%

The three networks offered a good service with an average setup and held calls rate of 96.6%. One can notice that both SHR and PQR show degradation on Fridays.



	2012	2011	2010
SMS service	2 637 tests	3 096 tests	1 569 tests
% of received SMS (in 2 min)	**99.6%**	**99.7%**	**99.2%**
Statistical accuracy	0.2%	0.2%	0.4%
% of received SMS (in 30 sec)	**99.3%**	**99.3%**	**96.9%**
Statistical accuracy	0.3%	0.3%	0.9%
% of received SMS (in 15 sec)	**96.5%**	**97.5%**	
Statistical accuracy	0.7%	0.5%	
Average reception delay (sec)	**8**	**10**	**13**

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

The average observed SMS reception delay was 8 seconds

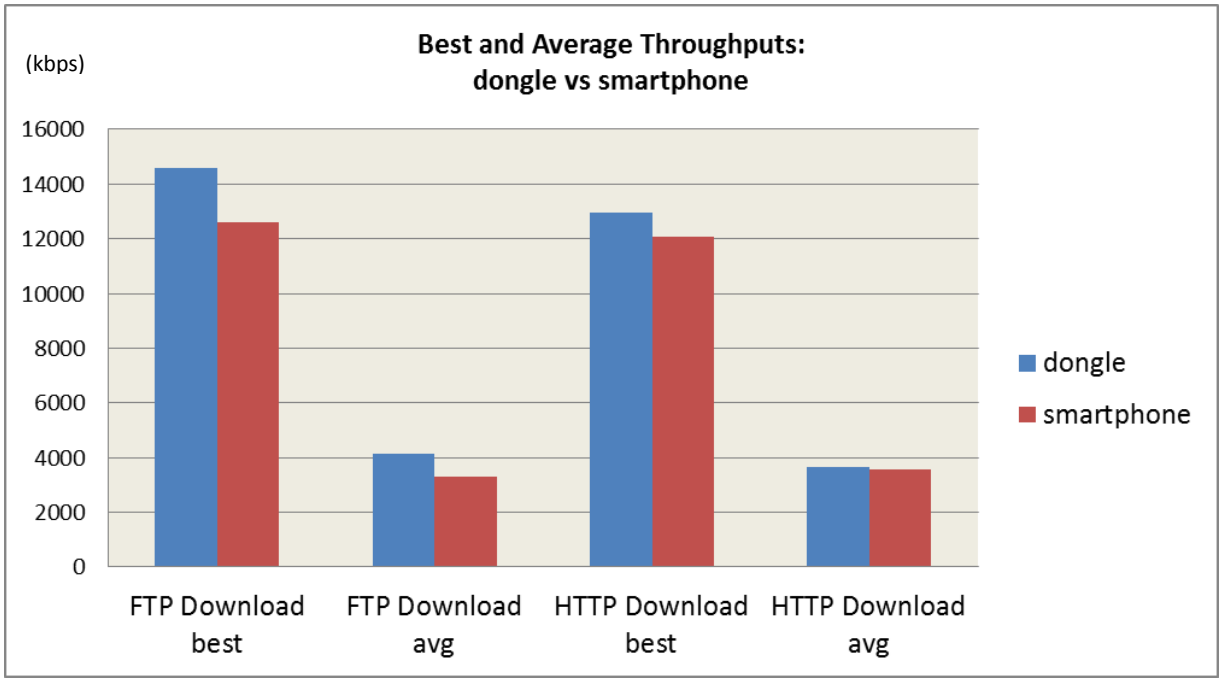
3.2.2 Computer dongle measurements

	2012	2011	2010
Dongle connection	2 152 tests	4 859 tests	4 152 tests
Rate of successful connections to network	**99.2%**	**99.8%**	**98.8%**
Statistical accuracy	0.4%	0.1%	0.3%
Rate of successful connections within 10s	**94.4%**	**99.7%**	**98.7%**
Statistical accuracy	1.0%	0.2%	0.3%

The average performance is lower compared to previous years, particularly on the successful connections within 10 seconds.

3.2.3 Computer dongles versus Smartphone performances

The audit of the data throughputs available in the Kingdom of Bahrain has been carried out using representative devices used by customers. To appreciate the extent to which a device can alter results, specific measurements on hotspots selected by each operator have been performed, using dongles and smartphones.



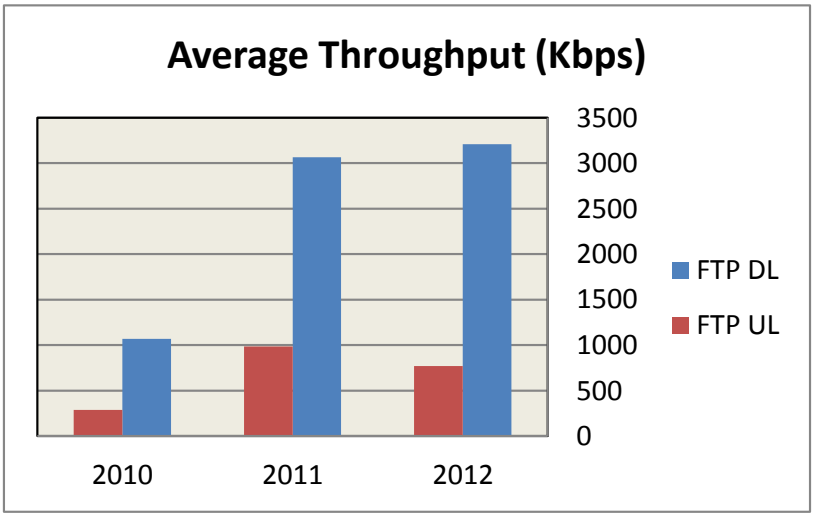
Although smartphones' performances are rapidly increasing, one can still notice that using dongles plugged to a computer instead of mobile devices allows for slightly higher throughputs.

3.2.4 Smartphone data measurements

Rate of successful smartphone data transfers	2012
FTP DL	98.9%
statistical accuracy	0.7%
FTP UL	99.2%
statistical accuracy	0.6%
HTTP DL	99.0%
statistical accuracy	0.5%
HTTP UL	97.8%
statistical accuracy	0.7%
WEB	99.1%
statistical accuracy	0.1%

Compared to previous years the size of the files downloaded are much larger this year (20MB vs 5MB previously) since the throughput performance has increased.

The average throughput available on the downlink continued to increase but at a marginal level compared to last year when a technology change occurred.



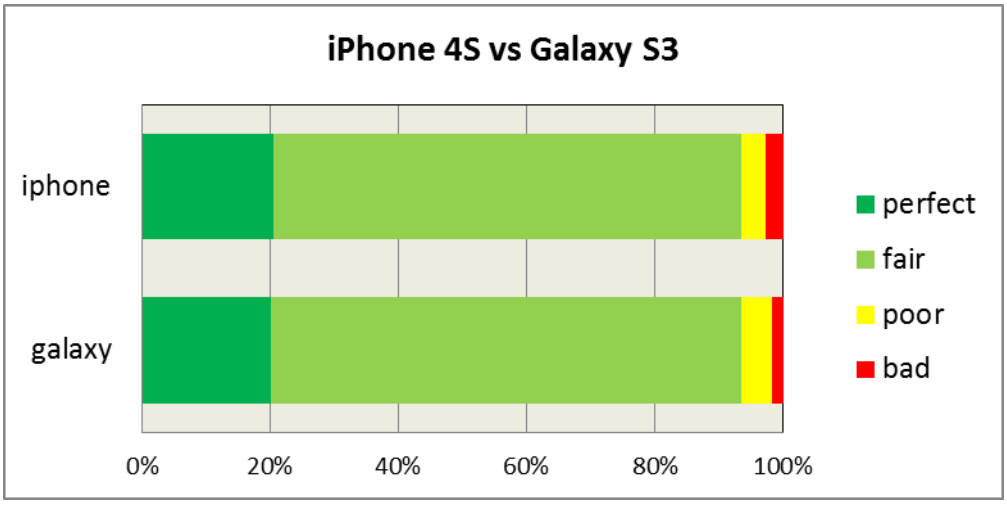
Average throughput evolution

3.2.5 Streaming measurements

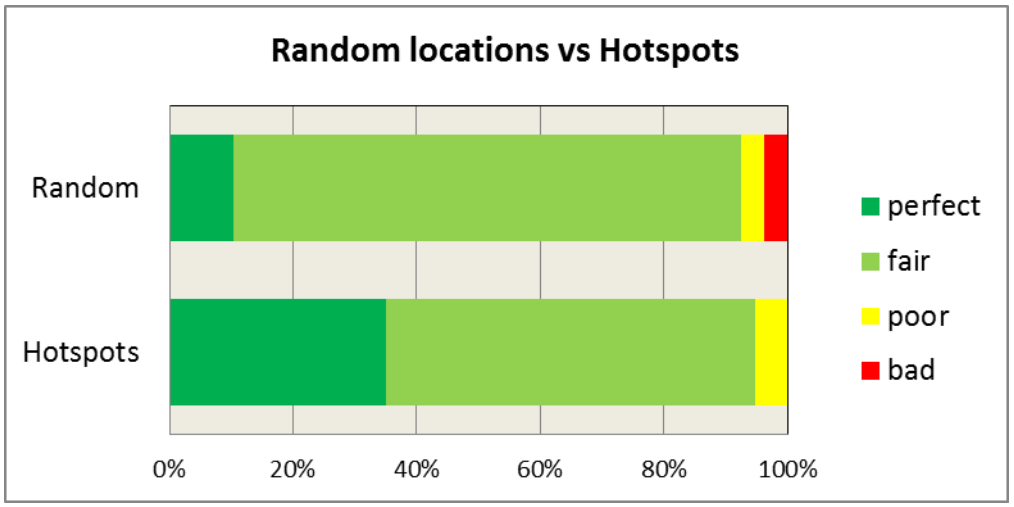
	2012
LHV : % of videos set-up and held for 2 min	95%
statistical accuracy	3.1%
VPQR : % of videos set-up, held for 2 min, and marked 4	20%
statistical accuracy	5.7%
VCQR : % of videos set-up, held for 2 min, and marked 3 or 4	93%
statistical accuracy	3.5%
Average delay seconds	9
Minimum delay seconds	3

Streaming measurements were carried out for the first time this year and cannot therefore be compared to other references.

The diagram below show that the type of smartphone used did not affect the results observed:



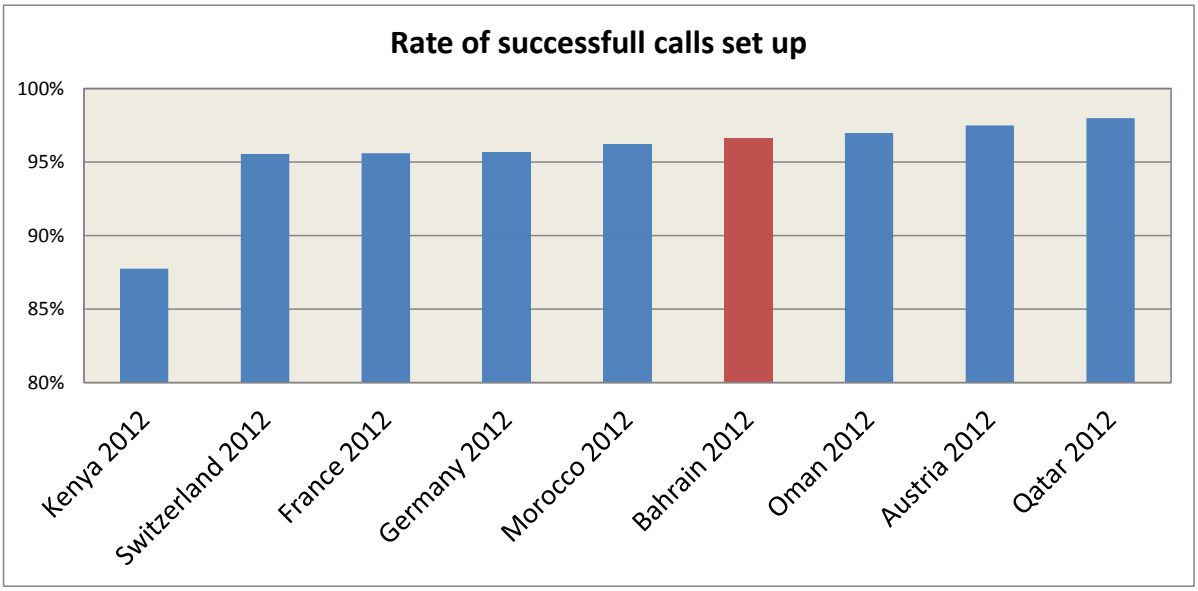
As expected, measurements carried out under better network conditions tend to present better results:

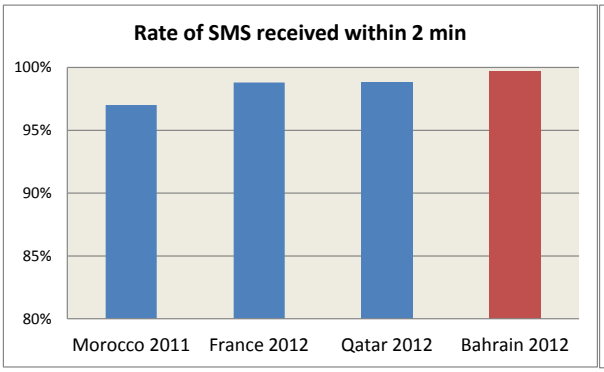


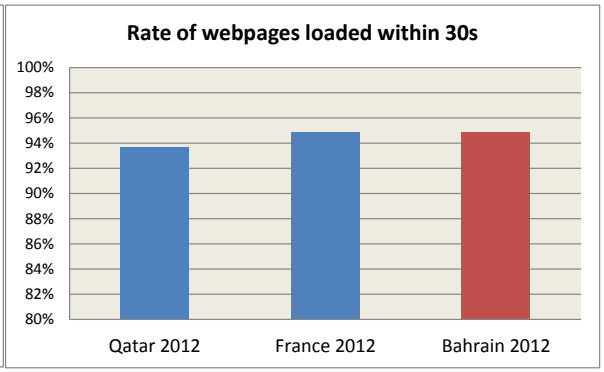
4 BENCHMARK TO REFERENCE OPERATORS

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

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







Compared with international references, Bahrain's Mobile Operators offer good performances for voice services and top the charts for SMS and webpage loading.

5 MEASUREMENTS SPECIFICATIONS

5.1 Team and Equipment

5.1.1 Team

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

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

5.1.2 Equipment

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

Network	Voice / SMS	Fixed Phone	Dongles	Smartphone
BATELCO	HTC Desire	BATELCO	provided by batelco	[1]Samsung Galaxy S3 and iPhone 4S
ZAIN			provided by zain	
VIVA			provided by viva	

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

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

5.1.3 Sim cards

SIM cards were sourced locally.

	BATELCO	VIVA	ZAIN
VOICE & SMS	SimSim	Viva prepaid	EasyTalk
	Super 30	Viva postpaid	Hewar 3000
DATA	Unlimited Mobile Broadband BD10	VIVA Broadband 20	e-GO “just got better” Package 7
COVERAGE	Unlimited Mobile Broadband BD10	VIVA Broadband 20	e-GO “just got better” Package 7

[1] The Authority thanks Viva for having provided S3 handsets for the audit

5.2 Voice service quality testing

5.2.1 Measurement

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

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

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

Call distribution was as follows:

call origination & termination	
Mobile to Mobile (MTM) own network	70%
Mobile to Fixed Line	30%

Voice measurements were performed in three configurations:

- Indoor : Pedestrian Indoor in public and private buildings
- Outdoor: Pedestrian Outdoor in the busiest outdoor places. 1/3 of the measurements were dynamic, walking from one point to another and 2/3 were static.
- In car: On road links (In car Road) and within Town borders (In car Town)

field configuration	
incar	50%
indoor	25%
outdoor	25%

Audio Quality marking:

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

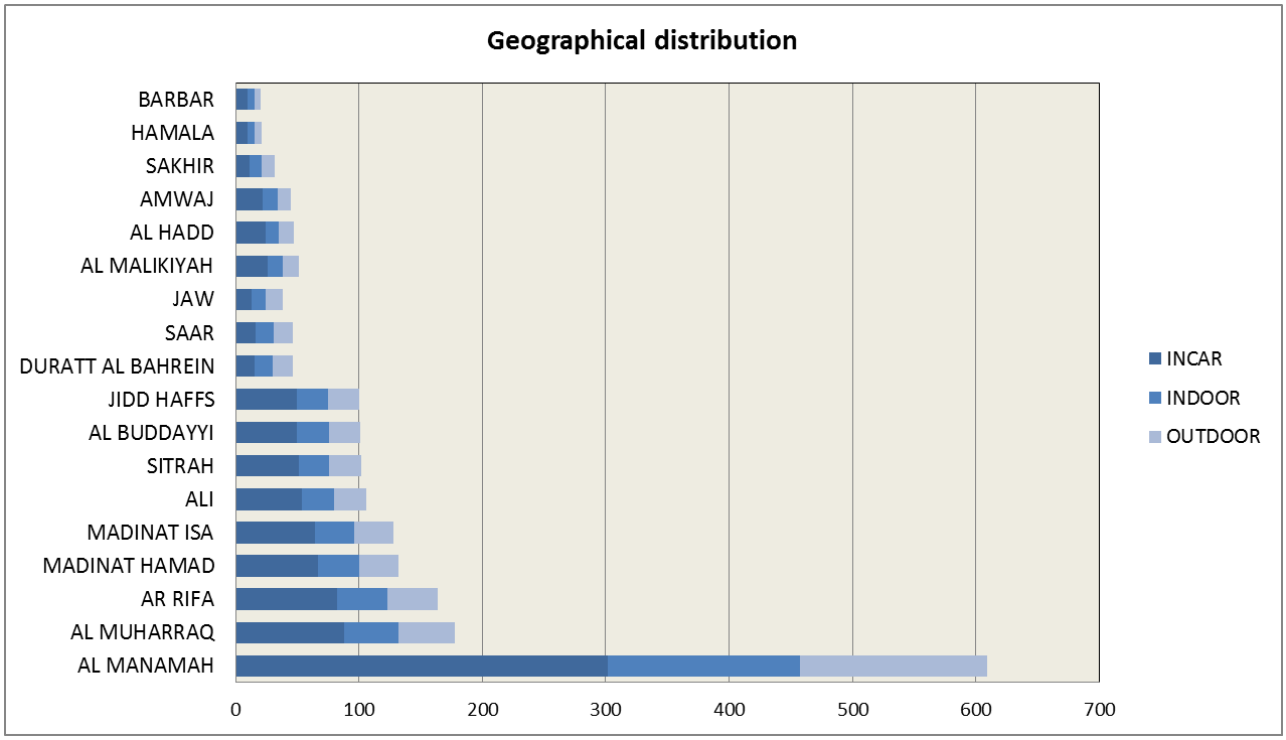
Level 4 : Perfect	Engineer doesn't notice any defect
Level 3 : Fair	One defect occurs while the conversation goes on uninterrupted
Level 2 : Poor	The natural flow of the conversation is altered and the engineer has to repeat himself
Level 1 : Bad	The defect is so strong that conversation cannot proceed.

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.

5.2.2 Testing Area and sample size

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



In cities of more than 50,000 inhabitants, tested zones are divided into equal areas, and a number of test calls are allocated to each of these areas. Field testers adapt their journey depending on external events (traffic, one way road…), with the aim of covering the zone as per test plan.

In smaller cities (less than 50,000 inhabitants), measurements are made on paths that includes major roads and constructed zones (Downtown, airport, stations, touristic places and business centers).

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

Test locations: voice service

5.2.3 Measurements specifications - Towns

❖ ***In car measurements***

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

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

❖ ***Pedestrian measurements***

Pedestrian measurements were equally distributed over an area

- Pedestrian outdoor measurements

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

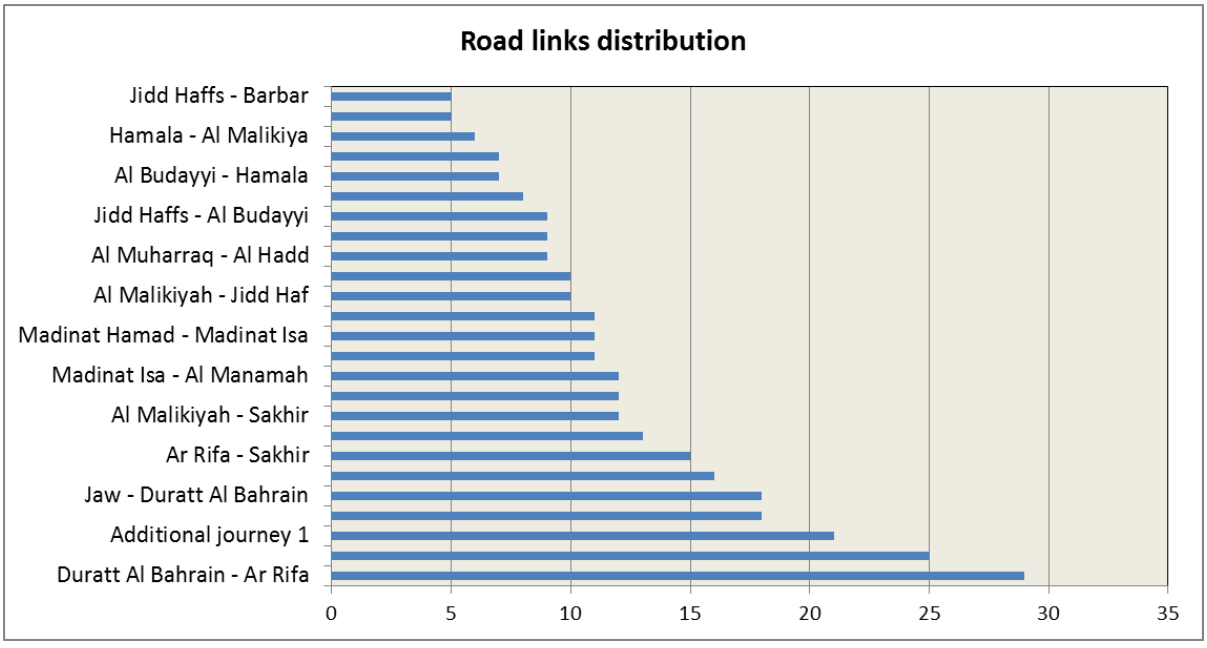
- Pedestrian indoor measurements

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

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

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

5.2.4 Measurements specifications - Road links



This histogram shows the number of incar voice calls made on each road link.

5.2.5 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.

5.2.6 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.

In case of abnormal behavior of a handset, it was replaced and 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.

5.3 SMS measurements

5.3.1 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. 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 reception of the message on the other phone and taking note of the time; a message not received after 2 minutes elapse time was marked as failed.
- Opening and checking integrity of the received message and index matching

SMS test areas excluded road links, SMS testing schedule was the same as for voice testing.

5.4 Data service testing

5.4.1 Dongle data measurements

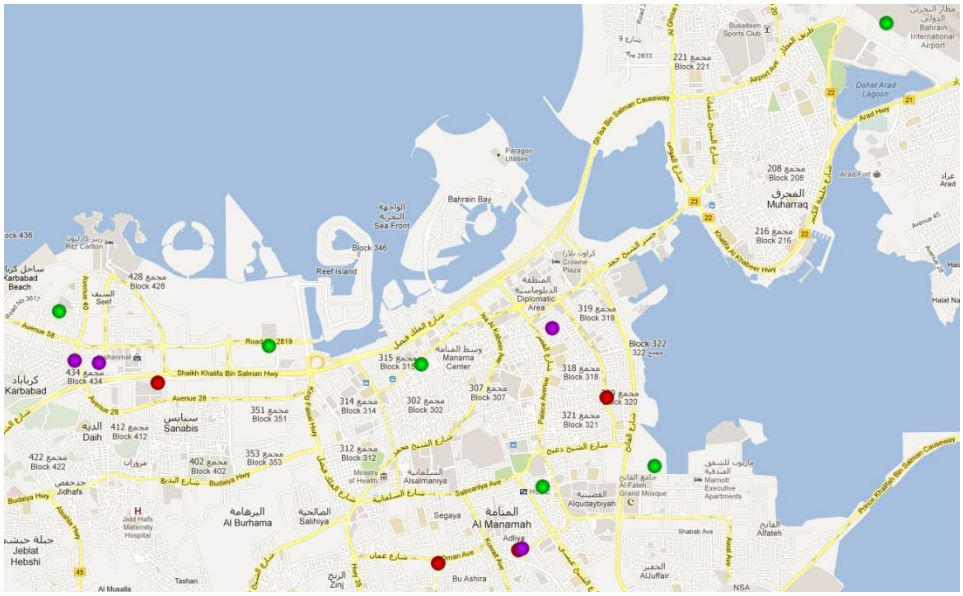
Dongle data measurements were carried out automatically via **Mobi.Net** ©, Directique's software data test.

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 20MB file via FTP & HTTP.
- Uploading 1MB file via FTP & HTTP.

2380 tests have been performed over hotspots locations indicated by each operator.



Dongle test samples repartition

5.4.2 Web measurements

Web and Mail measurements were carried out automatically with **Mobi.Net** © (introduced earlier).

The test 3G+ USB dongle was connected to a laptop and **Mobi.Net** © was launched on each selected test point.

On each network, a measurement consisted of:

- Attempting to set up a radio connection before timeout set to 1 minute. Record connection time.
- For Web : downloading one of the 10 most visited public homepages and the homepage of each operator, taking note of completion time, errors on page if any, with a 2 minutes timeout.

BATELCO	VIVA	ZAIN
http://www.batelco.com	http://www.bh.zain.com/portal/page/home	http://www.viva.com.bh/static/CorporatePortal/English/Home/index.htm
http://www.google.com.bh/		
http://www.facebook.com/		
http://www.google.com/		
http://www.youtube.com/		
http://www.live.com		
http://www.yahoo.com		
http://www.wikipedia.org		
http://www.apple.com/		
http://www.instagram.com/		
http://www.vuclip.com/		

List of webpages tested

5.4.3 Streaming Measurements

Streaming Measurements have been carried out by assessing the quality of selected Youtube videos with smartphones in order to represent closely as possible the customer experience. The evaluation started when the video was launched and lasted 2 minutes. Each video and audio defect was categorized and its duration was collected in order to determine if the viewing was perfect, fair, poor or bad. Once the sequence had been completed, a grade was given to describe 3 global appraisal criteria (sharpness, audio/video synchronization and sound quality)

Recording process

STEP 1	STEP 2	STEP 3
Configuration and conditions	Observations during the sequence	Global appraisal

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

Video appraisal criteria	
SUPERIMPOSITION	Superimposition or interlaced images during transitions between frames
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 under 18fps, 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.

Global appraisal criteria	
AUDIO SEQUENCE QUALITY	Overall audio quality of the sequence
SHARPNESS	Sharpness reflects the level of detail in the images displayed.
AUDIO/VIDEO SYNCHRONIZATION	The level of desynchronization is measured proportionally to the length of the delay between audio and video.

5.4.4 Smartphone measurement

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

On each network, a measurement consisted of:

- Downloading 20MB file via FTP & HTTP.
- Uploading 1MB file via FTP & HTTP.

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 etc.

Smartphone testing area excluded road links

CITY	FTP DL	FTP UL	HTTP DL	HTTP UL	WEB	Total
ADLIYAH	25	25	25	25		100
AL MALIKIA	36	36	36	36	94	238
ALI	64	64	64	64	217	473
AMWAJ	24	24	24	24	93	189
BARBAR	8	8	8	8	32	64
BUDAYAH	80	80	80	80	270	590
DURAT AL BAHRAIN	16	16	16	16	86	150
HAMALA	6	6	6	6	27	51
HIDD	30	30	30	30	106	226
HOORA	26	25	26	26		103
JANDOOL	6	6	6	6		24
JAW	8	8	8	8	58	90
JIDD HAFFS	74	74	74	77	237	536
KARBABAD	50	54	62	62		228
MADINAT HAMAD	84	84	84	84	295	631
MADINAT ISA	92	92	92	92	317	685
MANAMA	711	590	709	710	1299	4019
MUHARRAQ	100	100	100	100	419	819
RIFFA	120	120	120	120	373	853
SAAR	22	22	22	22	93	181
SAKHIR	12	12	12	12	79	127
SANABIS	39		39	39		117
SEEF	179	88	185	185		637
SITRA	38	38	36	36	244	392
ZINJ	25	25	25	25		100
Total	1875	1627	1889	1893	4339	11623

Smartphone test sample repartition

6 AUDIT RESULTS

6.1 Key Performance Indicators

6.1.1 Voice KPIs

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

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

6.1.2 SMS KPIs

KPIs	Definition
RS 2 (% 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.
RS 30 (% of SMS received SMS within 30 sec)	SMS not refused when sent out and received within 30 seconds without being altered.
RS 15 (% of SMS received SMS within 15 sec)	SMS not refused when sent out and received within 15 seconds without being altered.

6.1.3 Dongle specific 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

6.1.4 Web KPIs

KPIs	Definition
% of successful data transfers	Successful page loading within 60s. Indicator is based on the total number of connection attempts
Average download time	Average delay once connected, applied only to successful data transfers
Min download time	Best delay to load a webpage
Standard deviation download time	Standard download time deviation applied only to successful data transfers

6.1.5 Streaming KPIs

KPIs	Definition
LHV : % of videos set-up and held for 2 min	Video launched on first attempt, and held for 2 min without drop
VPQR : % of videos set-up, held for 2 min, and marked 4	Video excluded = failed on first attempt, dropped before 2 min, or been marked 3 or lower - (PQR : Perfect Quality Rate)
VCQR : % of videos set-up, held for 2 min, and marked 3 or 4	Video excluded = failed on first attempt, dropped before 2 min, or been marked 2 or lower - (CQR : Correct Quality Rate)
Delay (min, average)	delay between the launch click and the beginning of the sequence

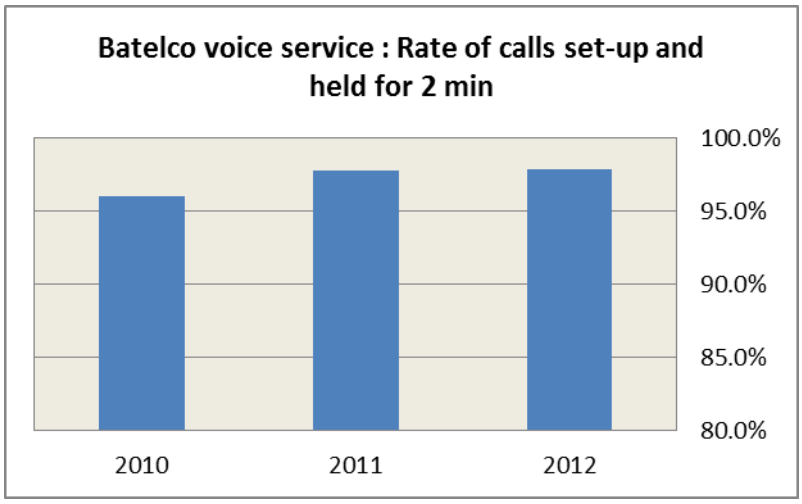
6.1.6 FTP &HTTP

KPIs	Definition
% of successful data transfers	Successful data transfer without radio drop. Indicator is based on the total number of connection attempts
Average Throughput	Average throughput once connected, applied only to successful data transfers
Best Throughput	Best throughput recorded for a data transfer measurement

6.2 Batelco results

6.2.1 Global voice results (Cities & Road links)

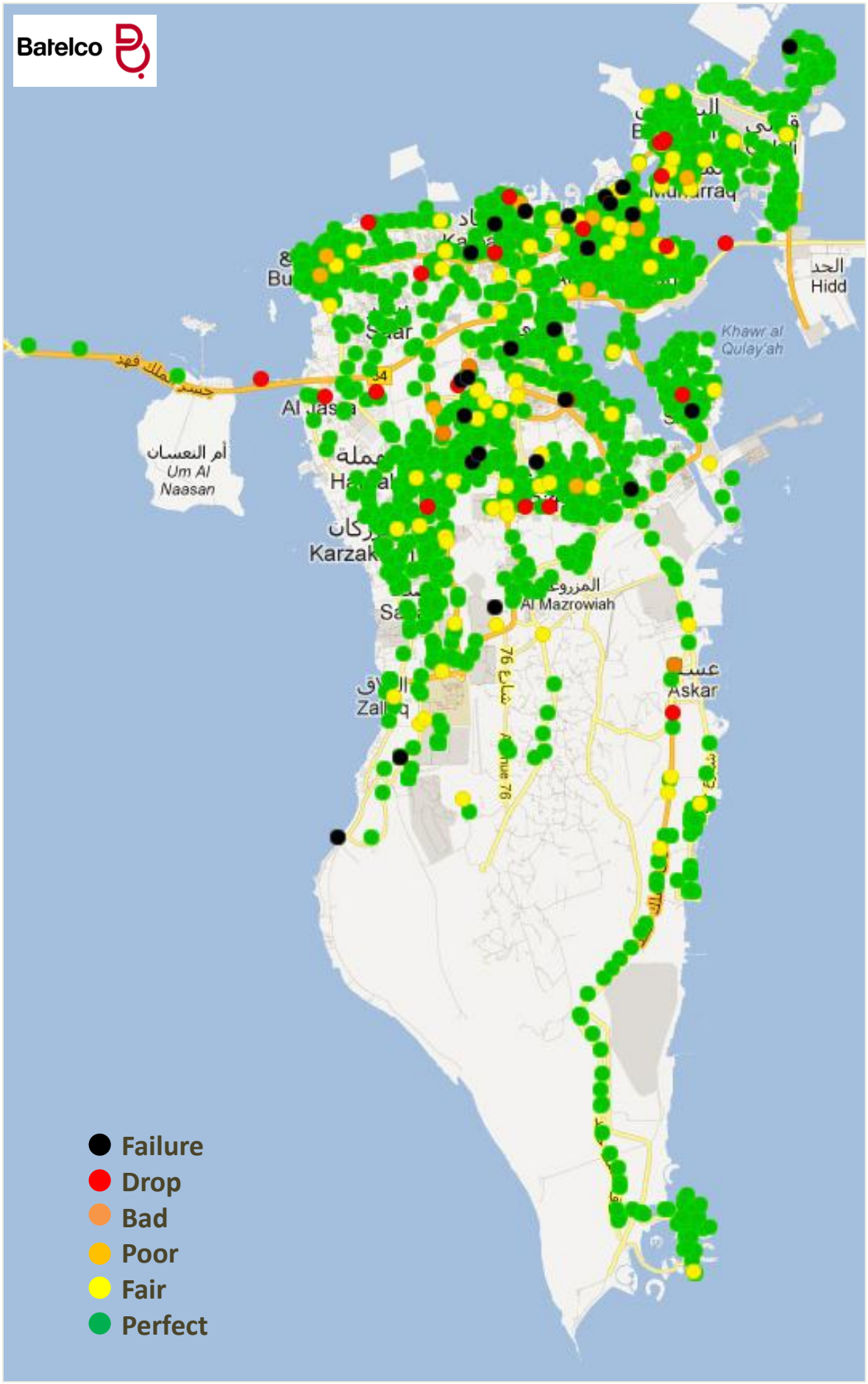
		Batelco
Global voice service		2 275 tests
Rate of calls set-up and held for 2 min		**97.9%**
statistical accuracy		0.6%
and marked	**Rate of calls marked 4-perfect (PQR)**	**94.1%**
	statistical accuracy	1.0%
	Rate of calls marked 4-perfect or 3-fair (CQR)	**97.4%**
	statistical accuracy	0.7%



		Batelco
Cities voice service (incar, outdoor, indoor)		1 966 tests
Rate of calls set-up and held for 2 min		**98.5%**
statistical accuracy		0.5%
and marked	**4-perfect (PQR)**	**95.5%**
	statistical accuracy	0.9%
	4-perfect or 3-fair (CQR)	**98.1%**
	statistical accuracy	0.6%

		Batelco
Cities voice service (incar only)		955 tests
Rate of calls set-up and held for 2 min		**98.0%**
	statistical accuracy	0.9%
and marked	**4-perfect (PQR)**	**93.9%**
	statistical accuracy	1.5%
	4-perfect or 3-fair (CQR)	**97.5%**
	statistical accuracy	1.0%

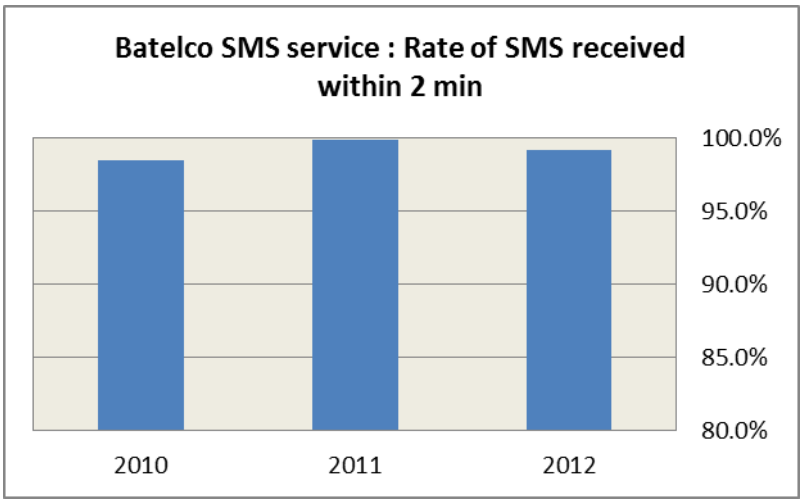
		Batelco
Road links service		309 tests
Rate of calls set-up and held for 2 min		**94.2%**
	statistical accuracy	1.0%
and marked	**4-perfect (PQR)**	**84.8%**
	statistical accuracy	1.6%
	4-perfect or 3-fair (CQR)	**92.9%**
	statistical accuracy	1.1%



BATELCO Global voice results

6.2.2 SMS results

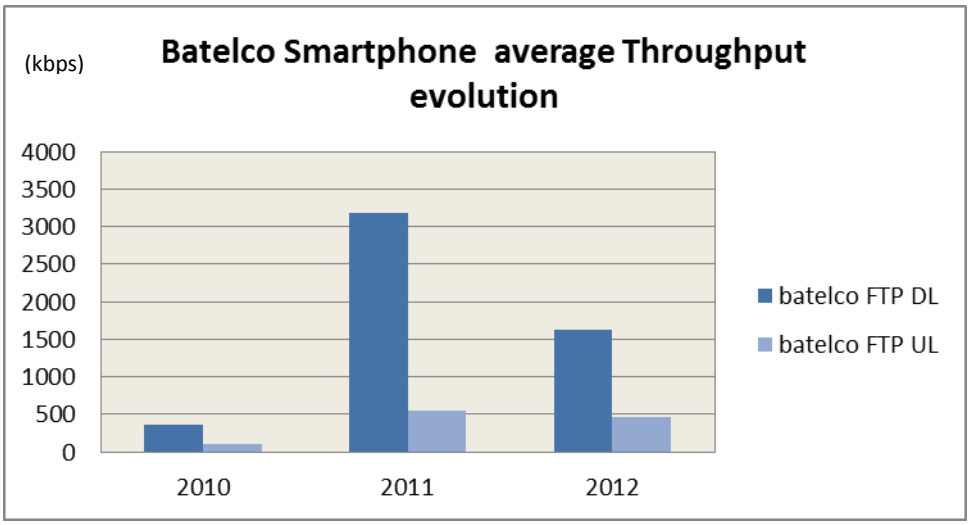
	BATELCO
SMS service	984 tests
% of received SMS (RS2)	**99.2%**
Statistical accuracy	0.6%
% of received SMS (RS30)	**99.0%**
Statistical accuracy	0.6%
% of received SMS (RS15)	**98.1%**
Statistical accuracy	0.9%
Average reception delay (s)	**8**



6.2.3 Data smartphone results

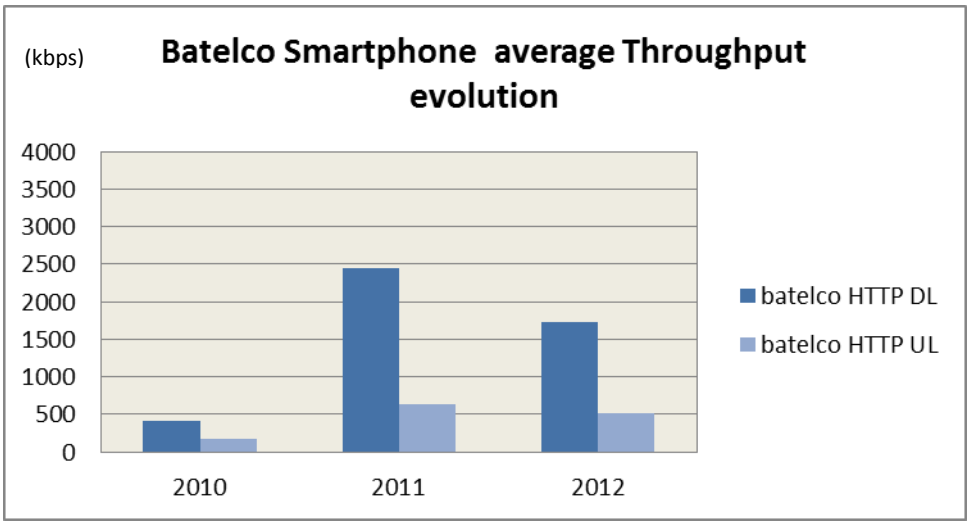
	BATELCO
FTP DL	694 tests
Rate of successful data transfers Statistical accuracy	**100.0%** 0.0%
Average Throughput (kbps)	**1617**
Max throughput (kbps)	**6155**
Standard deviation throughput (kbps)	902

	BATELCO
FTP UL	535 tests
Rate of successful data transfers Statistical accuracy	**100.0%** 0.0%
Average Throughput (kbps)	**470**
Max throughput (kbps)	**2151**
Standard deviation throughput (kbps)	304



	BATELCO
HTTP DL	693 tests
Rate of successful data transfers Statistical accuracy	**99.4%** 0.6%
Average Throughput (kbps)	**1734**
Max throughput (kbps)	**6471**
Standard deviation throughput (kbps)	911

	BATELCO
HTTP UL	696 tests
Rate of successful data transfers Statistical accuracy	**97.7%** 1.1%
Average Throughput (kbps)	**521**
Max throughput (kbps)	**2586**
Standard deviation throughput (kbps)	322



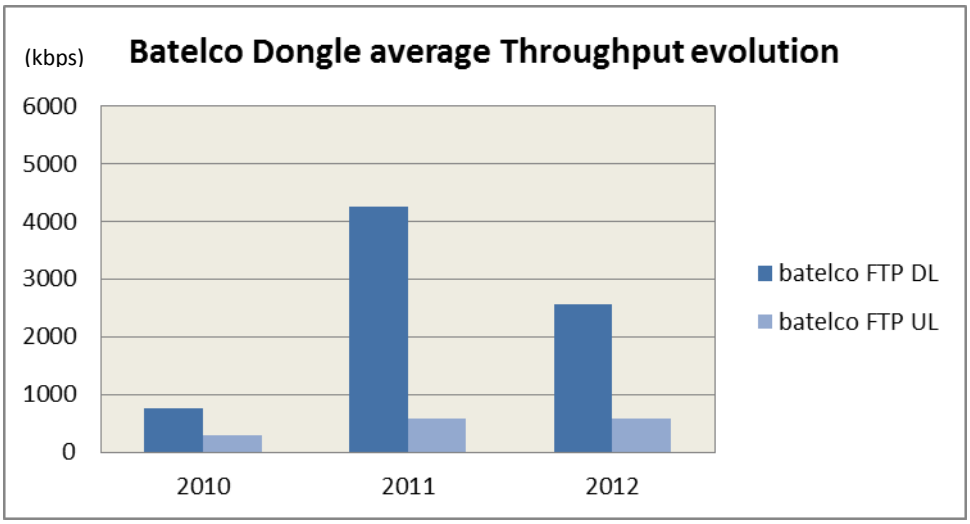
	BATELCO
WEB	1 304 tests
Rate of successful data transfers Statistical accuracy	**98.7%** 0.2%
Average download time (s)	**14.5**
Min download time (s)	**2.4**
Standard deviation download time (s)	10.0

6.2.4 Dongle KPIs

	BATELCO
Rate of successful radio connections to network	100.0%
Statistical accuracy	0.0%
Rate of successful radio connections within 10s	100.0%
Statistical accuracy	0.0%

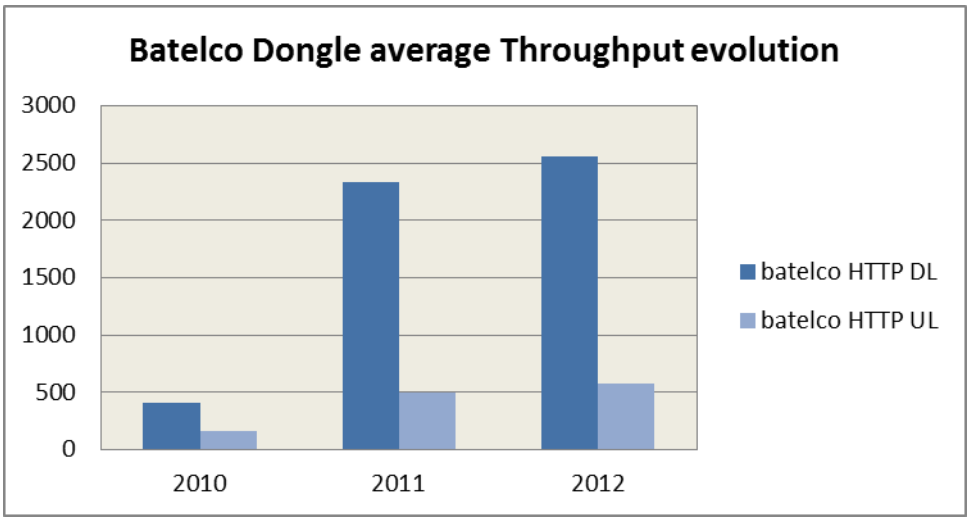
	BATELCO
FTP DL	200 tests
Average Throughput (kbps)	**2561**
Max throughput (kbps)	**7384**

	BATELCO
FTP UL	200 tests
Average Throughput (kbps)	**579**
Max throughput (kbps)	**2427**



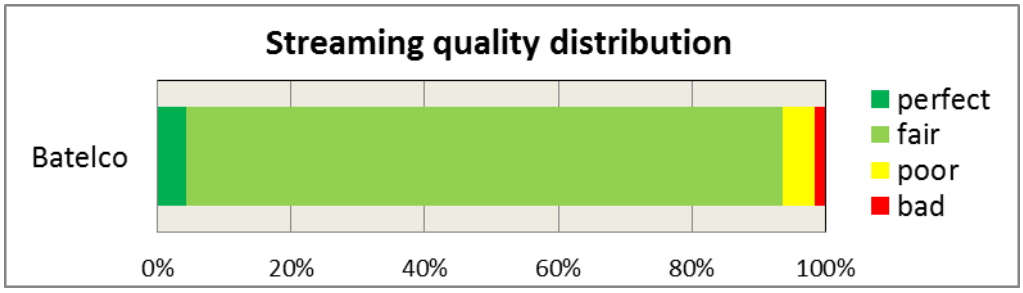
	BATELCO
HTTP DL	200 tests
Average Throughput (kbps)	**1963**
Max throughput (kbps)	**4863**

	BATELCO
HTTP UL	200 tests
Average Throughput (kbps)	**556**
Max throughput (kbps)	**1794**



6.2.5 Streaming KPIs

	BATELCO
LHV : % of videos set-up and held for 2 min	96%
statistical accuracy	2.9%
VPQR : % of videos set-up, held for 2 min, and marked 4	4%
statistical accuracy	2.9%
VCQR : % of videos set-up, held for 2 min, and marked 3 or 4	94%
statistical accuracy	3.5%
Average delay	13
Minimum delay	3



6.2.6 Data Coverage

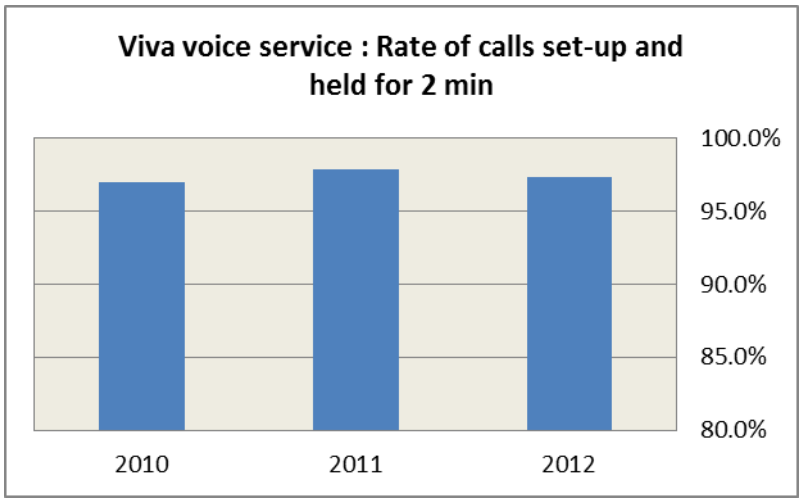
	BATELCO
Network technology distribution	3 086 tests
EDGE	**1%**
statistical accuracy	0.4%
HDSPA	**97%**
statistical accuracy	0.6%
UMTS	**2%**
statistical accuracy	0.5%
HSDPA 2011	**79%**

This table provides the technology breakdown used by Mobile Operators as recorded during measurements. These samples have been taken in towns and on road links. They are shown as contextual information at the time of the audit. The KPIs provided are representative of user experience and are affected by temporary breakdowns and congestion. Thus, one has to keep in mind that such figures might not be the exact reflection of the effective deployment of antennas by operators.

6.3 Viva results

6.3.1 Global voice results (Cities & Road links)

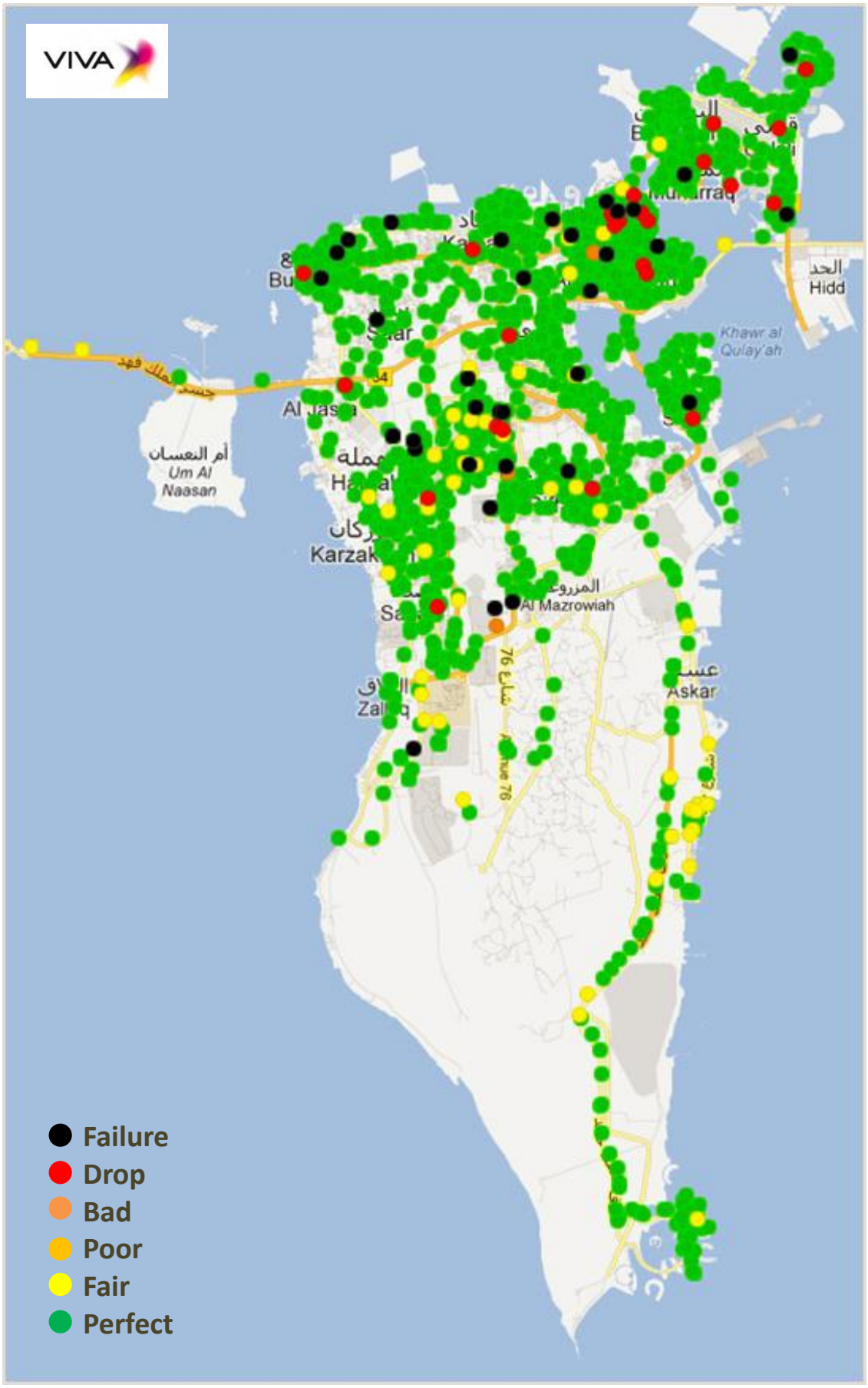
		Viva
Global voice service		2 274 tests
Rate of calls set-up and held for 2 min		**97.4%**
statistical accuracy		0.7%
and marked	**Rate of calls marked 4-perfect (PQR)**	**94.9%**
	statistical accuracy	1.0%
	Rate of calls marked 4-perfect or 3-fair (CQR)	**97.2%**
	statistical accuracy	0.7%



		Viva
Cities voice service (incar, outdoor, indoor)		1 962 tests
Rate of calls set-up and held for 2 min		**97.3%**
statistical accuracy		0.7%
and marked	**4-perfect (PQR)**	**95.6%**
	statistical accuracy	0.9%
	4-perfect or 3-fair (CQR)	**97.2%**
	statistical accuracy	0.7%

		Viva
Cities voice service (incar only)		956 tests
Rate of calls set-up and held for 2 min		**97.2%**
statistical accuracy		1.1%
and marked	**4-perfect (PQR)**	**94.8%**
	statistical accuracy	1.4%
	4-perfect or 3-fair (CQR)	**97.1%**
	statistical accuracy	1.1%

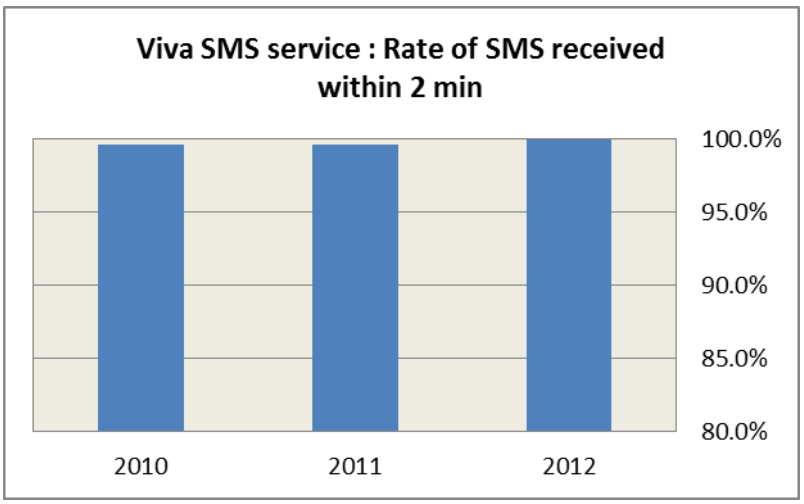
		Viva
Road links service		312 tests
Rate of calls set-up and held for 2 min		**97.8%**
statistical accuracy		0.7%
and marked	**4-perfect (PQR)**	**90.4%**
	statistical accuracy	1.3%
	4-perfect or 3-fair (CQR)	**96.8%**
	statistical accuracy	0.8%



VIVA Global voice results

6.3.2 SMS results

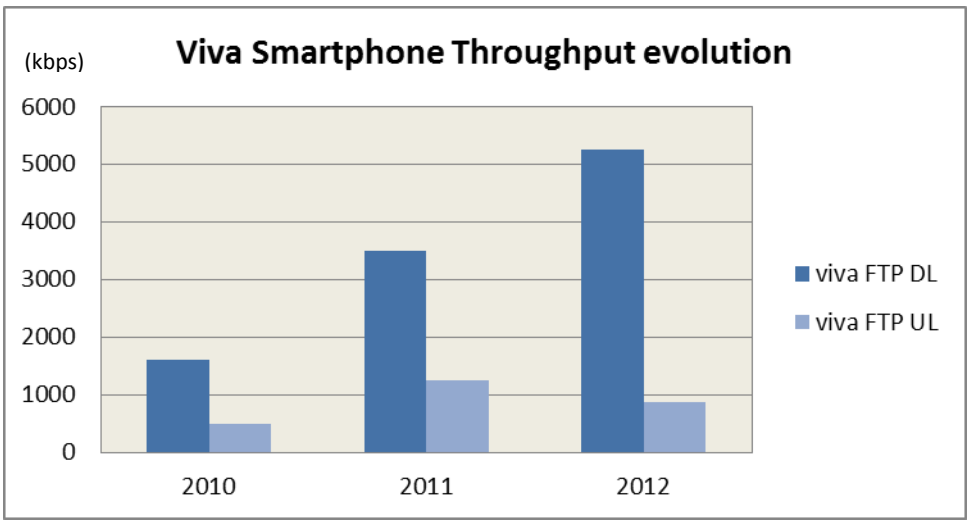
	viva
SMS Service	946 tests
% of received SMS (RS2)	**100.0%**
Statistical accuracy	0.0%
% of received SMS (RS30)	**99.6%**
Statistical accuracy	0.4%
% of received SMS (RS15)	**98.1%**
Statistical accuracy	0.9%
Average reception delay (s)	**8**



6.3.3 Data smartphone results

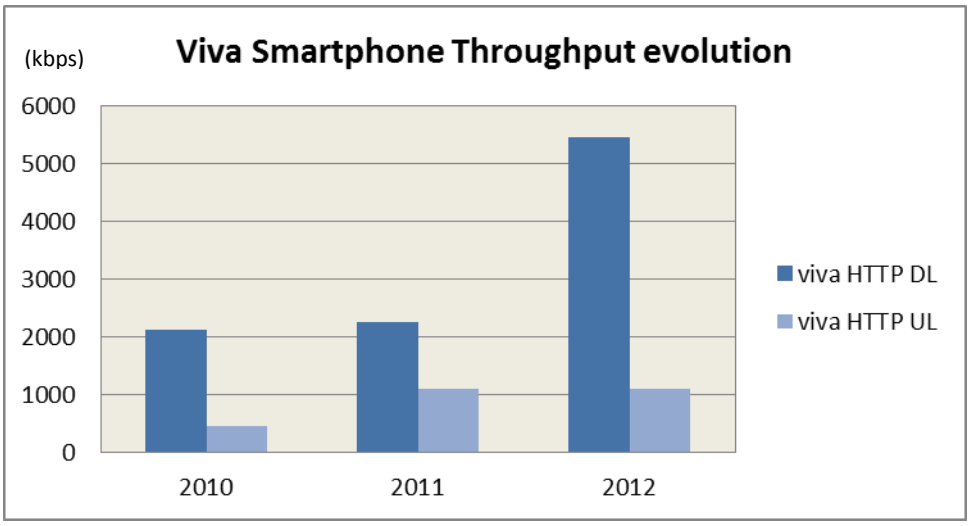
	viva
FTP DL	624 tests
Rate of successful data transfers Statistical accuracy	**98.4%** 1.0%
Average Throughput (kbps)	**5530**
Max throughput (kbps)	**13340**
Standard deviation throughput (kbps)	2465

	viva
FTP UL	622 tests
Rate of successful data transfers Statistical accuracy	**98.4%** 1.0%
Average Throughput (kbps)	**873**
Max throughput (kbps)	**2668**
Standard deviation throughput (kbps)	738



	viva
HTTP DL	643 tests
Rate of successful data transfers	**98.8%**
Statistical accuracy	0.9%
Average Throughput (kbps)	**5458**
Max throughput (kbps)	**12075**
Standard deviation throughput (kbps)	2379

	viva
HTTP UL	648 tests
Rate of successful data transfers	**98.1%**
Statistical accuracy	1.0%
Average Throughput (kbps)	**1083**
Max throughput (kbps)	**2712**
Standard deviation throughput (kbps)	721



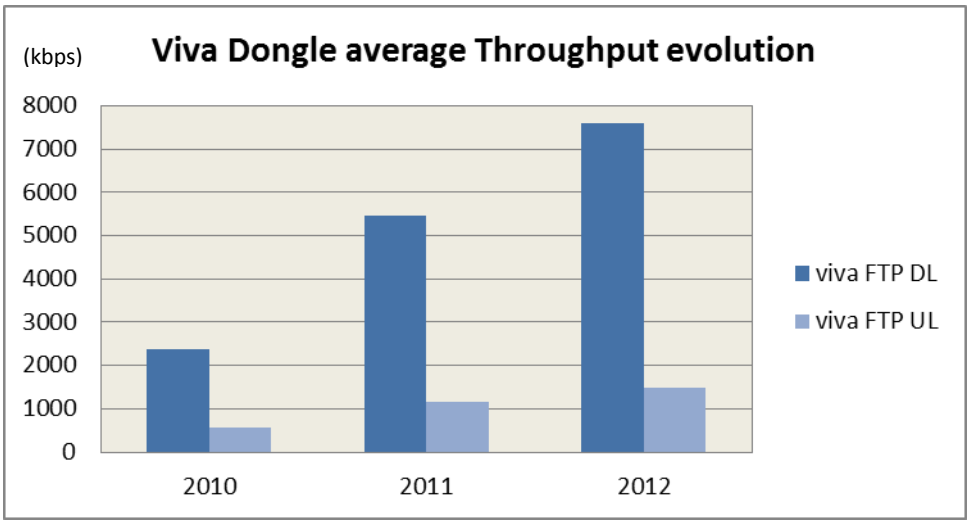
	viva
WEB	1 751 tests
Rate of successful data transfers	**99.4%**
Statistical accuracy	0.4%
Average download time (s)	**6.1**
Min download time (s)	**1.3**
Standard deviation download time (s)	6.4

6.3.4 Dongle KPIs

	viva
Dongle connection	840 tests
Rate of successful connections to network	**100.0%**
Statistical accuracy	0.0%
Rate of successful connections within 10s	**100.0%**
Statistical accuracy	0.0%

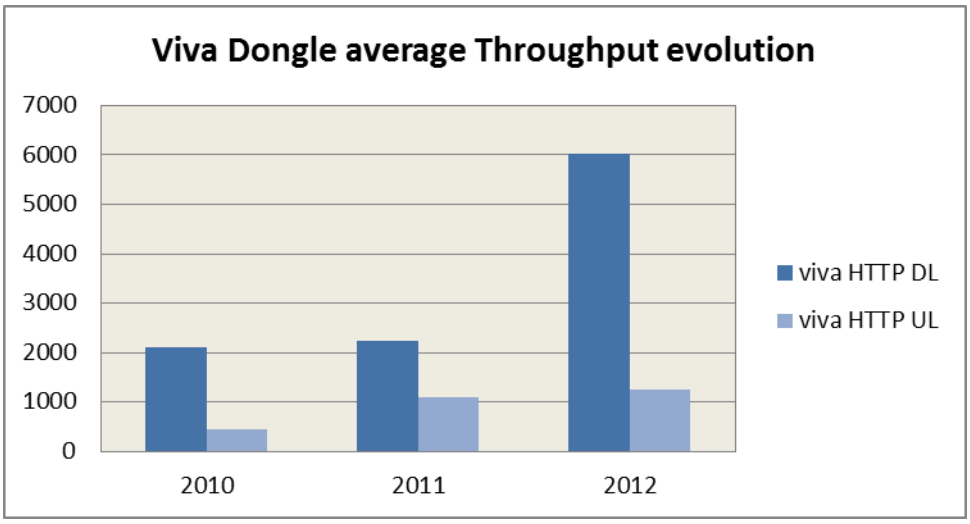
	viva
FTP DL	200 tests
Average Throughput (kbps)	**7 592**
Max throughput (kbps)	**14 580**

	viva
FTP UL	200 tests
Average Throughput (kbps)	**1 492**
Max throughput (kbps)	**2 281**



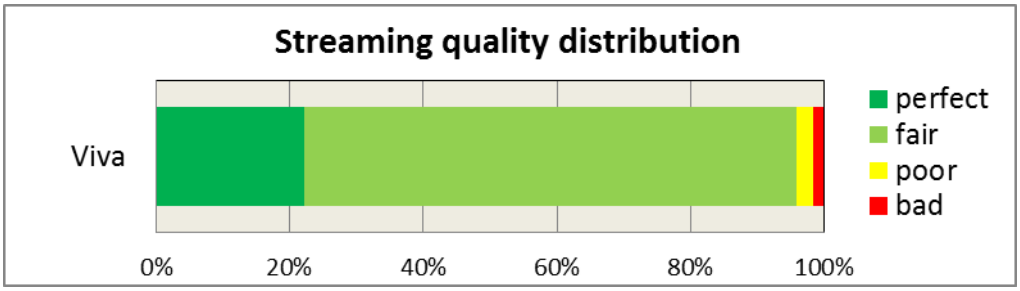
	viva
HTTP DL	200 tests
Average Throughput (kbps)	**6 016**
Max throughput (kbps)	**12 932**

	viva
HTTP UL	200 tests
Average Throughput (kbps)	**1 245**
Max throughput (kbps)	**2 198**



6.3.5 Streaming Results

	VIVA
LHV : % of videos set-up and held for 2 min	97%
statistical accuracy	2.3%
VPQR : % of videos set-up, held for 2 min, and marked 4	22%
statistical accuracy	5.3%
VCQR : % of videos set-up, held for 2 min, and marked 3 or 4	96%
statistical accuracy	2.5%
Average delay	7
Minimum delay	3



6.3.6 Data Coverage

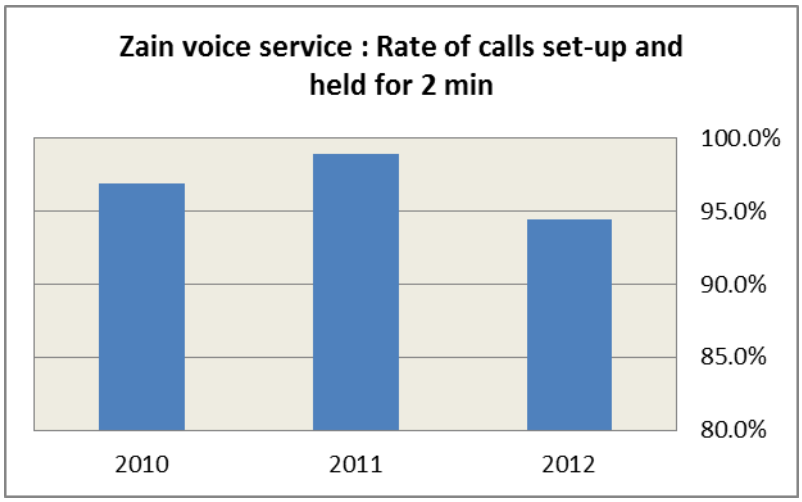
	VIVA
Network technology distribution	3 259 tests
EDGE	**6%**
statistical accuracy	0.8%
HDSPA	**94%**
statistical accuracy	0.8%
UMTS	**0.0%**
statistical accuracy	0.0%
HSDPA 2011	**99%**

This table provides the technology breakdown used by Mobile Operators as recorded during measurements. These samples have been taken in towns and on road links. They are shown as contextual information at the time of the audit. The KPIs provided are representative of user experience and are affected by temporary breakdowns and congestion. Thus, one has to keep in mind that such figures might not be the exact reflection of the effective deployment of antennas by operators.

6.4 Zain results

6.4.1 Global voice results (Cities & Road links)

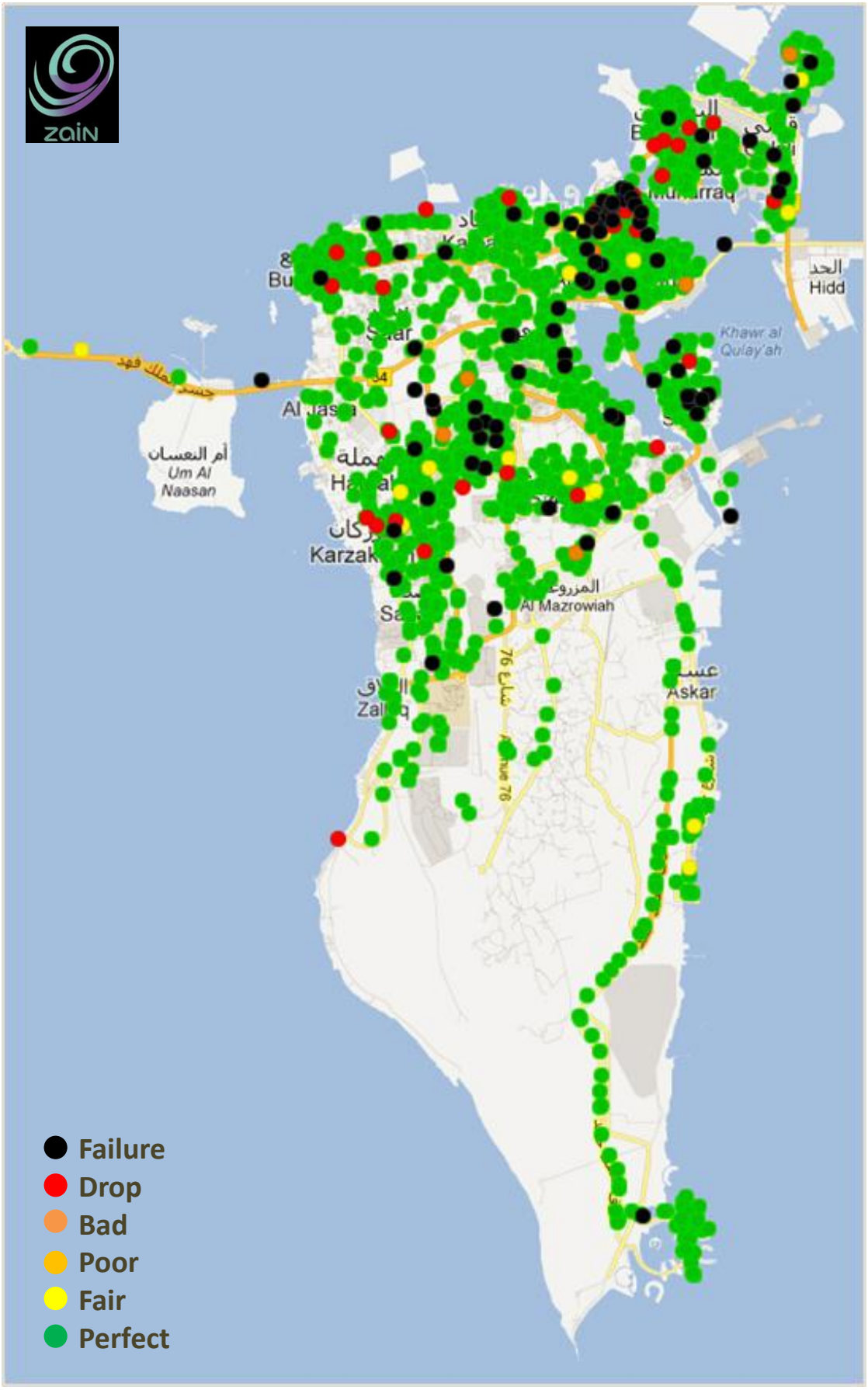
		ZAIN
Global voice service		2 279 tests
Rate of calls set-up and held for 2 min		**94.4%**
statistical accuracy		1.0%
and marked	**Rate of calls marked 4-perfect (PQR)**	**93.3%**
	statistical accuracy	1.1%
	Rate of calls marked 4-perfect or 3-fair (CQR)	**94.1%**
	statistical accuracy	1.0%



		ZAIN
Cities voice service (incar, outdoor, indoor)		1 967 tests
Rate of calls set-up and held for 2 min		**94.6%**
statistical accuracy		1.0%
and marked	**4-perfect (PQR)**	**93.5%**
	statistical accuracy	1.1%
	4-perfect or 3-fair (CQR)	**94.3%**
	statistical accuracy	1.0%

		ZAIN
Cities voice service (incar only)		956 tests
Rate of calls set-up and held for 2 min		**94.2%**
statistical accuracy		1.5%
and marked	**4-perfect (PQR)**	**92.8%**
	statistical accuracy	1.6%
	4-perfect or 3-fair (CQR)	**93.8%**
	statistical accuracy	1.5%

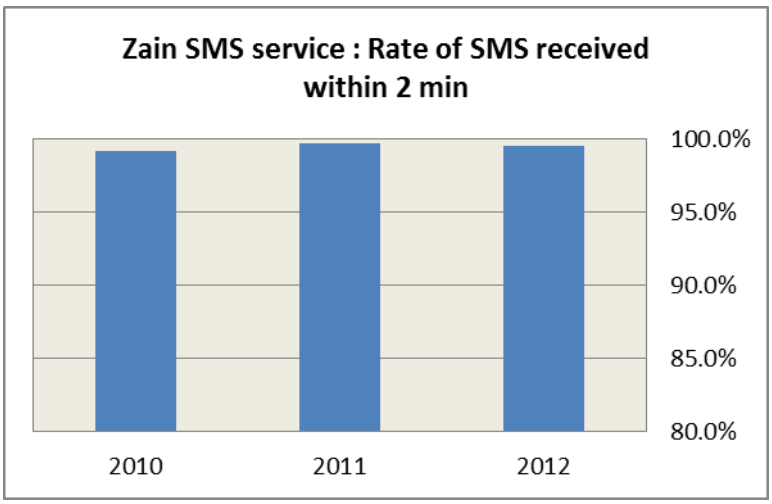
		ZAIN
Road links service		312 tests
Rate of calls set-up and held for 2 min		**93.3%**
statistical accuracy		1.1%
and marked	**4-perfect (PQR)**	**92.0%**
	statistical accuracy	1.2%
	4-perfect or 3-fair (CQR)	**92.6%**
	statistical accuracy	1.2%



ZAIN Global voice results

6.4.2 SMS results

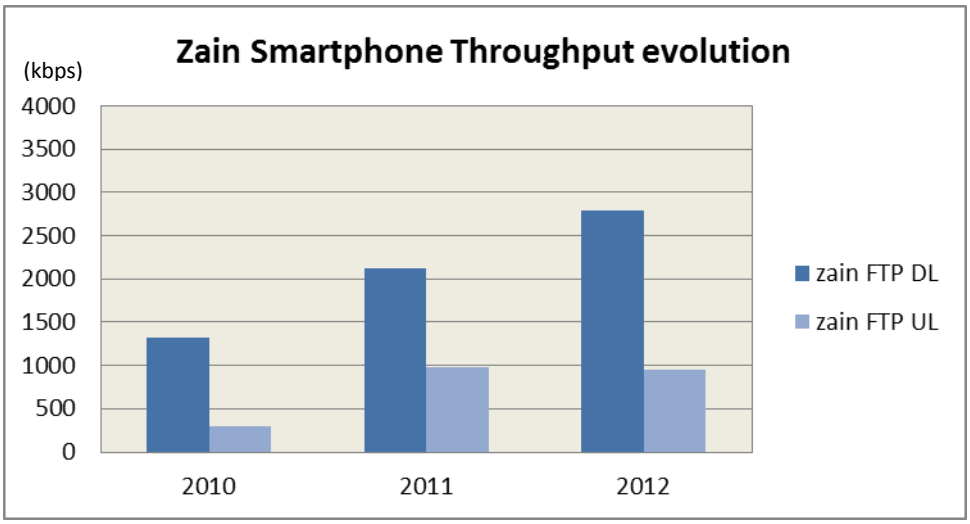
	ZAIN
SMS service	707 tests
% of received SMS (RS2)	**99.6%**
Statistical accuracy	0.5%
% of received SMS (RS30)	**99.4%**
Statistical accuracy	0.6%
% of received SMS (RS15)	**92.1%**
Statistical accuracy	2.0%
Average reception delay (s)	**8**



6.4.3 Data smartphone results

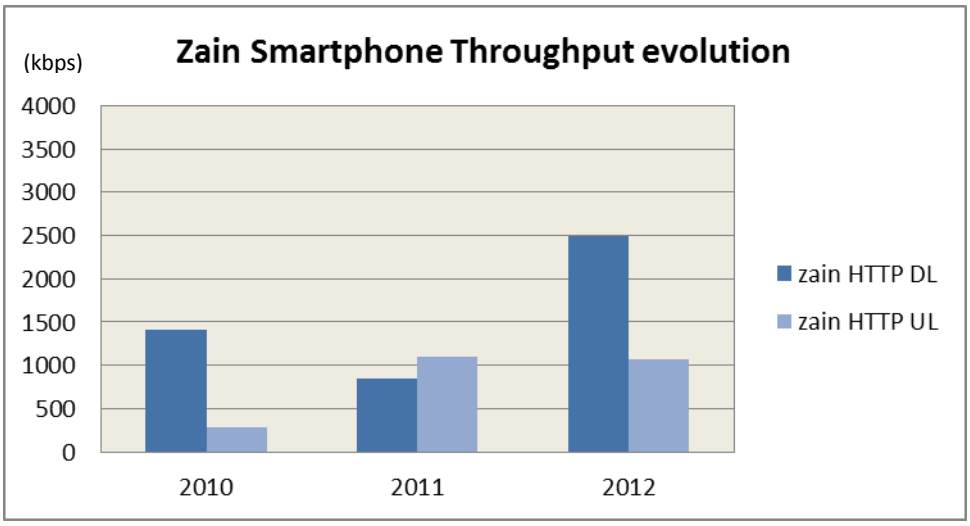
	ZAIN
FTP DL	601 tests
Rate of successful data transfers	**98.5%**
Statistical accuracy	1.0%
Average Throughput (kbps)	**2864**
Max throughput (kbps)	**6704**
Standard deviation throughput (kbps)	1371

	ZAIN
FTP UL	524 tests
Rate of successful data transfers	**99.2%**
Statistical accuracy	0.7%
Average Throughput (kbps)	**956**
Max throughput (kbps)	**1697**
Standard deviation throughput (kbps)	581



	ZAIN
HTTP DL	600 tests
Rate of successful data transfers Statistical accuracy	**98.8%** 0.9%
Average Throughput (kbps)	**2496**
Max throughput (kbps)	**7441**
Standard deviation throughput (kbps)	1159

	ZAIN
HTTP UL	600 tests
Rate of successful data transfers Statistical accuracy	**97.8%** 1.2%
Average Throughput (kbps)	**1069**
Max throughput (kbps)	**2015**
Standard deviation throughput (kbps)	613



	ZAIN
WEB	1 555 tests
Rate of successful data transfers Statistical accuracy	**99.1%** 0.5%
Average download time (s)	**11.6**
Min download time (s)	**1.7**
Standard deviation download time (s)	11.3

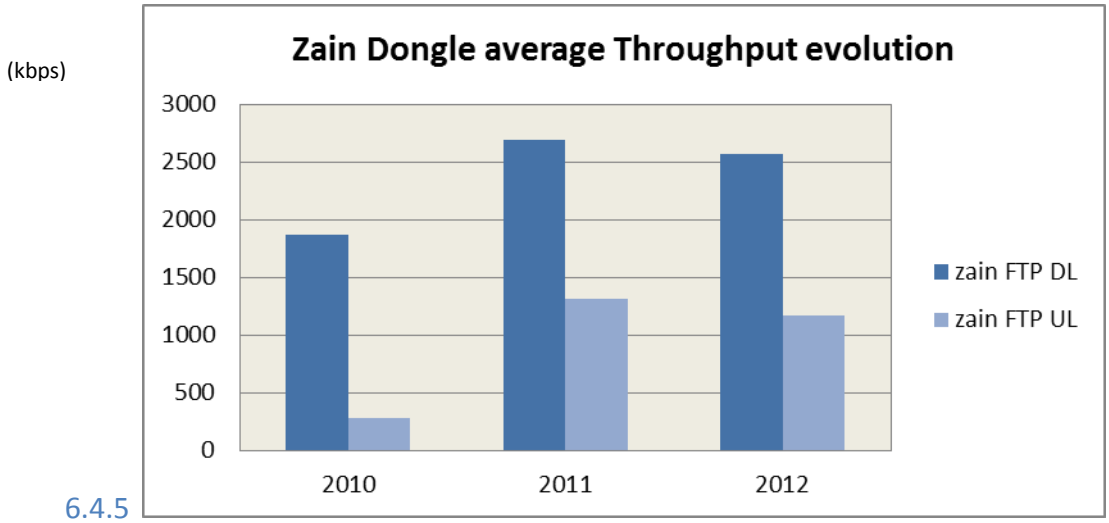
6.4.4 Dongle KPIs

	ZAIN
Dongle connection	712 tests
Rate of successful connections to network	**97.2%**
Statistical accuracy	1.2%
Rate of successful connections within 10s	**79.2%**
Statistical accuracy	3.0%

	ZAIN
FTP DL	200 tests
Average Throughput (kbps)	**2 572**
Max throughput (kbps)	**4 482**

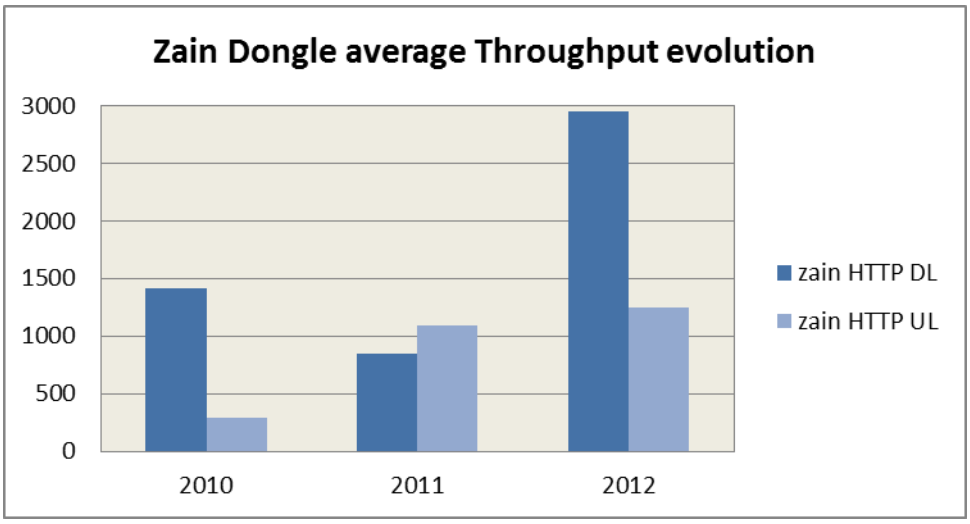
	ZAIN
FTP UL	200 tests
Average Throughput (kbps)	**1 173**
Max throughput (kbps)	**1 715**

6.4.5



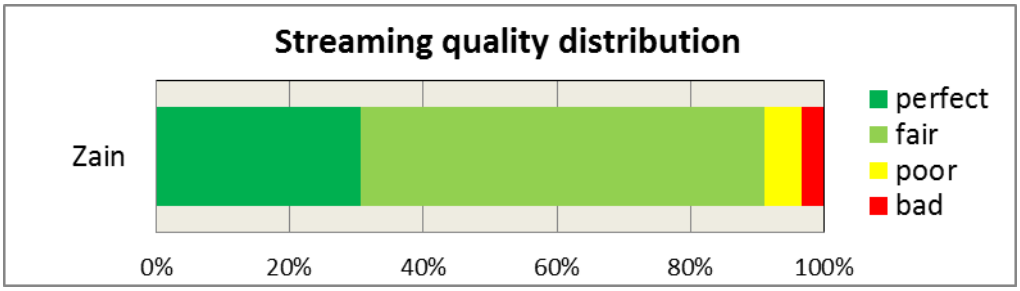
	ZAIN
HTTP DL	200 tests
Average Throughput (kbps)	**2 948**
Max throughput (kbps)	**3 755**

	ZAIN
HTTP UL	200 tests
Average Throughput (kbps)	**1 248**
Max throughput (kbps)	**1 667**



6.4.6 Streaming Results

	ZAIN
LHV : % of videos set-up and held for 2 min	93%
statistical accuracy	3.2%
VPQR : % of videos set-up, held for 2 min, and marked 4	31%
statistical accuracy	5.8%
VCQR : % of videos set-up, held for 2 min, and marked 3 or 4	91%
statistical accuracy	3.6%
Average delay	9
Minimum delay	3



6.4.7 Data Coverage

	ZAIN
Network technology distribution	2 758 tests
EDGE	**2%**
statistical accuracy	0.4%
HDSPA	**90%**
statistical accuracy	1.2%
UMTS	**8%**
statistical accuracy	1.2%
HSDPA 2011	**94%**

This table provides the technology breakdown used by Mobile Operators as recorded during measurements. These samples have been taken in towns and on road links. They are shown as contextual information at the time of the audit. The KPIs provided are representative of user experience and are affected by temporary breakdowns and congestion. Thus, one has to keep in mind that such figures might not be the exact reflection of the effective deployment of antennas by operators.

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