Directique
Customer Quality Perspectives

هيئة تنظيم الاتصالات
Telecommunications Regulatory Authority

Quality of Mobile Services

Kingdom of Bahrain - 2014

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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

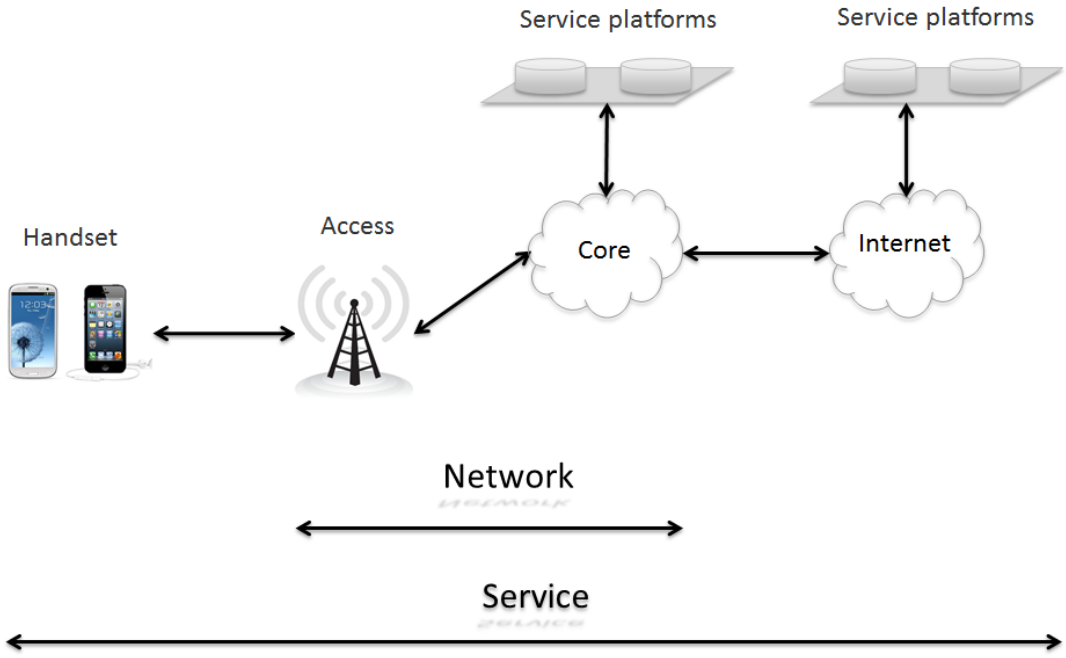
This audit is a benchmark focused on qualitative assessment of the end to end service provided from the user point of view.

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, HTTP file transfers)
- Smartphones data tests on hotspots (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.

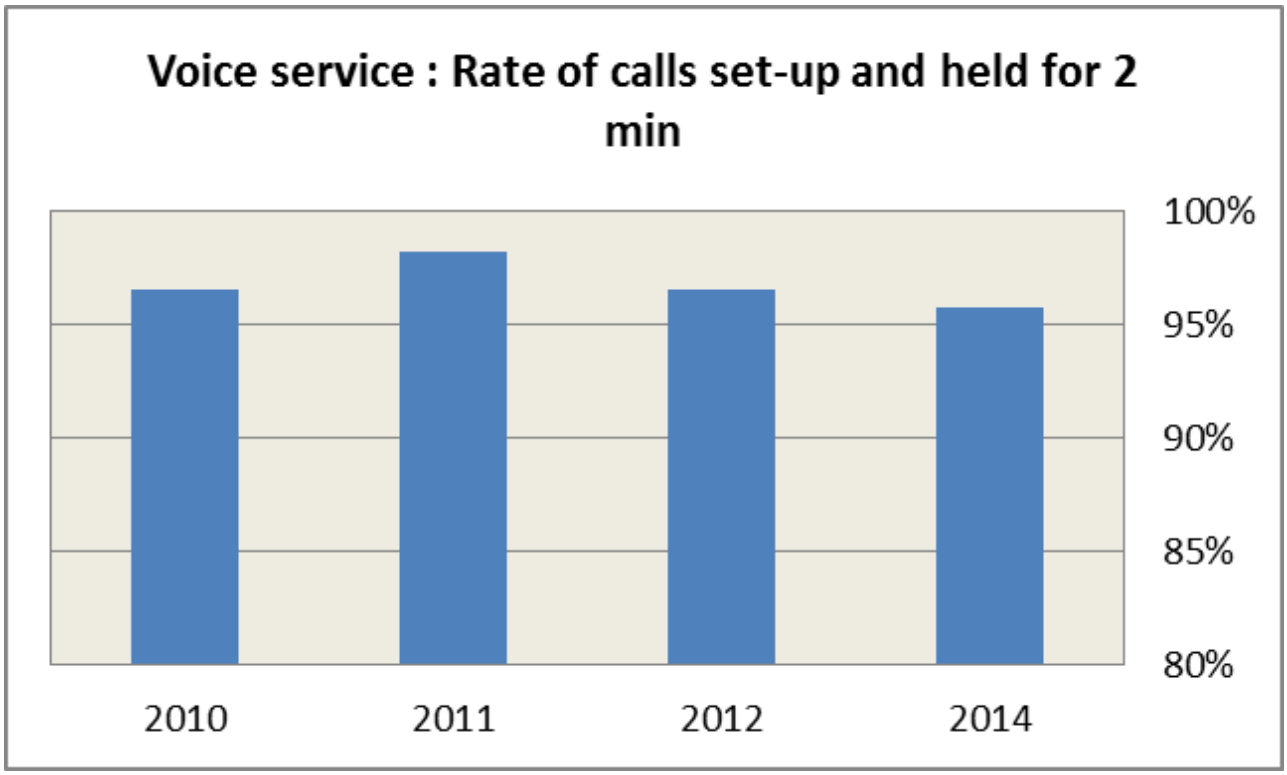
This QoS audit was conducted from 2nd June 2014 to 2nd July 2014 inclusive. Measurements were performed between 9:00 am and 10:00 pm every day except Saturdays.

3.2 Industry results

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

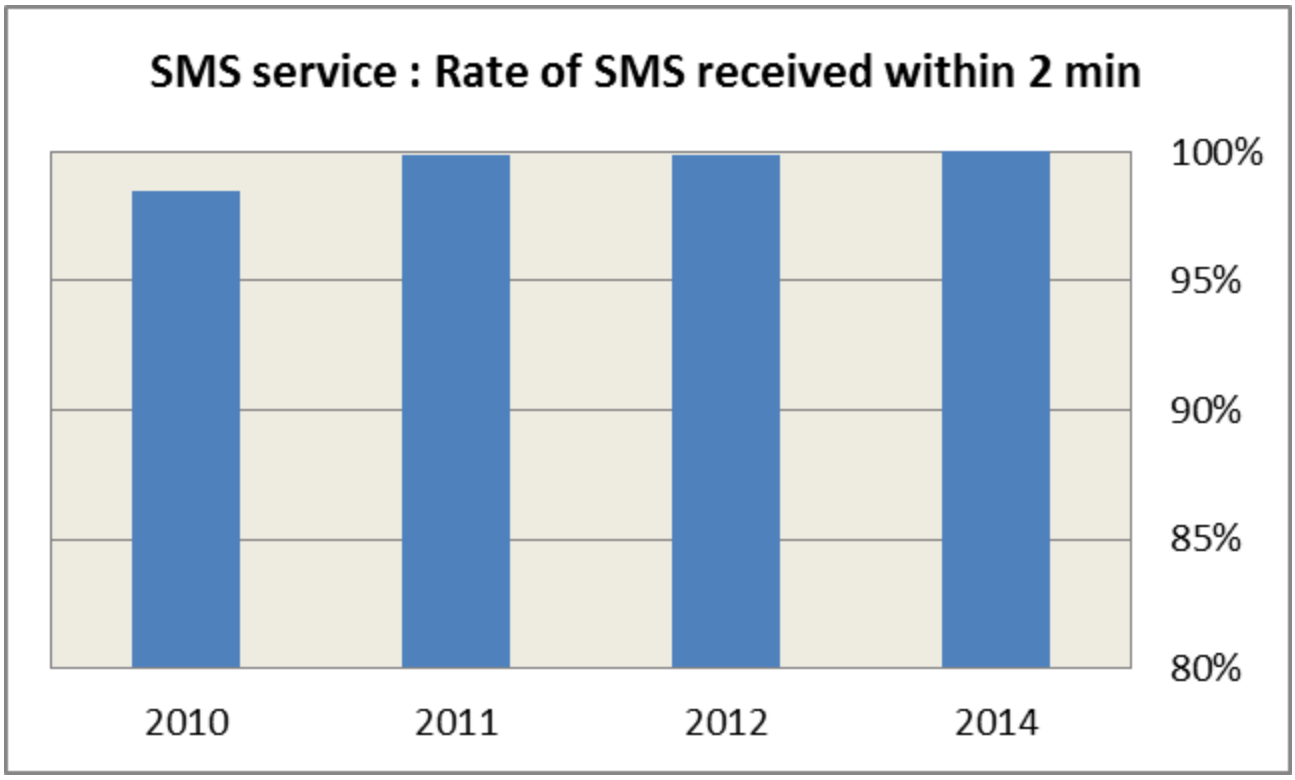
3.2.1 Voice and messaging services

		2014	2012	2011	2010
Global voice service		6 673 tests	6 828 tests	6 822 tests	7 059 tests
Rate of calls set-up and held for 2 min (SHR)		**95.8%**	**96.6%**	**98.2%**	**96.6%**
	statistical accuracy	0.5%	0.4%	0.3%	0.4%
and marked	**4-perfect (PQR)**	**93.8%**	**94.1%**	**94.5%**	**94.1%**
	statistical accuracy	0.6%	0.6%	0.5%	0.5%
	4-perfect or 3-fair (CQR)	**95.0%**	**96.2%**	**97.2%**	**95.7%**
	statistical accuracy	0.5%	0.5%	0.4%	0.5%



The three networks offered a good service with an average setup and held calls rate of 95.8%. . However, this rate has been declining since 2011.

	2014	2012	2011	2010
SMS service	4 547 tests	2 637 tests	3 096 tests	1 569 tests
% of received SMS (RS2)	**99.9%**	99.6%	99.7%	99.2%
Statistical accuracy	0.1%	0.2%	0.2%	0.4%
% of received SMS (RS30)	**98.3%**	99.3%	99.3%	96.9%
Statistical accuracy	0.4%	0.3%	0.3%	0.9%
% of received SMS (RS15)	**91.5%**	96.5%	97.5%	
Statistical accuracy	0.8%	0.7%	0.5%	
Average reception delay (s)	**7**	8	10	13



All networks offered very good SMS service within two minutes with 0.1% defects.

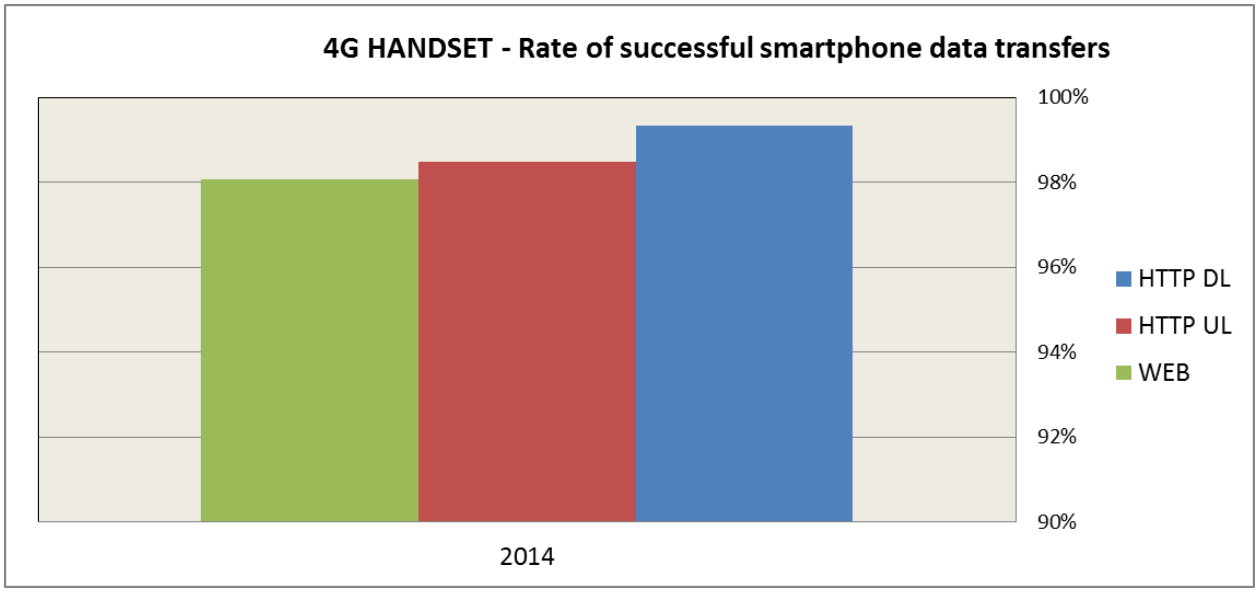
The average observed SMS reception delay was below 7 seconds

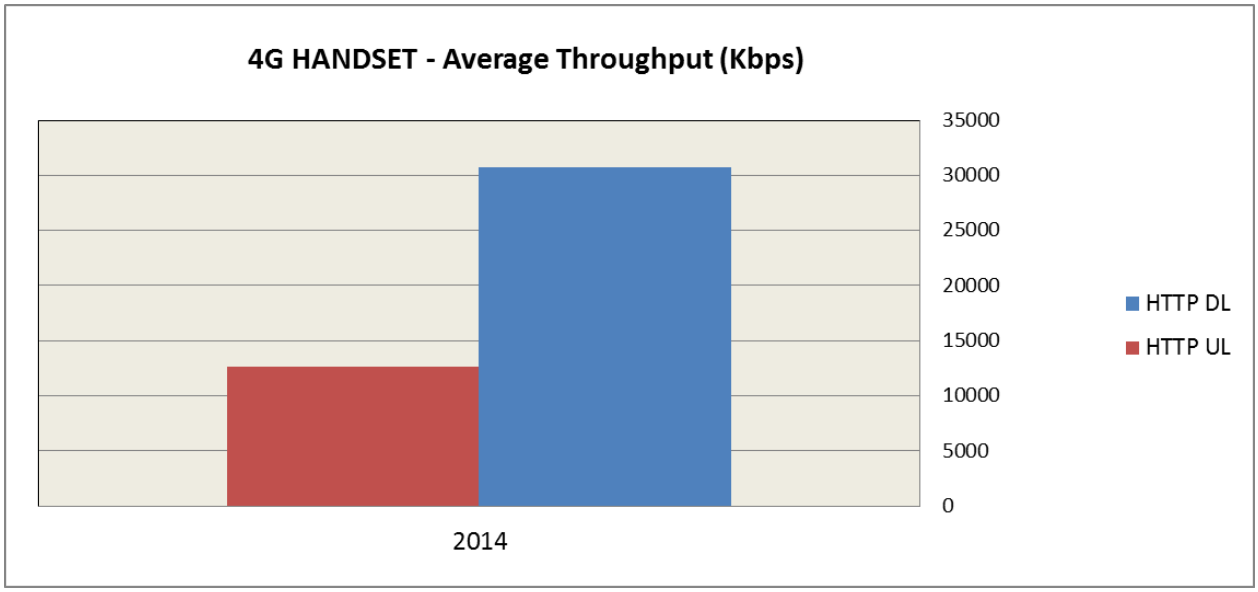
3.2.2 Smartphone data measurements

4G HANDSET :

For the first time, data measurements were leaded on all operators' LTE network:

Rate of successful smartphone data transfers	2014
HTTP DL statistical accuracy	**99.2%** 0.5%
HTTP UL statistical accuracy	**98.4%** 0.9%
WEB statistical accuracy	**97.7%** 0.5%

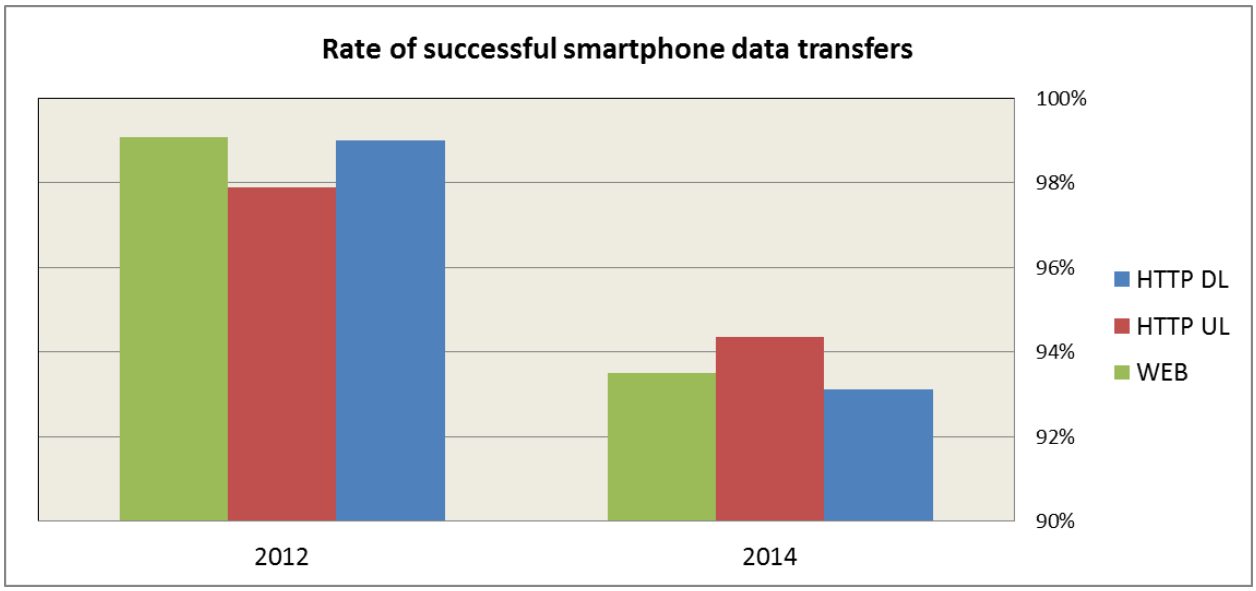




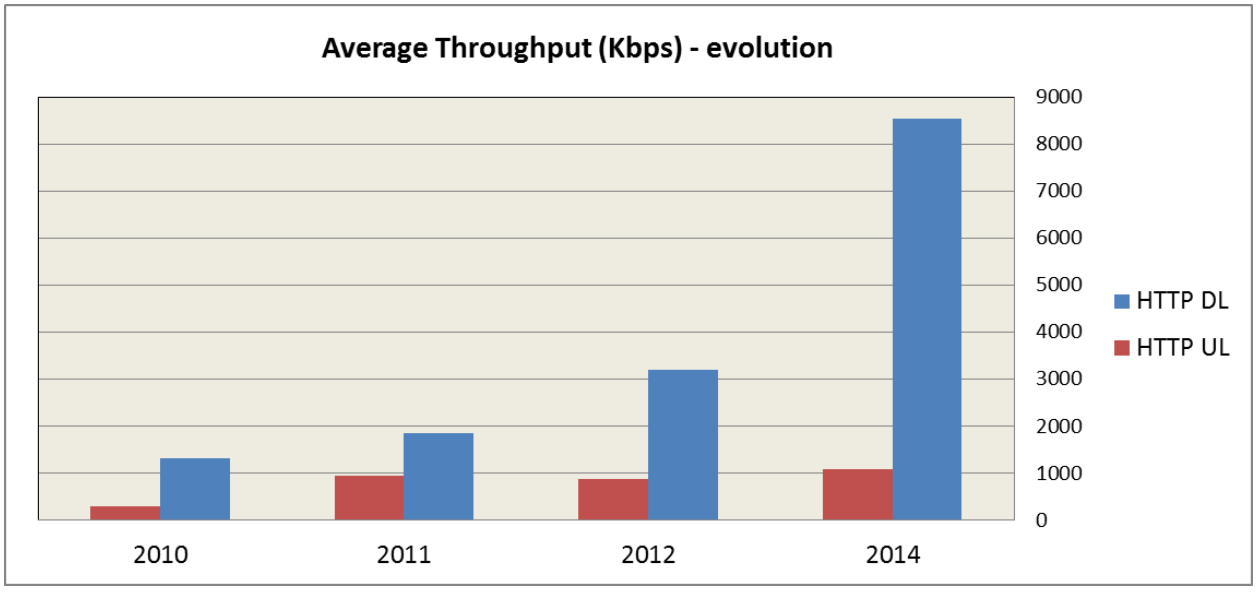
3G HANDSET :

Rate of successful smartphone data transfers	2014	2012
HTTP DL	**92.7%**	**99.0%**
statistical accuracy	1.7%	0.5%
HTTP UL	**94.3%**	**97.9%**
statistical accuracy	1.7%	0.7%
WEB	**93.3%**	**99.1%**
statistical accuracy	0.8%	0.1%

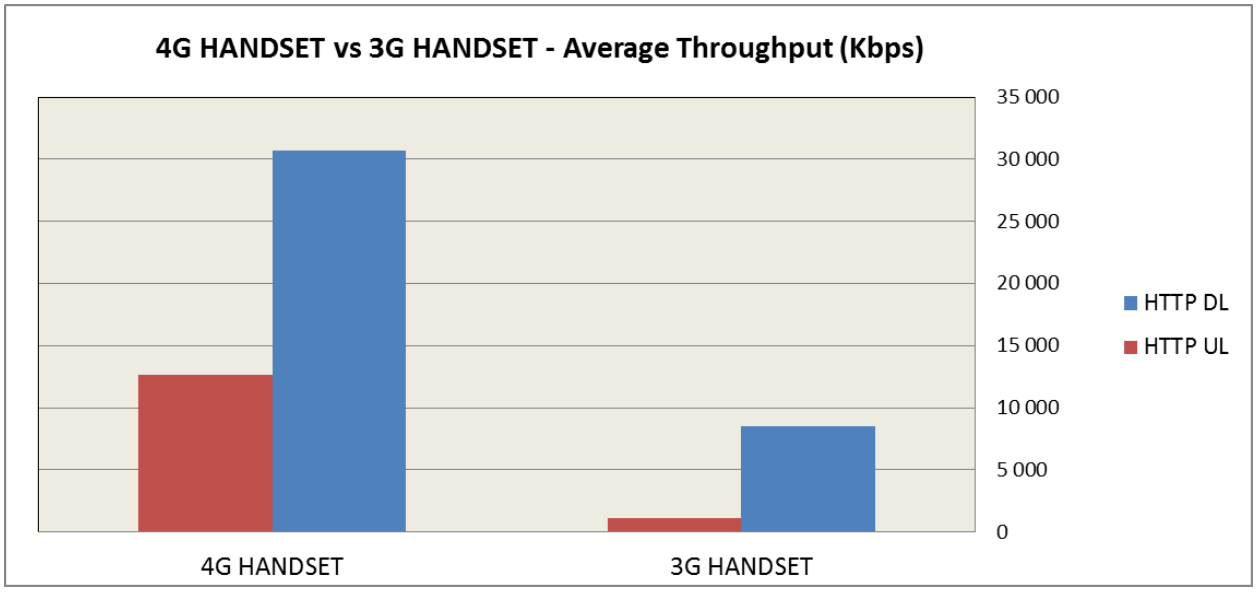
Compared to previous year, the rate of successful transfer is significantly lower.



On the other hand, the average throughput available on the downlink has significantly increased between 2012 and 2014 :



4G HANDSET vs 3G HANDSET

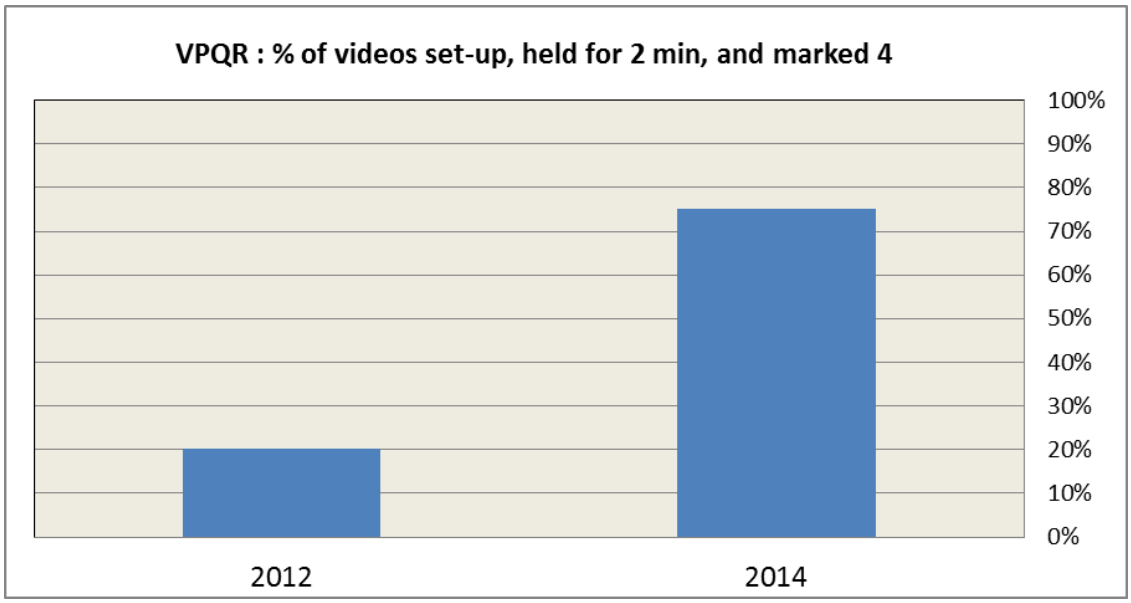


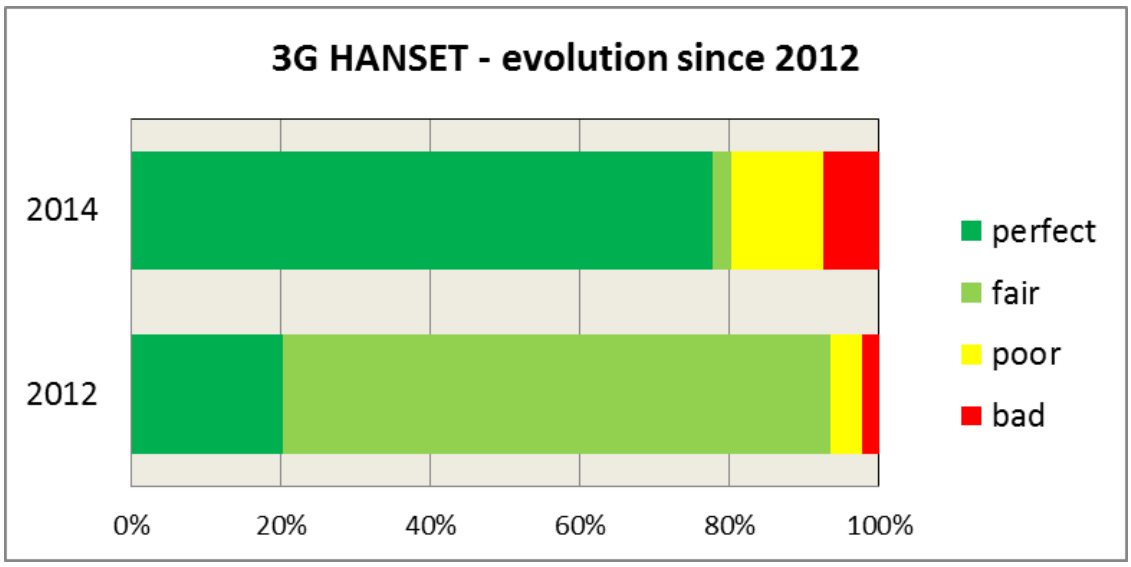
3.2.3 Streaming measurements

3G HANDSET

	2014	2012
LHV : % of calls set-up and held for 2 min	92%	95%
statistical accuracy	2.3%	3.1%
VPQR : % of calls set-up, held for 2 min, and marked 4	75%	20%
statistical accuracy	3.7%	5.7%
VCQR : % of calls set-up, held for 2 min, and marked 3 or 4	78%	93%
statistical accuracy	3.6%	3.5%
Average delay	5	9
Minimum delay	1	3

In comparison with 2012, quality of the video has significantly improved, as the rate of perfect sessions is now 75%.

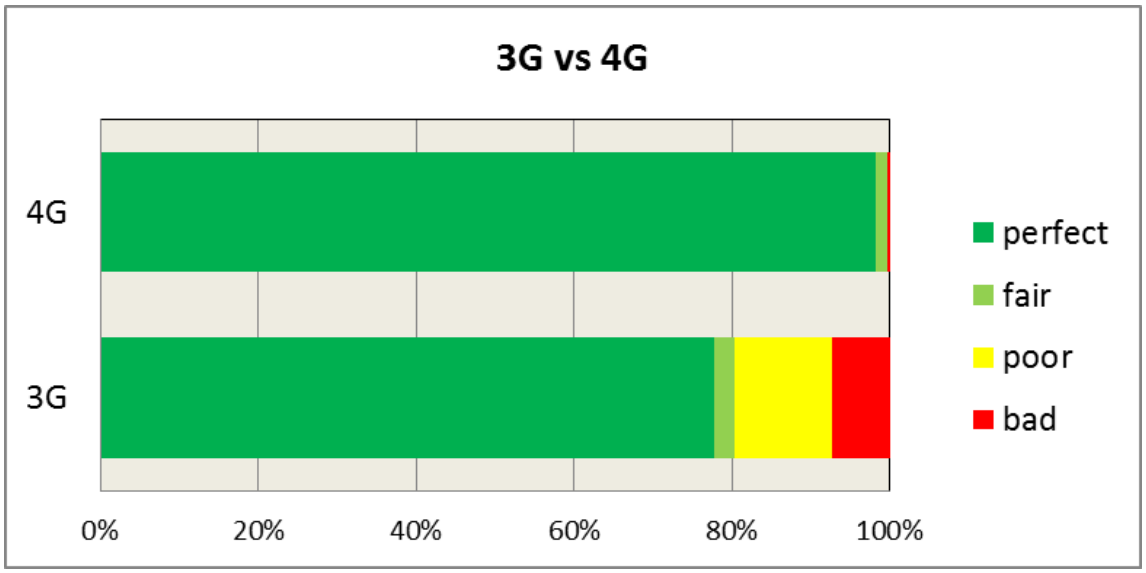




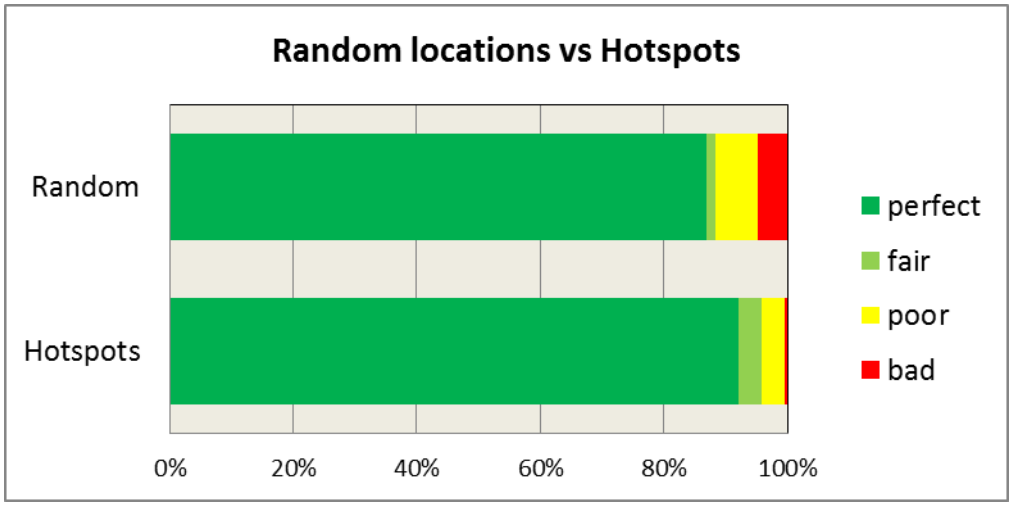
4G HANDSET

	2014
LHV : % of calls set-up and held for 2 min	97%
statistical accuracy	1.4%
VPQR : % of calls set-up, held for 2 min, and marked 4	96%
statistical accuracy	1.7%
VCQR : % of calls set-up, held for 2 min, and marked 3 or 4	93%
statistical accuracy	2.1%
Average delay	3
Minimum delay	1
sample	513

4G improves significantly the quality of video:



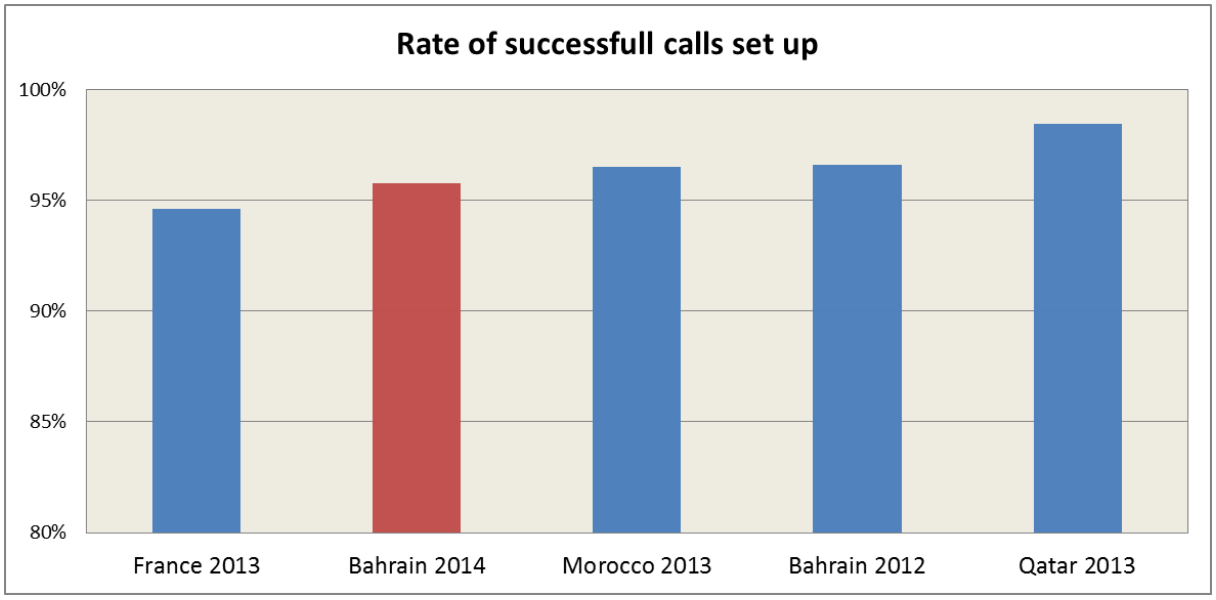
As expected, measurements carried out under better network conditions tend to present better results:

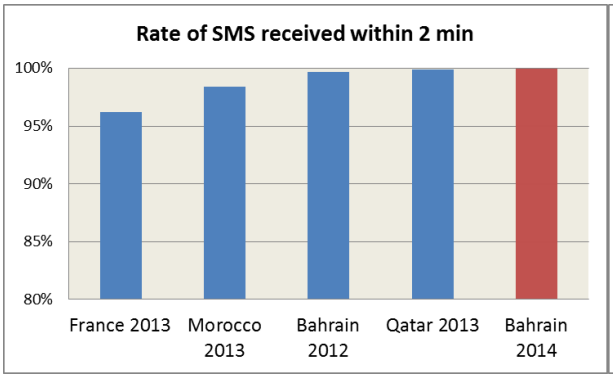


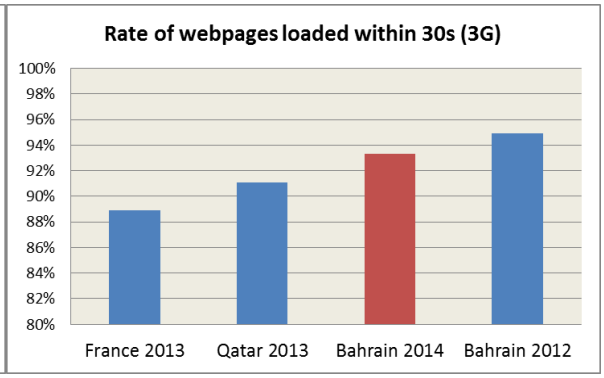
4 BENCHMARK TO REFERENCE OPERATORS

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	Data/Video
BATELCO	Samsung Galaxy S4	BATELCO	Samsung Note3
ZAIN			
VIVA			

All devices were compatible with voice, SMS and data technologies and were recommended or sold by Mobile Operators for 2G, 3G and 4G 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.

	Type	Distribution	BATELCO	VIVA	ZAIN
VOICE & SMS	Prepaid	50%	SimSim	Viva prepaid	EasyTalk
	Postpaid	50%	Smart 30	VIVA Postpaid 20 Basic	Hewar 3000
DATA	Postpaid 3G	50%	20GB	35 BD/month	Data 15GB
	Postpaid 4G	50%	50GB FUP	35 BD/month	Data 15GB
Coverage	Postpaid 3G	50%	20GB	35 BD/month	Data 15GB
	Postpaid 4G	50%	50GB FUP	35 BD/month	Data 15GB

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:

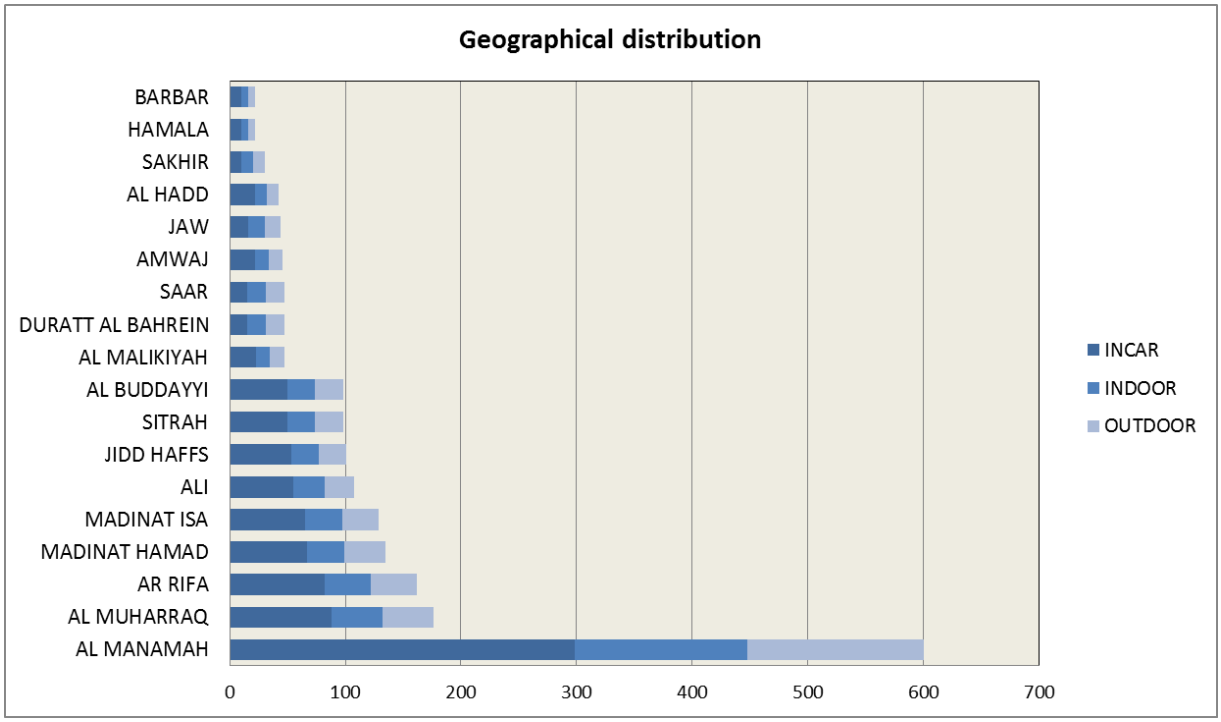
Failed and dropped calls were registered in the database. Otherwise the audio quality was evaluated for established and 2 minutes maintained calls. Once a call was established, engineers followed a speech guideline, simulating an average conversation, and audio quality was marked on a scale of 1 to 4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

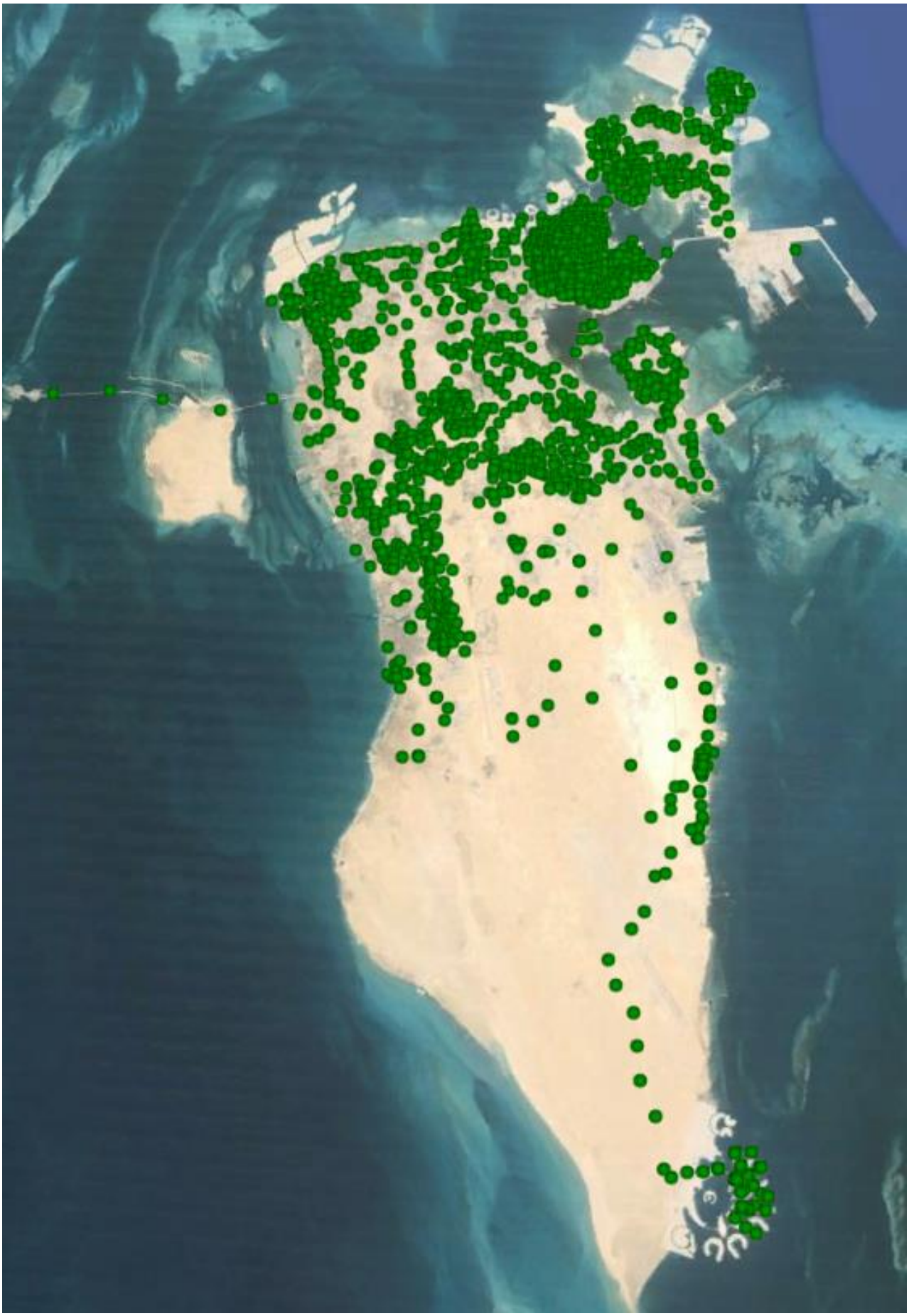
Sampling distribution between towns was based on population data and organized as follow:



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 ...)

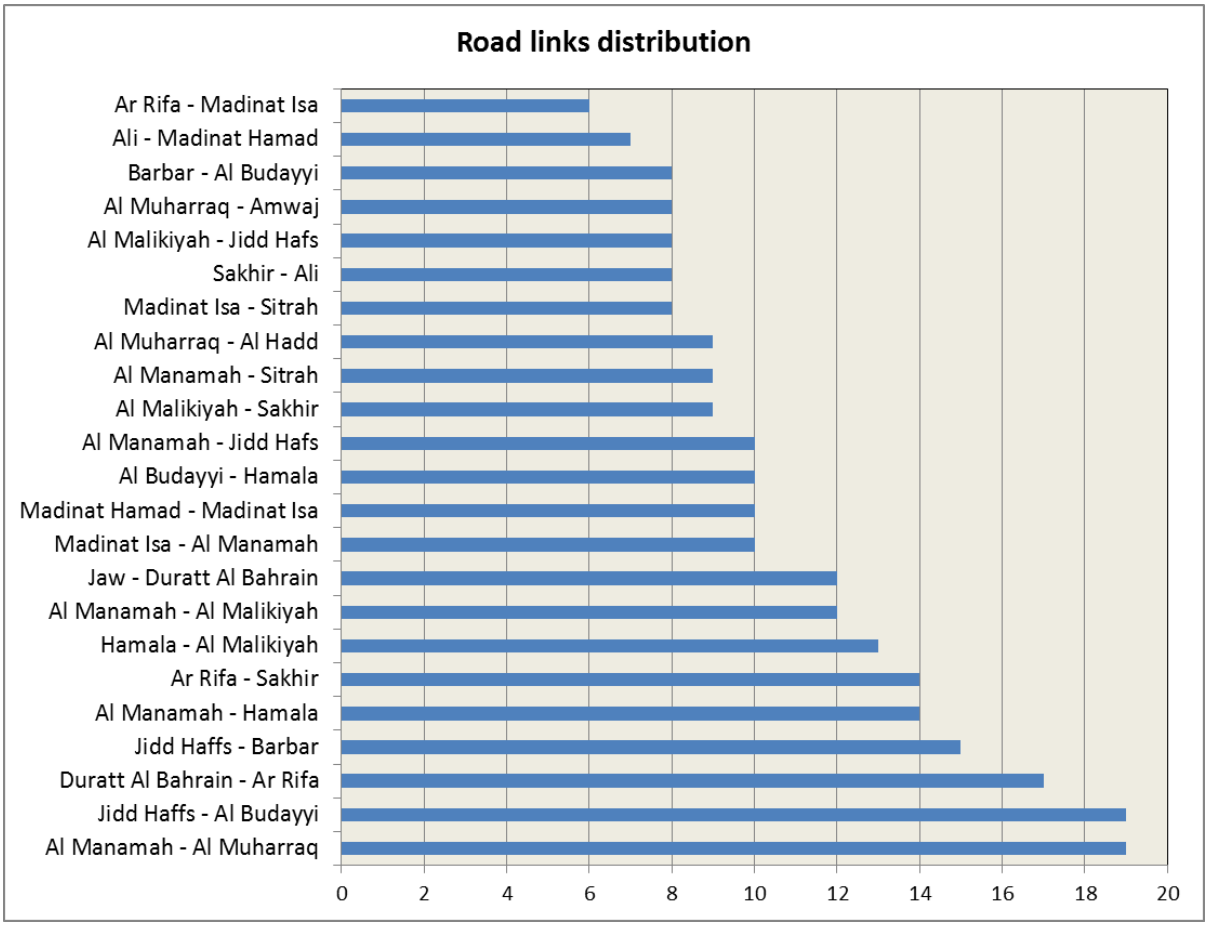
- Pedestrian indoor measurements

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 Description

Data measurements are spread between hotspots and random places.

There will not be any measurements with dongles on laptops in 2014, as they will be replaced by 4G measurements on smartphone.

Tests on 3G-smartphone and 4G smartphone will be done simultaneously on every location, under the condition that operators provide test servers with sufficient bandwidth (100Mb/s).

Tests matrix:

		3G - Smartphone	4G - Smartphone	Dongle
RANDOM	**FTP/HTTP/WEB**	✓	✓	
	Video streaming	✓	✓	
HOTSPOTS	**FTP/HTTP/WEB**	✓	✓	
	Video streaming	✓	✓	

5.4.2 HTTP transfer Measurement

On each network, a measurement consists of:

- Downloading a file* through HTTP. Time for downloading the entire file is recorded
- Uploading a file* through HTTP. Time for uploading the entire file is recorded

* File sizes are different depending on the technology:

- 3G : 20MB for DL / 1MB for UL
- 4G : 20MB and 50MB for DL / 1MB and 10MB for UL

Test servers, with sufficient bandwidth (100Mb/s), have been provided by the operators.

Data measurements were carried out automatically via ***Mobispeed*** ©, our data test app.

5.4.3 WEB Measurements

WEB measurements were carried out automatically via ***Mobispeed*** ©, our data test app.

On each network, a measurement consists of downloading one of the 10 most visited public homepages and one page from each Operator, taking note of completion time, errors on the page if any, with a 30 seconds timeout.

The list of websites to be tested has been confirmed with MNOs.

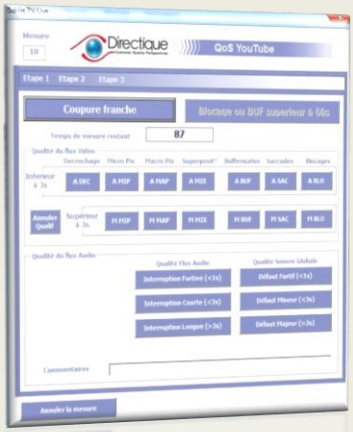
BATELCO	ZAIN	VIVA
http://portal.batelco.com/	http://www.bh.zain.com/ZainPortal/Zain_Home_Integrated.jsp	http://www.viva.com.bh/
http://m.facebook.com/		
http://www.google.com/		
http://m.youtube.com		
http://www.live.com/		
http://m.yahoo.com/		
http://www.wikipedia.org/		
http://www.apple.com/		
http://www.arabia.msn.com/		
http://m.vuclip.com/		

List of webpages tested

5.4.4 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.

5.4.5 Sample

CITY	HTTP DL	HTTP UL	HTTP PING	WEB	Total
Al Budayyi	72	72	36	280	460
Al Hadd	54	54	27	270	405
Al Malikiyah	42	42	21	210	315
Al Manamah	604	604	302	2890	4400
Al Muharraq	160	160	80	739	1139
Ali	74	74	37	370	555
Amwaj	67	68	33	335	503
Ar Rifa	168	167	84	839	1258
Barbar	12	12	6	40	70
Duratt Al Bahrein	68	68	34	303	473
Hamala	12	12	6	60	90
Jaww	48	48	24	216	336
Jidd Hafs	138	138	69	498	843
Madinat Hamad	124	124	62	621	931
Madinat Isa	190	190	95	959	1434
Saar	76	76	38	200	390
Sakhir	72	72	36	360	540
Sitrah	84	84	42	420	630

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 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

6.1.4 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

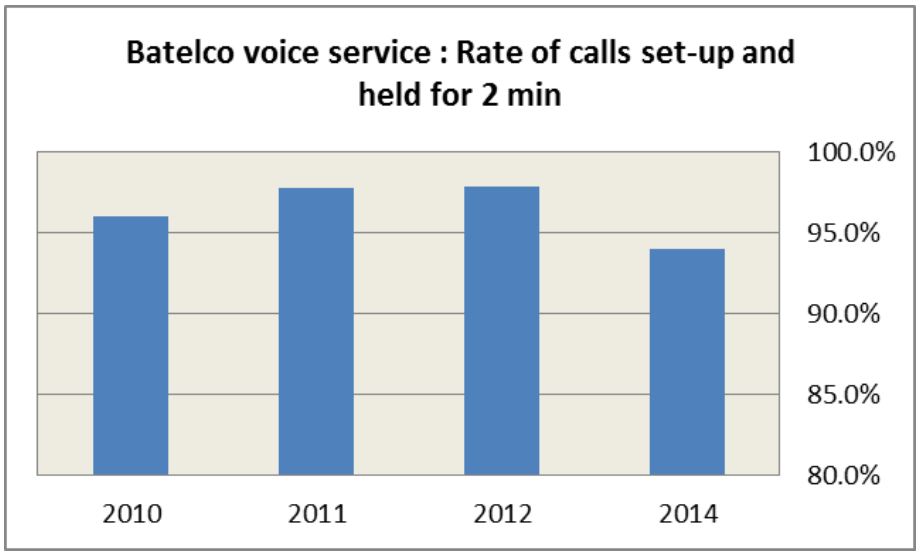
6.1.5 HTTP

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)

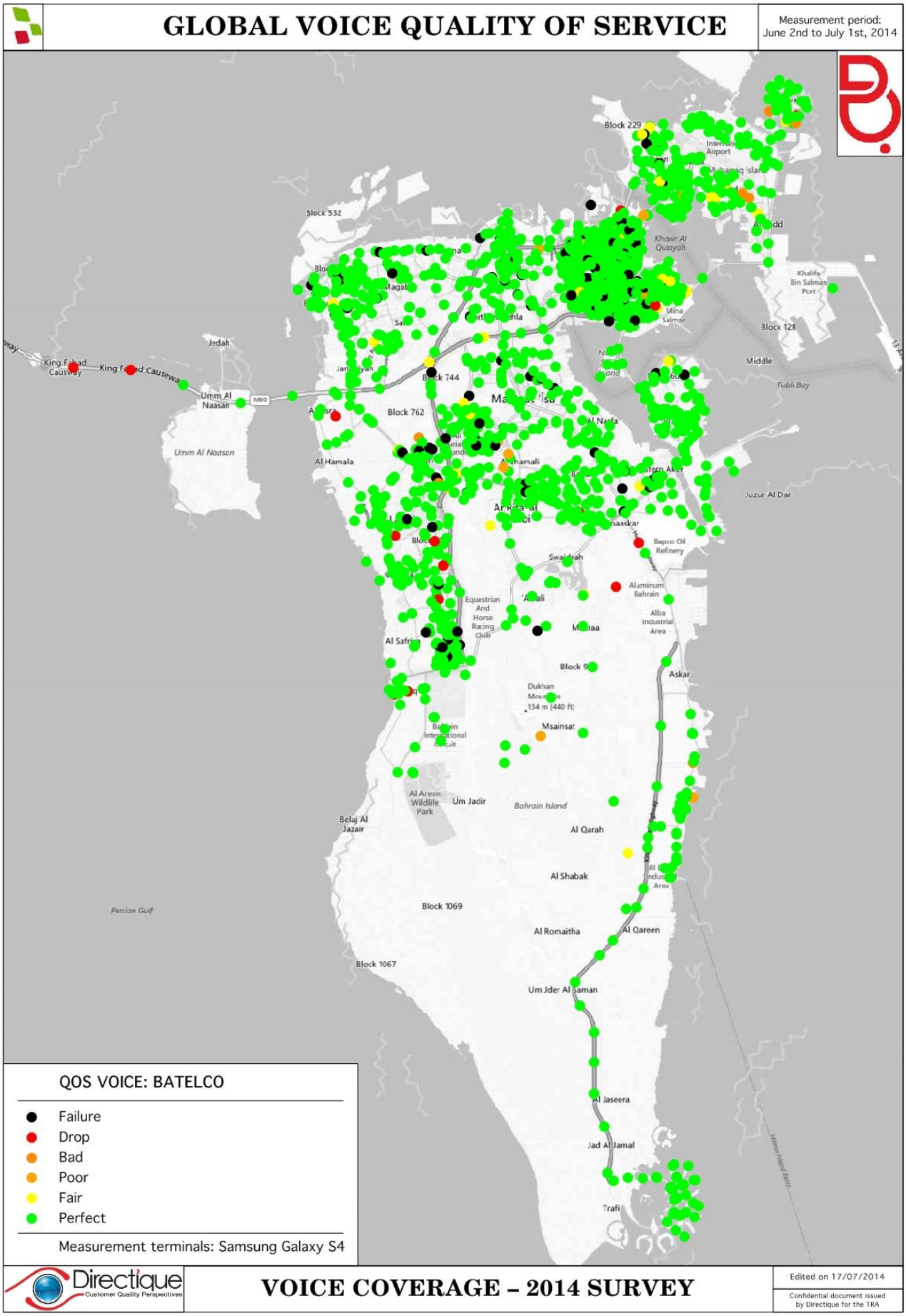
		Batelco
Global voice service		2 225 tests
Rate of calls set-up and held for 2 min		**94.0%**
statistical accuracy		1.0%
and marked	**Rate of calls marked 4-perfect (PQR)**	**90.3%**
	statistical accuracy	1.2%
	Rate of calls marked 4-perfect or 3-fair (CQR)	**92.5%**
	statistical accuracy	0.7%



		Batelco
Cities voice service (incar, outdoor, indoor)		1 954 tests
Rate of calls set-up and held for 2 min		**93.6%**
statistical accuracy		1.0%
and marked	**4-perfect (PQR)**	**89.7%**
	statistical accuracy	1.3%
	4-perfect or 3-fair (CQR)	**92.0%**
	statistical accuracy	1.1%

		Batelco
Cities voice service (incar only)		951 tests
Rate of calls set-up and held for 2 min		**89.7%**
statistical accuracy		1.3%
and marked	**4-perfect (PQR)**	**86.2%**
	statistical accuracy	1.4%
	4-perfect or 3-fair (CQR)	**88.6%**
	statistical accuracy	1.3%

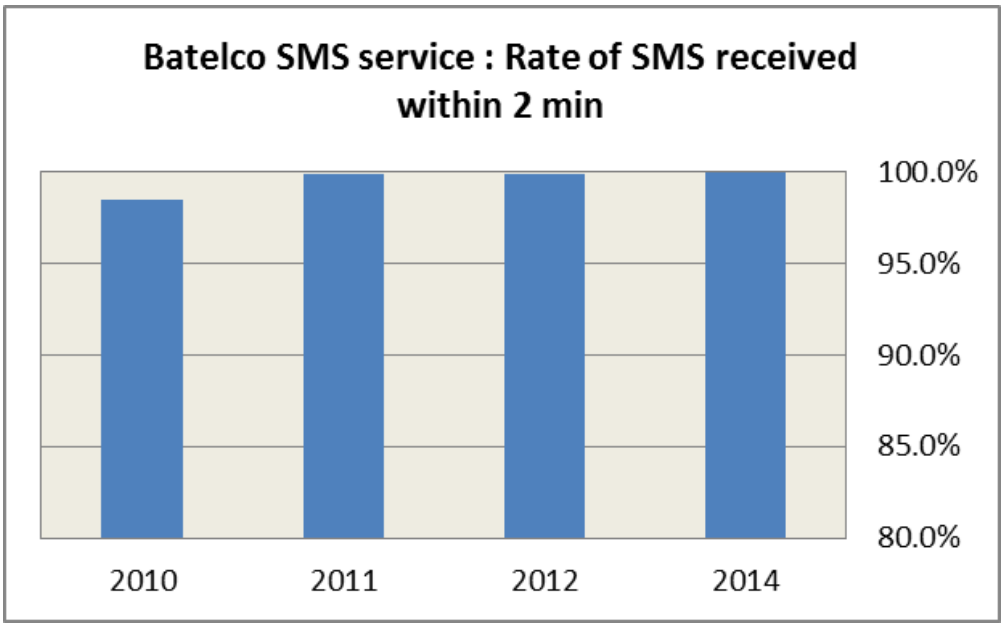
		Batelco
Road links service		271 tests
Rate of calls set-up and held for 2 min		**96.7%**
statistical accuracy		0.7%
and marked	**4-perfect (PQR)**	**95.2%**
	statistical accuracy	0.9%
	4-perfect or 3-fair (CQR)	**96.3%**
	statistical accuracy	0.8%



BATELCO Global voice results

6.2.2 SMS results

	BATELCO
SMS service	1 573 tests
% of received SMS (RS2)	**100.0%**
Statistical accuracy	0.0%
% of received SMS (RS30)	**98.1%**
Statistical accuracy	0.7%
% of received SMS (RS15)	**86.8%**
Statistical accuracy	1.7%
Average reception delay (s)	**8**

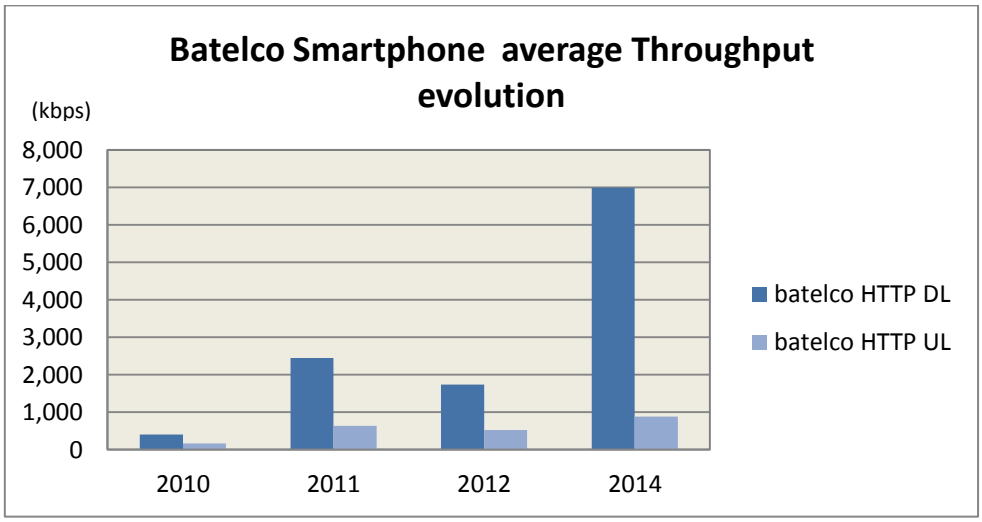


6.2.3 Data smartphone results

6.2.3.1 3G HANDSET

	BATELCO
HTTP DL	536 tests
Rate of successful data transfers Statistical accuracy	**86.9%** 2.6%
Average Throughput (kbps)	**6 692**
Max throughput (kbps)	**21 072**
Standard deviation throughput (kbps)	4 782

	BATELCO
HTTP UL	611 tests
Rate of successful data transfers Statistical accuracy	**94.3%** 1.8%
Average Throughput (kbps)	**886**
Max throughput (kbps)	**3 074**
Standard deviation throughput (kbps)	555

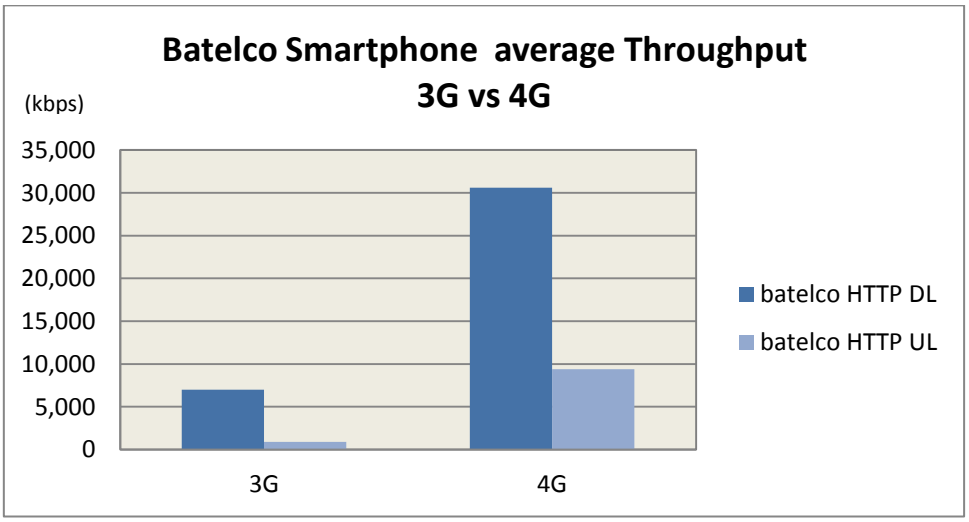


	BATELCO
WEB	2 892 tests
Rate of successful data transfers Statistical accuracy	**92.2%** 0.9%
Average download time (s)	**8.8**
Min download time (s)	**2.3**
Standard deviation download time (s)	4.9

6.2.3.2 4G HANDSET

	BATELCO
HTTP DL	635 tests
Rate of successful data transfers Statistical accuracy	**98.0%** 1.1%
Average Throughput (kbps)	**30 595**
Max throughput (kbps)	**81 120**
Standard deviation throughput (kbps)	14 122

	BATELCO
HTTP UL	633 tests
Rate of successful data transfers Statistical accuracy	**97.7%** 1.2%
Average Throughput (kbps)	**9 370**
Max throughput (kbps)	**12 258**
Standard deviation throughput (kbps)	3 205

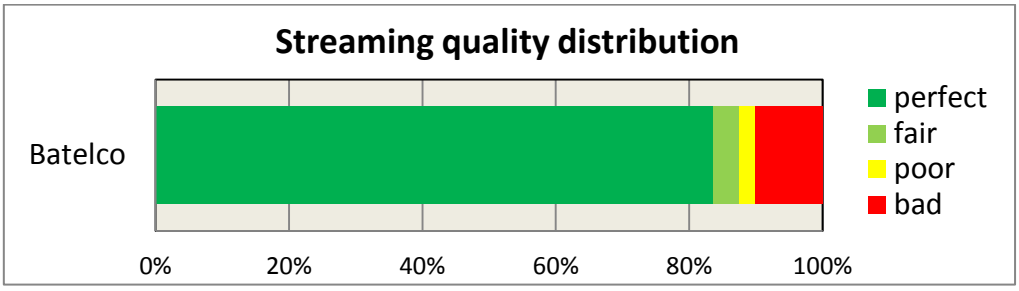


	BATELCO
WEB	3 162 tests
Rate of successful data transfers Statistical accuracy	**99.4%** 0.3%
Average download time (s)	**5.5**
Min download time (s)	**1.3**
Standard deviation download time (s)	3.6

6.2.4 Streaming KPIs

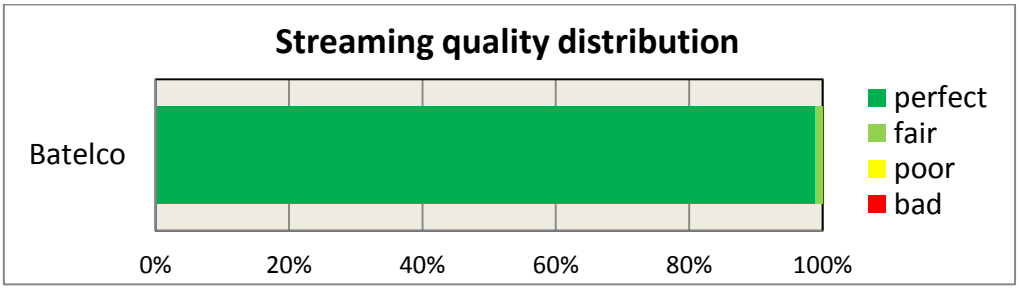
6.2.4.1 3G HANDSET

	BATELCO
LHV : % of videos set-up and held for 2 min statistical accuracy	88% 5.0%
VPQR : % of videos set-up, held for 2 min, and marked 4 statistical accuracy	82% 6.0%
VCQR : % of videos set-up, held for 2 min, and marked 3 or 4 statistical accuracy	86% 5.5%
Average delay	7
Minimum delay	2



6.2.4.2 4G HANDSET

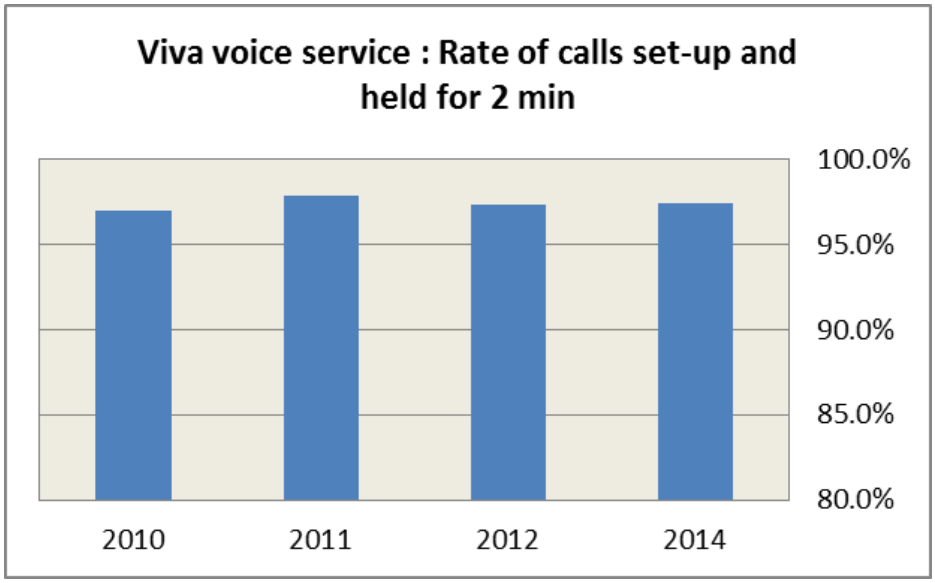
	BATELCO
LHV : % of videos set-up and held for 2 min statistical accuracy	97% 2.7%
VPQR : % of videos set-up, held for 2 min, and marked 4 statistical accuracy	96% 3.0%
VCQR : % of videos set-up, held for 2 min, and marked 3 or 4 statistical accuracy	97% 2.7%
Average delay	3
Minimum delay	1



6.3 Viva results

6.3.1 Global voice results (Cities & Road links)

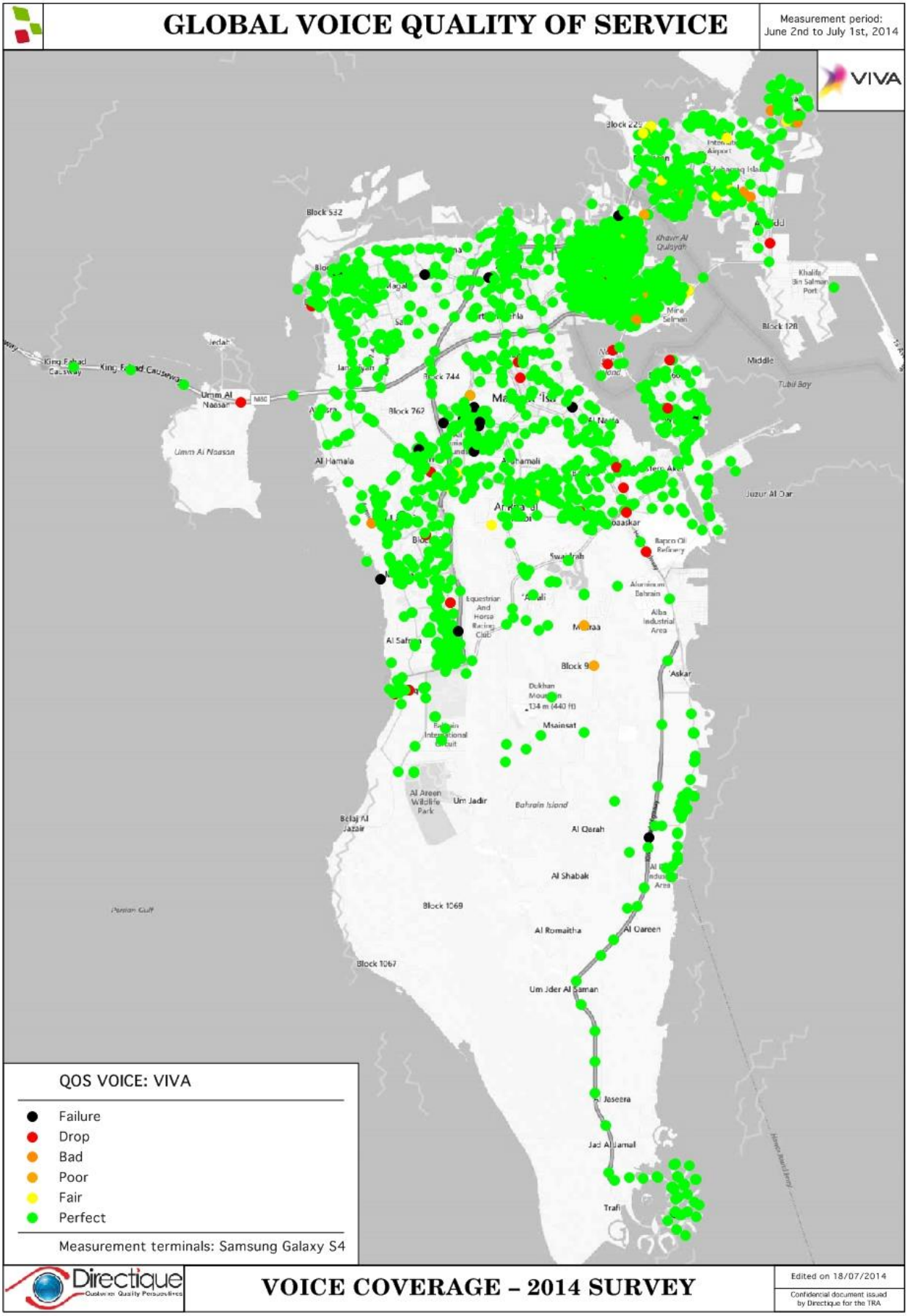
		Viva
Global voice service		2 225 tests
Rate of calls set-up and held for 2 min		**97.4%**
statistical accuracy		0.7%
and marked	**Rate of calls marked 4-perfect (PQR)**	**95.5%**
	statistical accuracy	0.9%
	Rate of calls marked 4-perfect or 3-fair (CQR)	**96.5%**
	statistical accuracy	0.8%



		Viva
Cities voice service (incar, outdoor, indoor)		1 954 tests
Rate of calls set-up and held for 2 min		**97.4%**
statistical accuracy		0.7%
and marked	**4-perfect (PQR)**	**95.3%**
	statistical accuracy	0.9%
	4-perfect or 3-fair (CQR)	**96.5%**
	statistical accuracy	0.8%

		Viva
Cities voice service (incar only)		951 tests
Rate of calls set-up and held for 2 min		**97.6%**
statistical accuracy		0.6%
and marked	**4-perfect (PQR)**	**95.4%**
	statistical accuracy	0.9%
	4-perfect or 3-fair (CQR)	**96.7%**
	statistical accuracy	0.7%

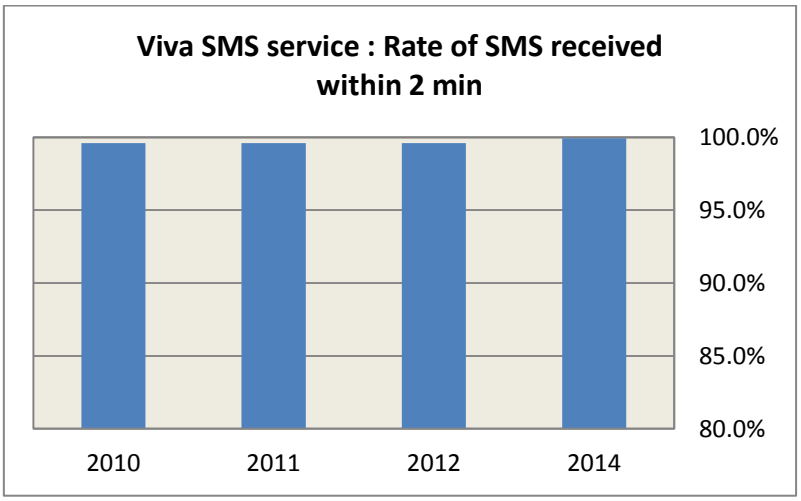
		Viva
Road links service		271 tests
Rate of calls set-up and held for 2 min		**97.4%**
statistical accuracy		0.7%
and marked	**4-perfect (PQR)**	**96.7%**
	statistical accuracy	0.7%
	4-perfect or 3-fair (CQR)	**96.7%**
	statistical accuracy	0.7%



VIVA Global voice results

6.3.2 SMS results

	viva
SMS Service	1 442 tests
% of received SMS (RS2)	**99.9%**
Statistical accuracy	0.1%
% of received SMS (RS30)	**99.1%**
Statistical accuracy	0.5%
% of received SMS (RS15)	**92.0%**
Statistical accuracy	1.4%
Average reception delay (s)	**6**

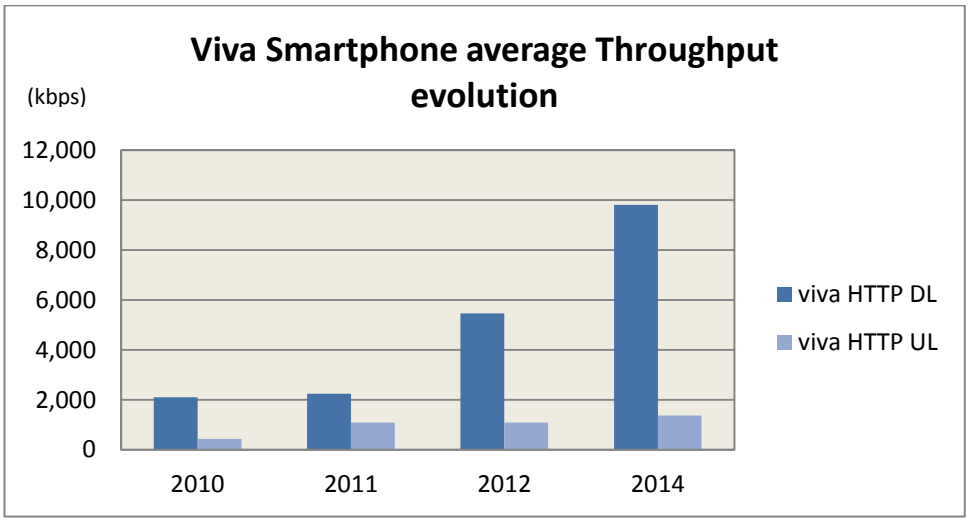


6.3.3 Data smartphone results

6.3.3.1 3G HANDSET

	viva
HTTP DL	718 tests
Rate of successful data transfers Statistical accuracy	**99.0%** 0.7%
Average Throughput (kbps)	**9 816**
Max throughput (kbps)	**21 907**
Standard deviation throughput (kbps)	4 945

	Viva
HTTP UL	671 tests
Rate of successful data transfers Statistical accuracy	**92.6%** 1.9%
Average Throughput (kbps)	**1 370**
Max throughput (kbps)	**2 612**
Standard deviation throughput (kbps)	796

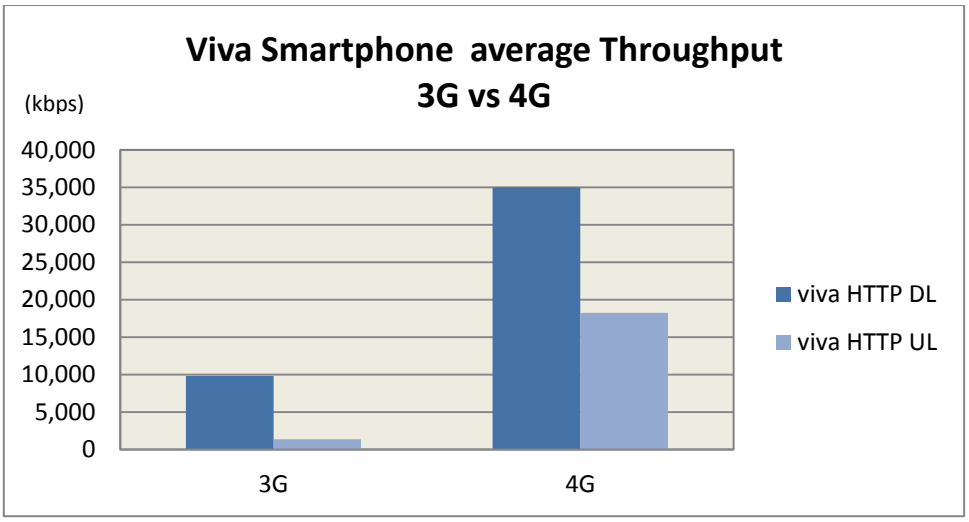


	viva
WEB	3 268 tests
Rate of successful data transfers Statistical accuracy	**94.2%** 0.8%
Average download time (s)	**7.6**
Min download time (s)	**1.6**
Standard deviation download time (s)	4.3

6.3.3.2 4G HANDSET

	viva
HTTP DL	720 tests
Rate of successful data transfers Statistical accuracy	**100.0%** 0.0%
Average Throughput (kbps)	**35 025**
Max throughput (kbps)	**78 077**
Standard deviation throughput (kbps)	15 446

	Viva
HTTP UL	707 tests
Rate of successful data transfers Statistical accuracy	**98.3%** 0.9%
Average Throughput (kbps)	**18 238**
Max throughput (kbps)	**31 036**
Standard deviation throughput (kbps)	7 736

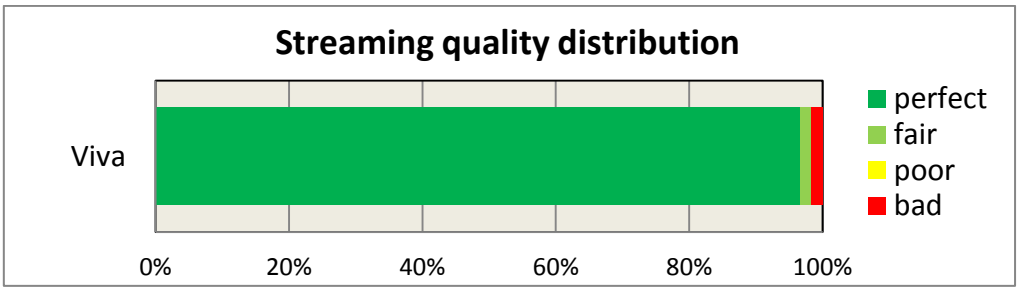


	viva
WEB	3 294 tests
Rate of successful data transfers Statistical accuracy	**95.2%** 0.7%
Average download time (s)	**4.6**
Min download time (s)	**1.2**
Standard deviation download time (s)	4.4

6.3.4 Streaming Results

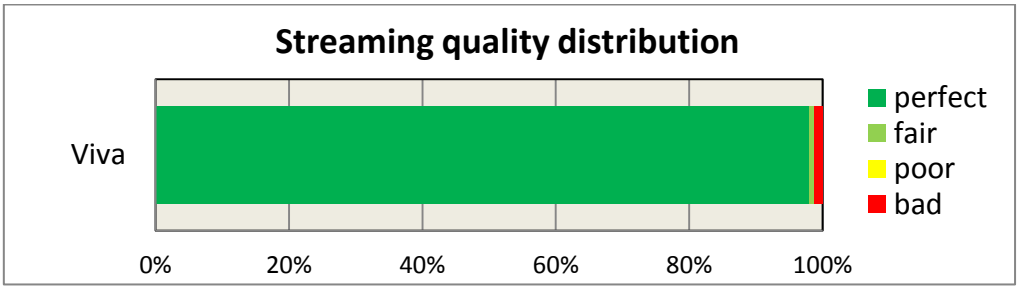
6.3.4.1 3G HANDSET

	VIVA
LHV : % of videos set-up and held for 2 min	94%
statistical accuracy	3.5%
VPQR : % of videos set-up, held for 2 min, and marked 4	92%
statistical accuracy	3.9%
VCQR : % of videos set-up, held for 2 min, and marked 3 or 4	94%
statistical accuracy	3.5%
Average delay	4
Minimum delay	1



6.3.4.2 4G HANDSET

	VIVA
LHV : % of videos set-up and held for 2 min	98%
statistical accuracy	1.9%
VPQR : % of videos set-up, held for 2 min, and marked 4	96%
statistical accuracy	2.8%
VCQR : % of videos set-up, held for 2 min, and marked 3 or 4	98%
statistical accuracy	1.9%
Average delay	3
Minimum delay	1



6.3.5 Data Coverage

6.3.5.1 3G HANDSET

	VIVA
Network technology distribution	4 029 tests
EDGE	**0%**
statistical accuracy	0.1%
HDSPA	**100%**
statistical accuracy	0.1%
UMTS	**0%**
statistical accuracy	0.0%
HSDPA 2012	**94%**

6.3.5.2 4G HANDSET

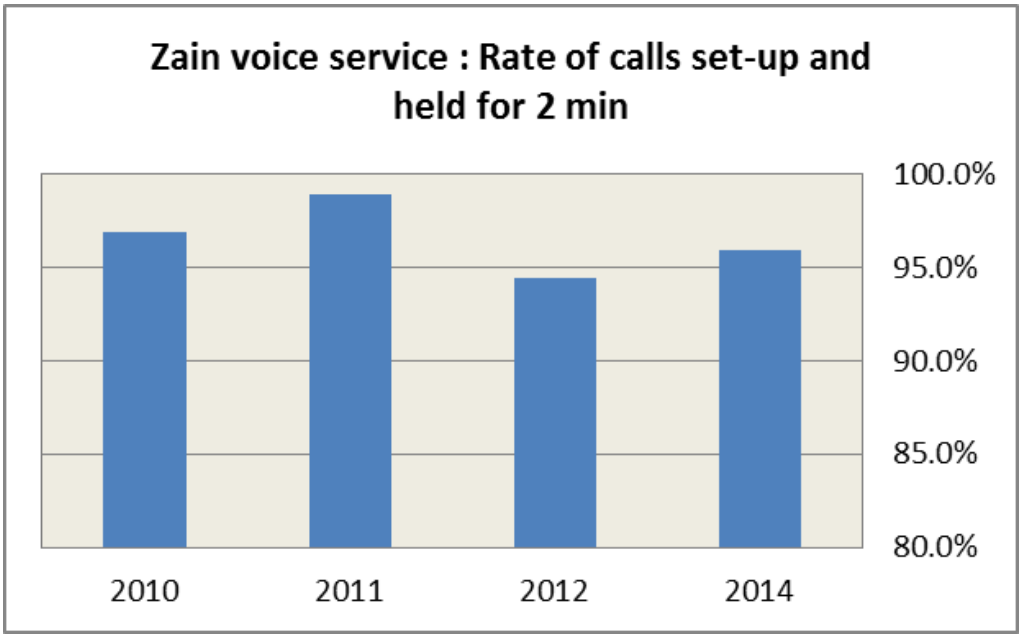
	VIVA
Network technology distribution	5 432 tests
EDGE	**0%**
statistical accuracy	0.0%
HDSPA	**0%**
statistical accuracy	0.1%
LTE	**100%**
statistical accuracy	0.1%
UMTS	**0%**
statistical accuracy	0.0%

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)

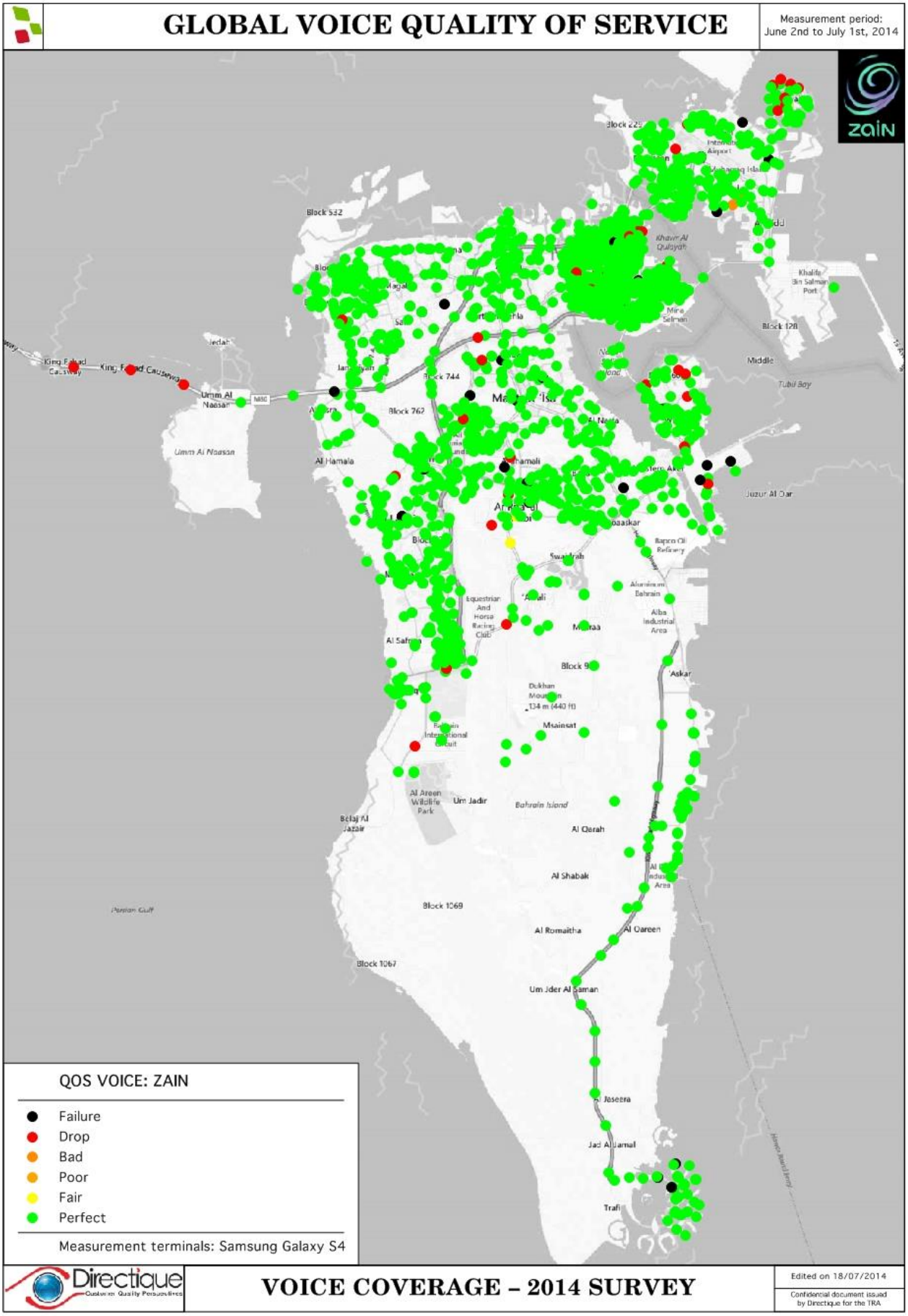
		ZAIN
Global voice service		2 225 tests
Rate of calls set-up and held for 2 min statistical accuracy		**95.9%** 0.8%
and marked	**Rate of calls marked 4-perfect (PQR)** statistical accuracy	**95.6%** 0.9%
	Rate of calls marked 4-perfect or 3-fair (CQR) statistical accuracy	**95.7%** 0.8%



		ZAIN
Cities voice service (incar, outdoor, indoor)		1 954 tests
Rate of calls set-up and held for 2 min statistical accuracy		**95.9%** 0.8%
and marked	**4-perfect (PQR)** statistical accuracy	**95.4%** 0.9%
	4-perfect or 3-fair (CQR) statistical accuracy	**95.6%** 0.8%

		ZAIN
Cities voice service (incar only)		951 tests
Rate of calls set-up and held for 2 min statistical accuracy		**96.5%** 0.8%
and marked	**4-perfect (PQR)** statistical accuracy	**96.1%** 0.8%
	4-perfect or 3-fair (CQR) statistical accuracy	**96.3%** 0.8%

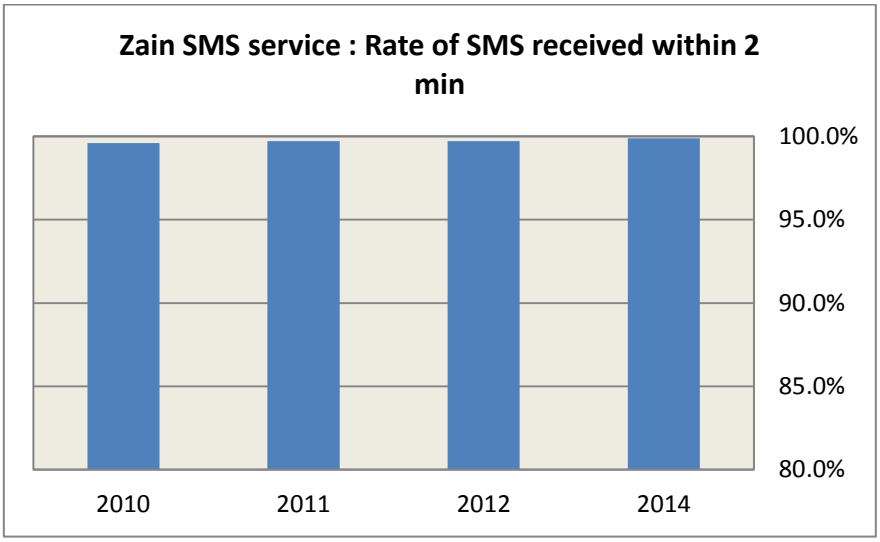
		ZAIN
Road links service		271 tests
Rate of calls set-up and held for 2 min statistical accuracy		**96.3%** 0.8%
and marked	**4-perfect (PQR)** statistical accuracy	**96.3%** 0.8%
	4-perfect or 3-fair (CQR) statistical accuracy	**96.3%** 0.8%



ZAIN Global voice results

6.4.2 SMS results

	ZAIN
SMS service	1 532 tests
% of received SMS (RS2)	**99.9%**
Statistical accuracy	0.2%
% of received SMS (RS30)	**97.8%**
Statistical accuracy	0.7%
% of received SMS (RS15)	**96.0%**
Statistical accuracy	1.0%
Average reception delay (s)	**6**

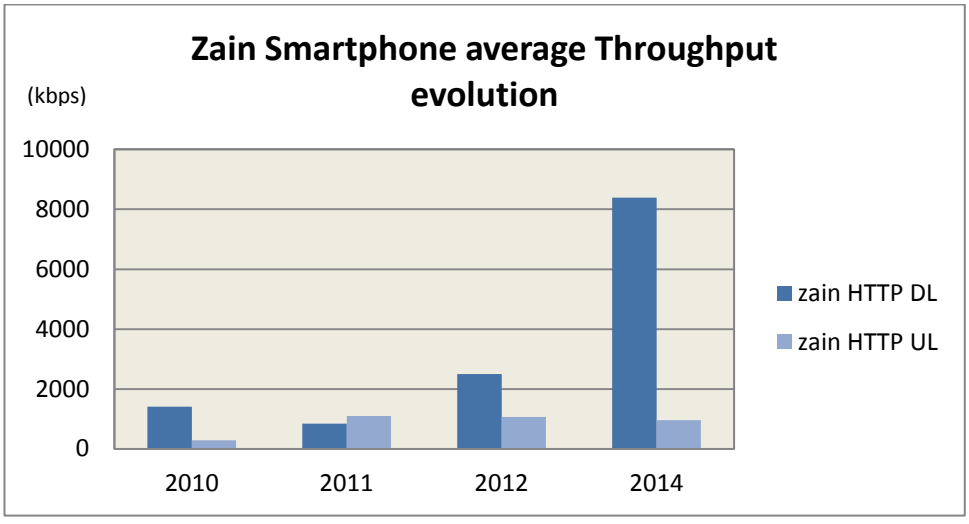


6.4.3 Data smartphone results

6.4.3.1 3G HANDSET

	ZAIN
HTTP DL	674 tests
Rate of successful data transfers Statistical accuracy	**92.3%** 1.9%
Average Throughput (kbps)	**8 390**
Max throughput (kbps)	**28 120**
Standard deviation throughput (kbps)	6, 286

	ZAIN
HTTP UL	702 tests
Rate of successful data transfers Statistical accuracy	**96.2%** 1.4%
Average Throughput (kbps)	**957**
Max throughput (kbps)	**3 593**
Standard deviation throughput (kbps)	826

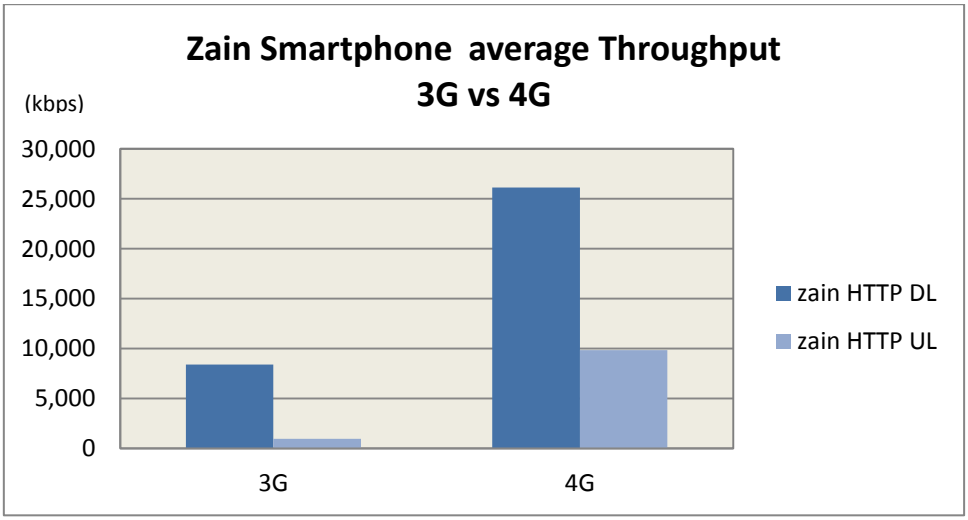


	ZAIN
WEB	3 082 tests
Rate of successful data transfers Statistical accuracy	**94.1%** 0.8%
Average download time (s)	**7.5**
Min download time (s)	**1.3**
Standard deviation download time (s)	4.5

6.4.3.2 4G HANDSET

	ZAIN
HTTP DL	695 tests
Rate of successful data transfers Statistical accuracy	**99.7%** 0.4%
Average Throughput (kbps)	**26, 117**
Max throughput (kbps)	**99 234**
Standard deviation throughput (kbps)	15 643

	ZAIN
HTTP UL	692 tests
Rate of successful data transfers Statistical accuracy	**99.1%** 0.7%
Average Throughput (kbps)	**9 844**
Max throughput (kbps)	**12 830**
Standard deviation throughput (kbps)	2 404

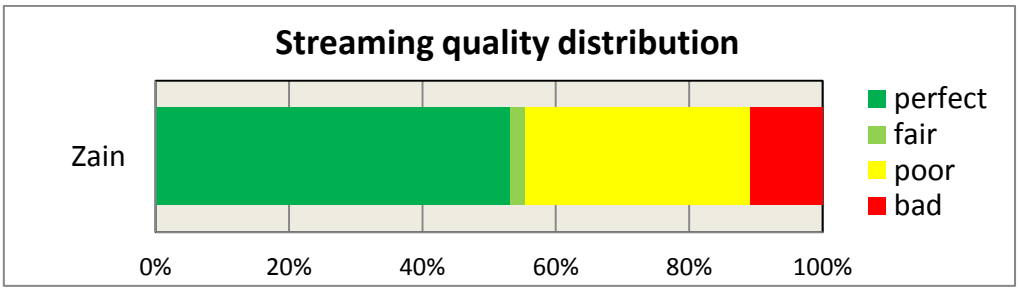


	ZAIN
WEB	2 686 tests
Rate of successful data transfers Statistical accuracy	**99.7%** 0.2%
Average download time (s)	**4.8**
Min download time (s)	**0.9**
Standard deviation download time (s)	3.2

6.4.4 Streaming Results

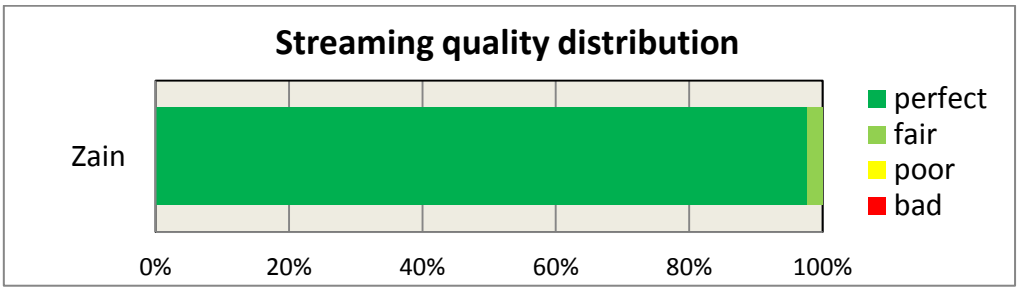
6.4.4.1 3G HANDSET

	ZAIN
LHV : % of videos set-up and held for 2 min	94%
statistical accuracy	3.6%
VPQR : % of videos set-up, held for 2 min, and marked 4	51%
statistical accuracy	7.4%
VCQR : % of videos set-up, held for 2 min, and marked 3 or 4	54%
statistical accuracy	7.4%
Average delay	5
Minimum delay	2



6.4.4.2 4G HANDSET

	ZAIN
LHV : % of videos set-up and held for 2 min	97%
statistical accuracy	2.7%
VPQR : % of videos set-up, held for 2 min, and marked 4	95%
statistical accuracy	3.1%
VCQR : % of videos set-up, held for 2 min, and marked 3 or 4	97%
statistical accuracy	2.7%
Average delay	3
Minimum delay	1



6.4.5 Data Coverage

6.4.5.1 3G HANDSET

	ZAIN
Network technology distribution	4 787 tests
EDGE	**0%**
statistical accuracy	0.2%
HDSPA	**100%**
statistical accuracy	0.2%
UMTS	**0%**
statistical accuracy	0.0%

HSDPA 2012	**90%**

6.4.5.2 4G HANDSET

	ZAIN
Network technology distribution	5 432 tests
EDGE	**0%**
statistical accuracy	0.1%
HDSPA	**7%**
statistical accuracy	0.7%
LTE	**93%**
statistical accuracy	0.7%
UMTS	**0%**
statistical accuracy	0.0%

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.

End of document