Communications Regulatory Authority
State of Qatar

هيئة تنظيم الاتصالات
دولة قطر

COVERAGE AND QOS MEASUREMENTS NETWORK AUDIT – 2017

July 11, 2018

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1. INTRODUCTION

As per the mandate provided to the Communications Regulatory Authority to safeguard the interest of telecoms consumers to publish information regarding Service Provider quality of service performance, including comparisons regarding the quality of service performance among different Service Providers, CRA in the past has conducted several Quality of Mobile Services Network Audit since 2012. CRA has conducted the Network Audit in the year 2017 to benchmark the Coverage as well as Quality of Service offered by the operators.

2. COVERAGE AUDIT

Coverage audit is conducted using drive test system and samples are collected from all roads of the State of Qatar. In addition, frequently accessed off road routes popularly used for fishing and camping in seasons are also considered for collecting coverage data.

2.1. Measurement Methodology

2.1.1. Coverage

Coverage is a measure of the Received Signal Strength for each generation of technology Rx lev (2G), RSCP (3G), RSRP (4G) for each operator.

2.1.2. Accessibility

- Call attempts to a pre-defined short number are scheduled automatically, until a ring-back tone or a specific audio recording (voicemail message) is received.
- The accessibility rate is the number of successful attempts to the total number of attempts to the network, after removal of congestion attempts, if any.

2.1.3. Data Coverage - Available Radio Access Technology

A series of 32 byte file is used to measure the round trip delay of the network. The technology breakdown (in %) for each tests is reported.

2.2. Equipment Used

- TSMW - High speed scanner/receiver (Rohde & Schwarz)
- UE-1: LTE CAT 6 device (Smartphone) for Data coverage measurement
- UE-2& 3: LTE CAT 3 device (Smartphone)

- UE-4: USB Dongle - LTE CAT 3 device
- ROMES Drive test software

2.3. Measurement Timeline

22nd May 2017 to 31st Dec 2017

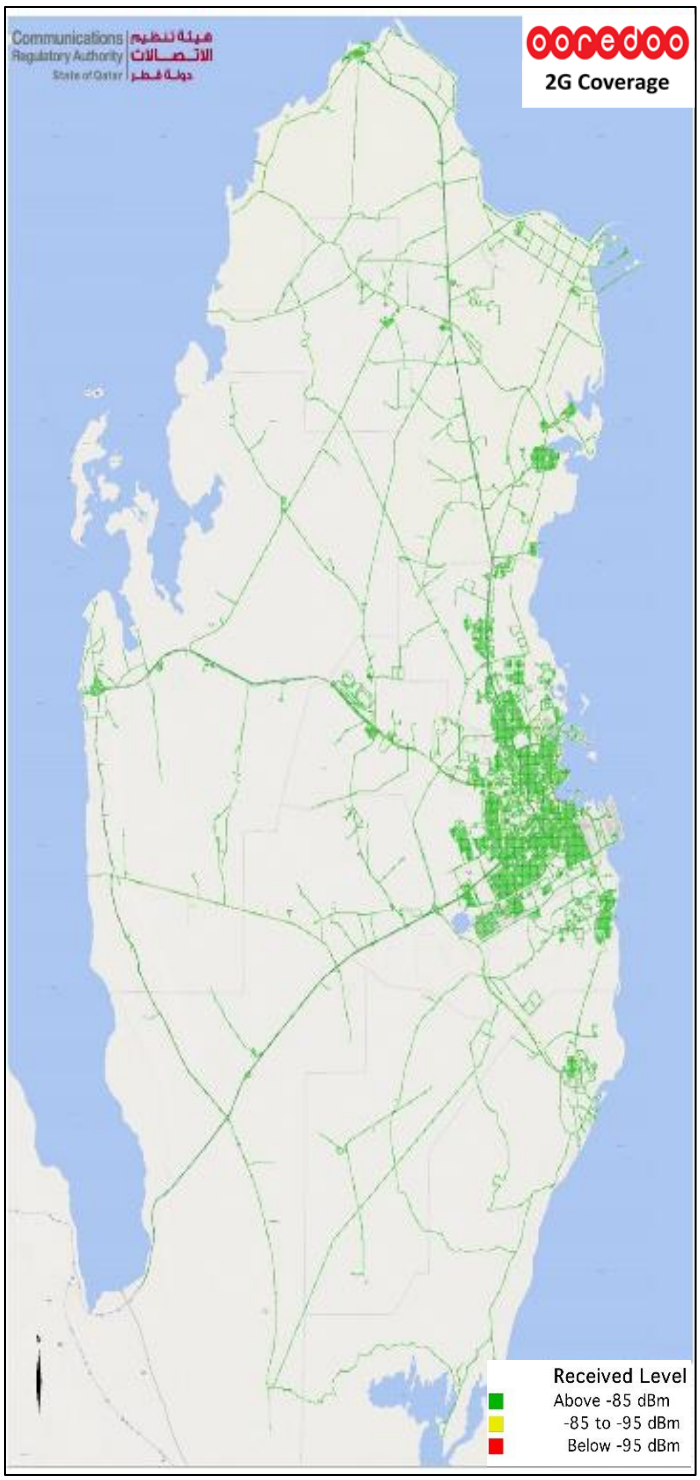
2.4. Samples

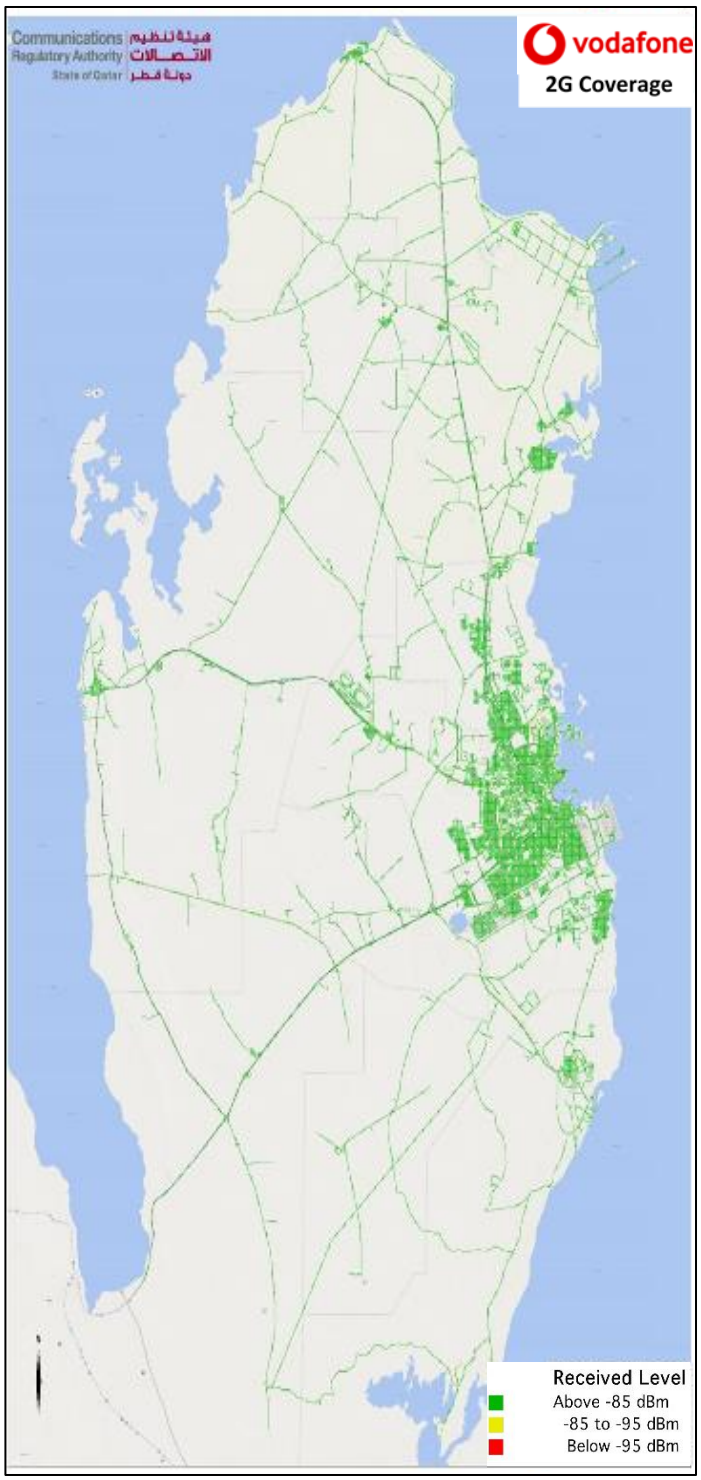
- Coverage Areas (100m x 100m) - 70,347
- Accessibility - 33,300
- Data Coverage - 60,600

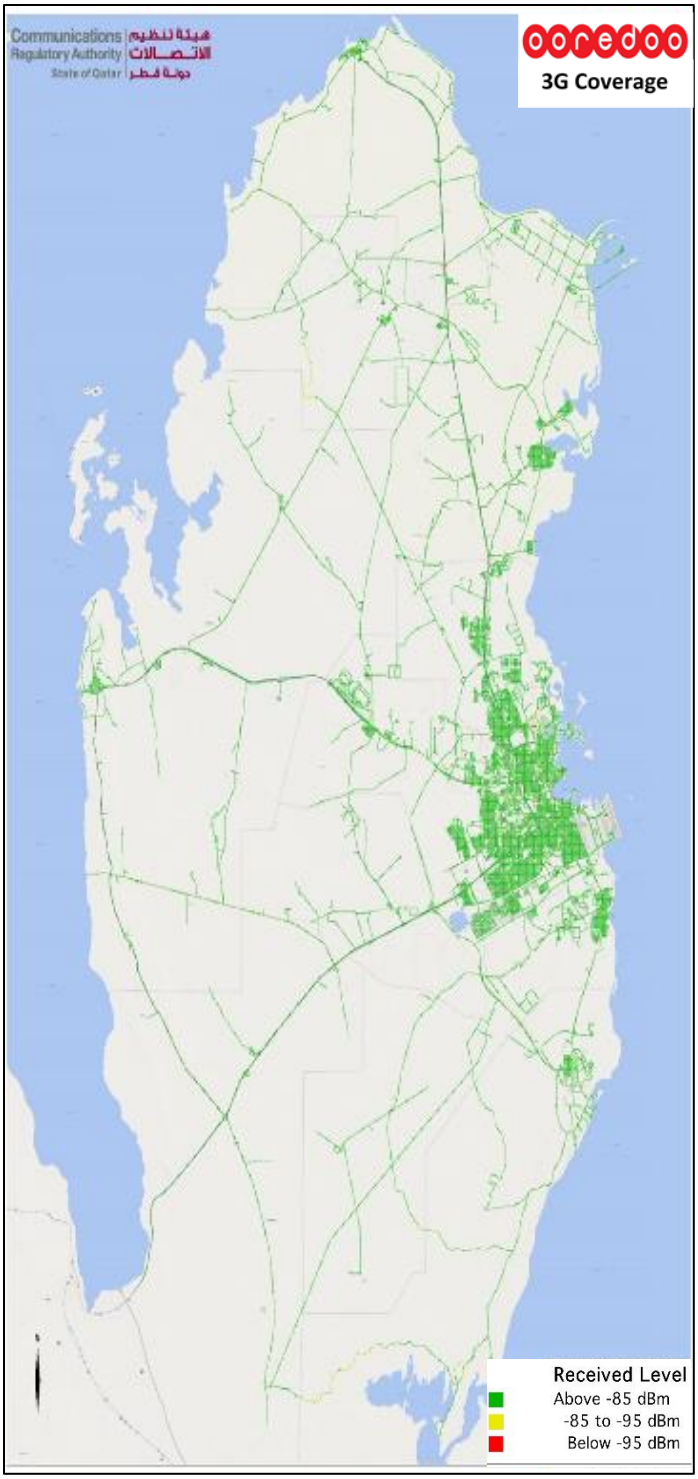
2.5. Geographical Coverage Plots

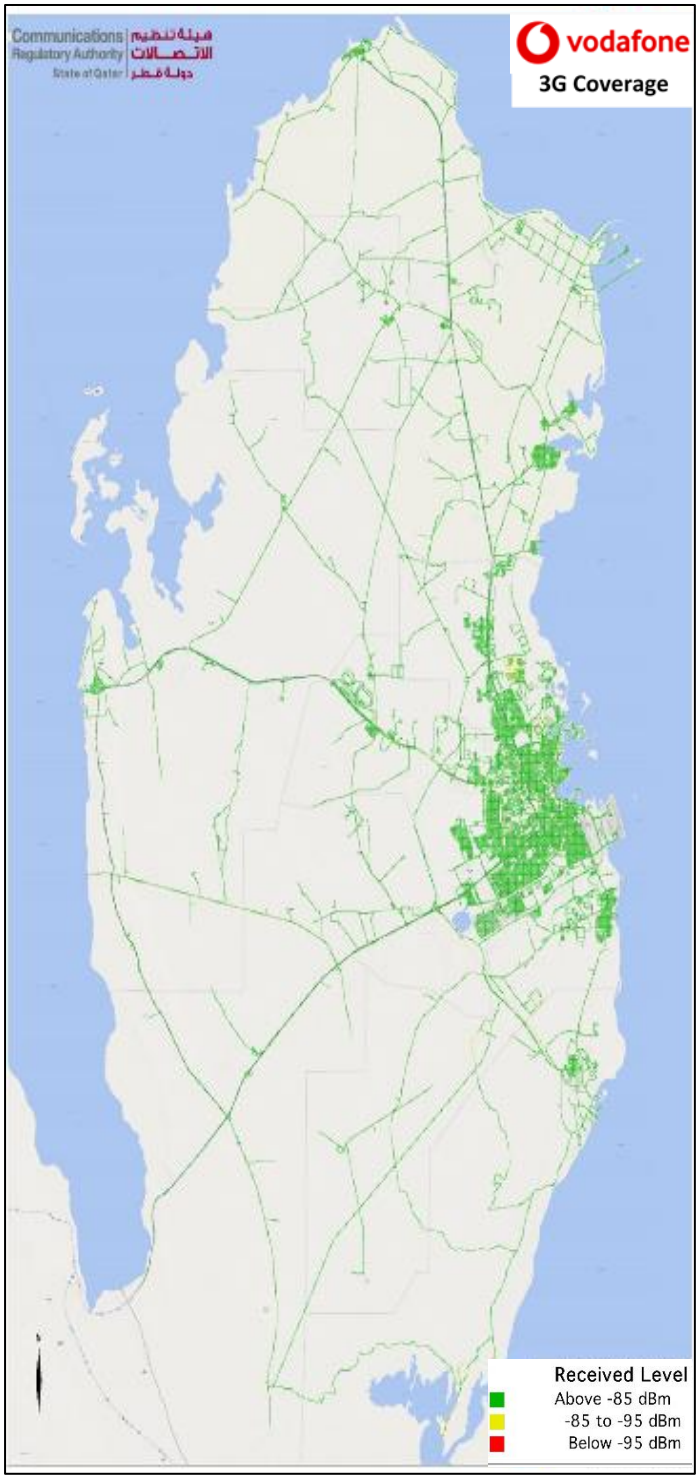
Coverage sample is a square of (100m x 100m) for each technology viz. Rx Lev (2G), RSCP (3G), RSRP (4G). The sample with the strongest received level in each squares for each technology is reported.

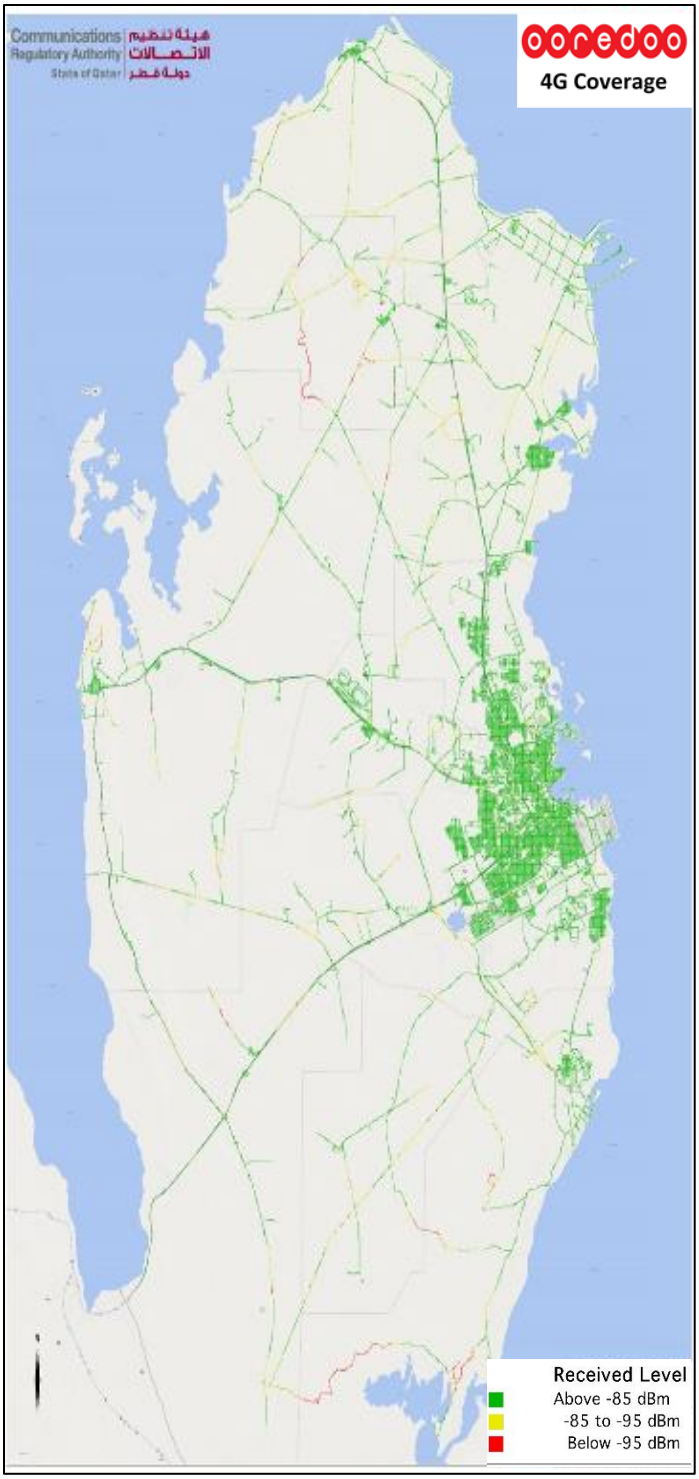
Signal Level	Ooredoo 2G	Vodafone 2G	Ooredoo 3G	Vodafone 3G	Ooredoo 4G	Vodafone 4G
Above -85dBm	99.88%	99.84%	99.17%	99.08%	88.73%	81.49%
-85dBm to -95dBm	0.09%	0.14%	0.73%	0.82%	9.60%	10.85%
Below -95dBm	0.02%	0.02%	0.10%	0.10%	1.67%	7.66%

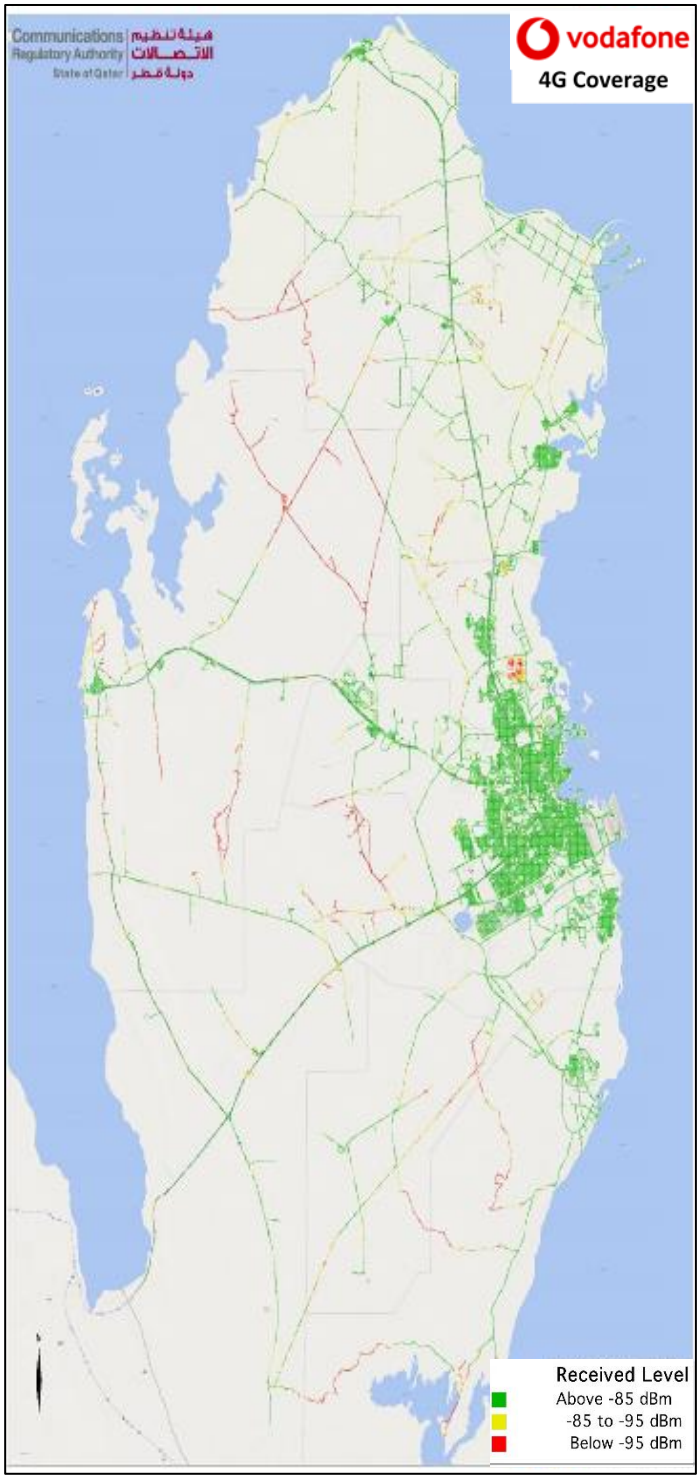

Communications Regulatory Authority State of Qatar
هيئة تنظيم الاتصالات دولة قطر
ooredoo
2G Coverage
Received Level
Above -85 dBm
-85 to -95 dBm
Below -95 dBm


Communications Regulatory Authority State of Qatar
هيئة تنظيم الاتصالات دولة قطر
vodafone
2G Coverage
Received Level
Above -85 dBm
-85 to -95 dBm
Below -95 dBm

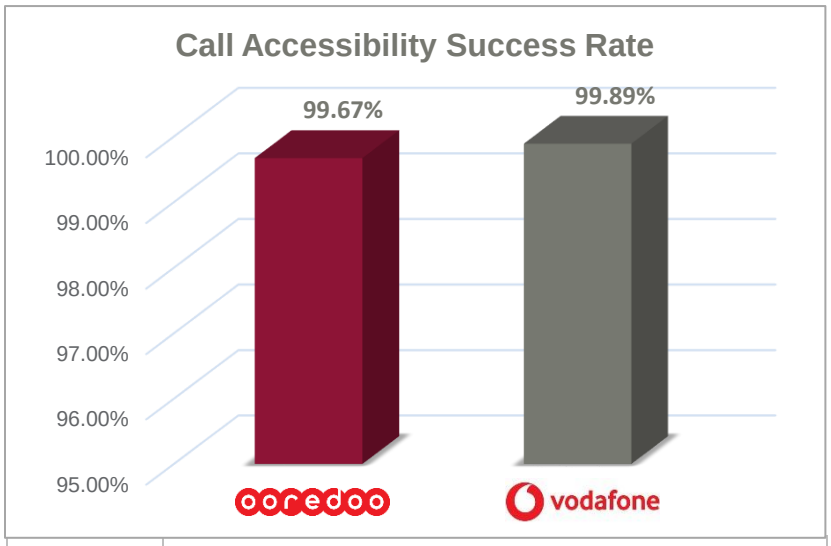

Communications Regulatory Authority State of Qatar
هيئة تنظيم الاتصالات دولة قطر
ooredoo
3G Coverage
Received Level
Above -85 dBm
-85 to -95 dBm
Below -95 dBm


Communications Regulatory Authority State of Qatar
هيئة تنظيم الاتصالات دولة قطر
vodafone
3G Coverage
Received Level
Above -85 dBm
-85 to -95 dBm
Below -95 dBm


Communications Regulatory Authority State of Qatar
هيئة تنظيم الاتصالات دولة قطر
ooredoo
4G Coverage
Received Level
Above -85 dBm
-85 to -95 dBm
Below -95 dBm

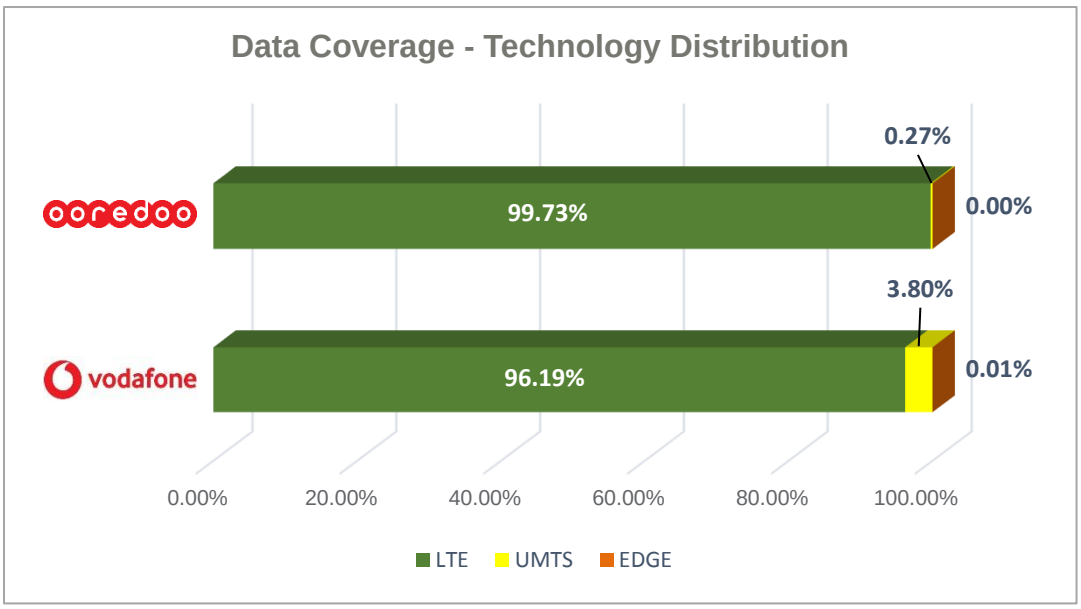

Communications Regulatory Authority State of Qatar
هيئة تنظيم الاتصالات دولة قطر
vodafone
4G Coverage
Received Level
Above -85 dBm
-85 to -95 dBm
Below -95 dBm

2.6. Accessibility Rate



Statistical Accuracy	±0.06%	±0.04%

2.7. Data Coverage - Available Radio Access Technology



3. QUALITY OF SERVICE AUDIT

The QoS audit is conducted to benchmark the Key performance Indicators of the services Voice calls, Short message service (SMS) and Data service offered to the consumers. The samples are collected in both drive test and stationary environments. Samples for stationary environment are weighted based on the population density of the zones/municipality for the State of Qatar.

3.1. Measurement Methodology

3.1.1. Voice Service Quality Testing

A voice measurement is a call to a Speech Quality Server for one minute duration and Mean Opinion Score (MOS) is recorded using POLQA algorithm.

3.1.2. Short Message Service

A 52 character sample SMS is send automatically and the received timings are recorded. Tests are conducted within and across networks.

3.1.3. Data Service Testing

- Data throughput measurement is carried out in stationary environment with a test file size of 100MB and 50MB for download and upload respectively.
- Webpage accessibility measurement is also carried out in drive test and stationary environment which includes download a standard test page from the server.

3.2. Equipment Used

- UE-1: LTE CAT 6 device (Smartphone).
- UE-2& 3: LTE CAT 3 device (Smartphone).
- UE-4: USB Dongle - LTE CAT 3 device.
- LTE CAT 9 device with Qualipoc software for Data measurements.
- ROMES Drive test software.

3.3. Measurement Timeline

22nd May 2017 to 31st Dec 2017

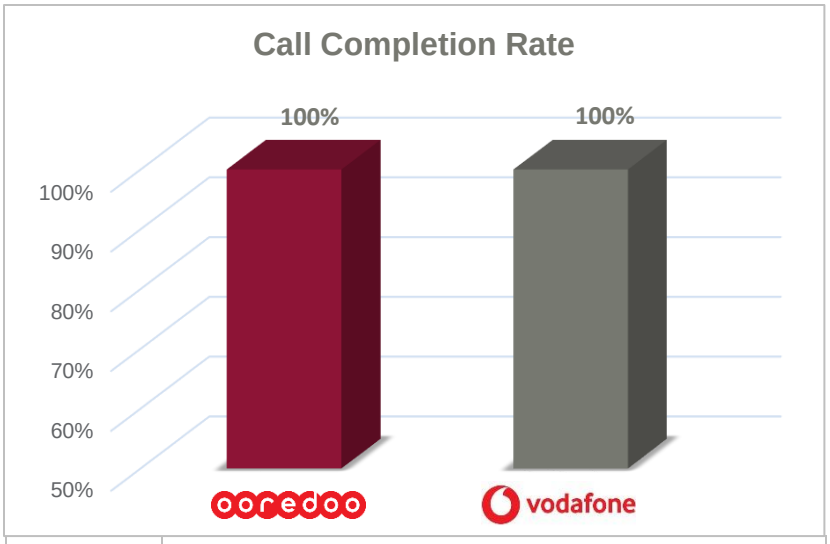
3.4. Samples

- Voice Service - 17,800
- Short Message Service - 4,402
- Data Service - 2,731
- Web Service - 40,600

3.5. Voice Service

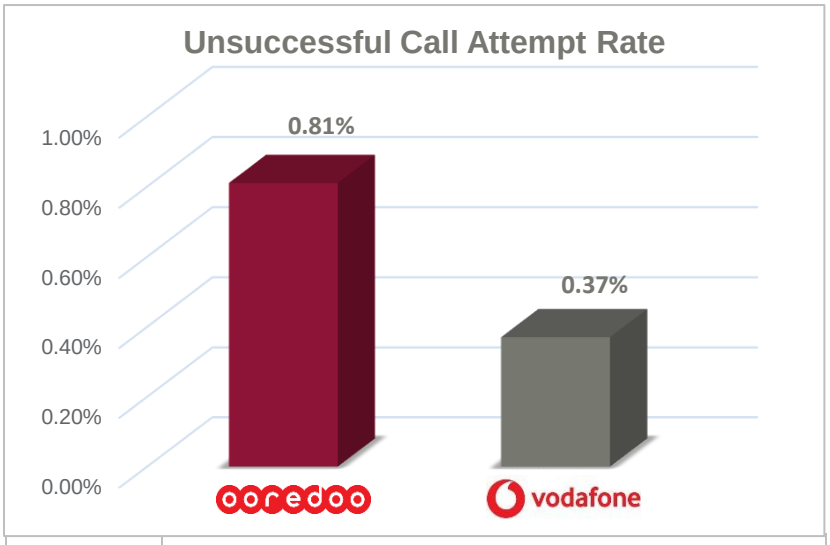
KPI	Definition
Call Completion Rate	Probability that a successful call attempt is maintained for 1 minute until it is released intentionally by user. $\text{Call completion rate} = \frac{\text{Number of normally ended calls}}{\text{All successful call attempts by all users}} \times 100$
Unsuccessful Call Attempt Rate	The call failure rate assesses the probability that the end user cannot complete the call within 30 seconds. $\text{Unsuccessful call attempt rate} = \frac{\text{Unsuccessful telephony service attempts by all users when service shown as available}}{\text{All telephony service attempts by all users}} \times 100$
Call Set Up Time	The call set-up time is the time period between sending of complete address information and receipt of call set up notification. Call set-up time = t (Connect established) - t (User pressed button on terminal)
Voice Quality (MOS)	Voice quality in mobile networks is measured with the ITU-T P.863 (POLQA) model is to predict overall listening speech quality from narrowband (300 to 3'400 Hz) to super wideband (50 to 14'000 Hz) telecommunication scenarios as perceived by the user. The average of Mean Opinion Score (MOS) over all samples each with call duration of 1 minute is reported.

3.5.1. Call Completion Rate



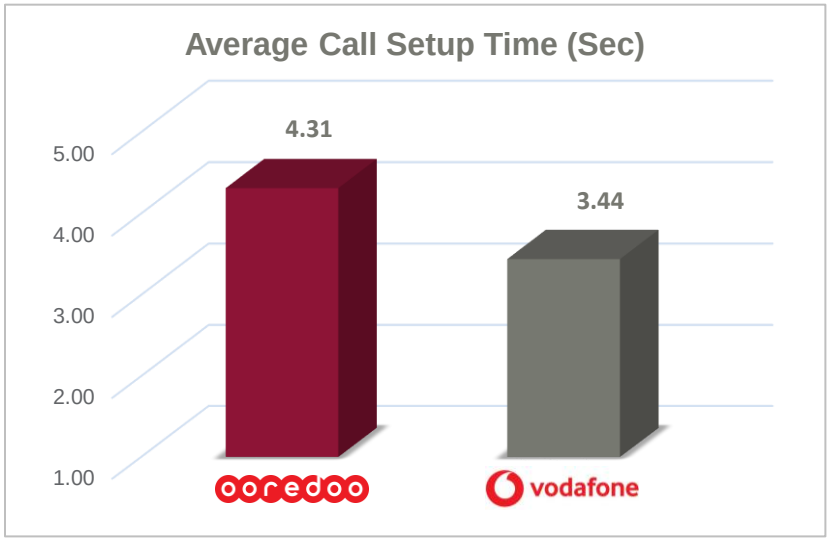
Statistical Accuracy	±0.0%	±0.0%

3.5.2. Unsuccessful Call Attempt Rate

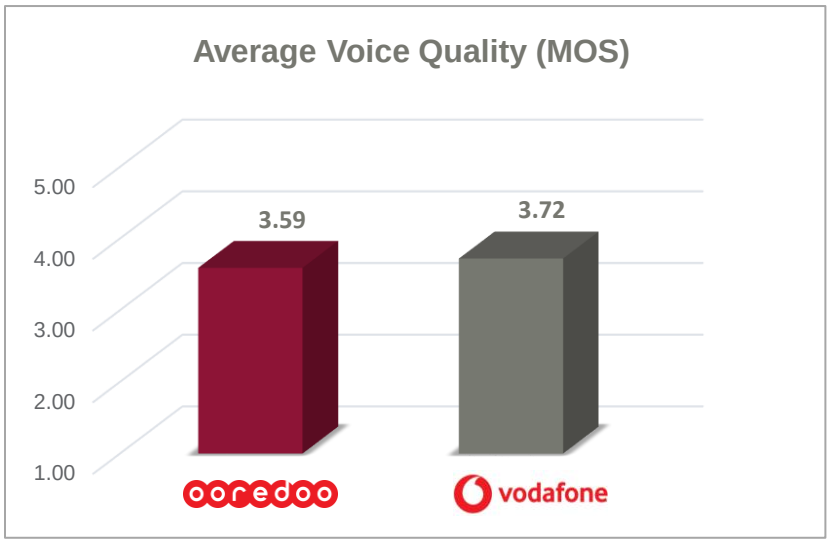


Statistical Accuracy	±0.13%	±0.09%

3.5.3. Call Setup Time

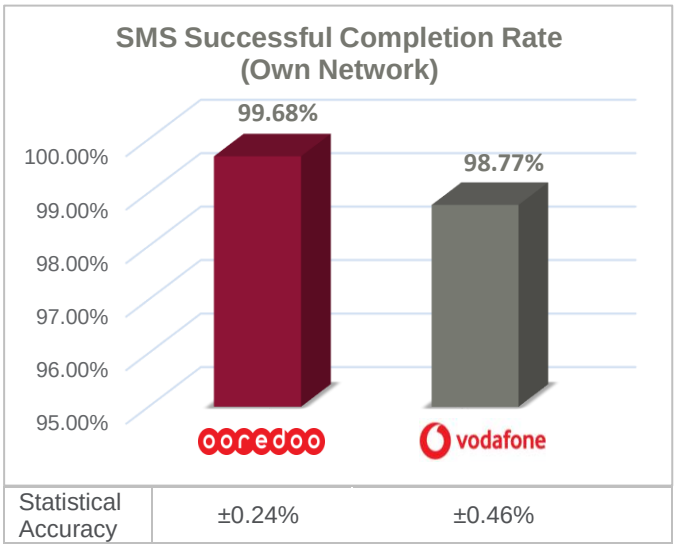


3.5.4. Voice Quality (MOS)

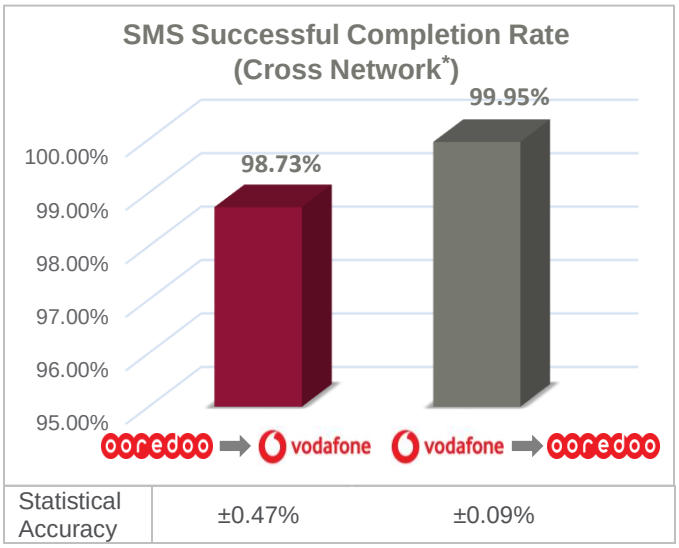


3.6. Short Message Service

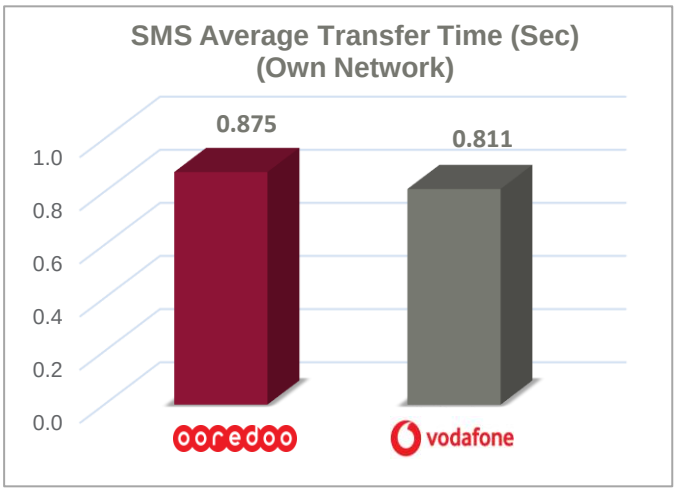
KPI	Definition
SMS Successful Completion Rate **(Own & Cross Network)**	$\text{SMS success rate} = \frac{\text{Number of SMS transfer completed}}{\text{Number of SMS Sent successfully}} \times 100$
SMS Transfer Time	The SMS end to end delivery time is the period of time between sending a short message to the network and the message being received at the distant terminal (user device). SMS end-to-end delivery time = t (B, received) - t (A, send)

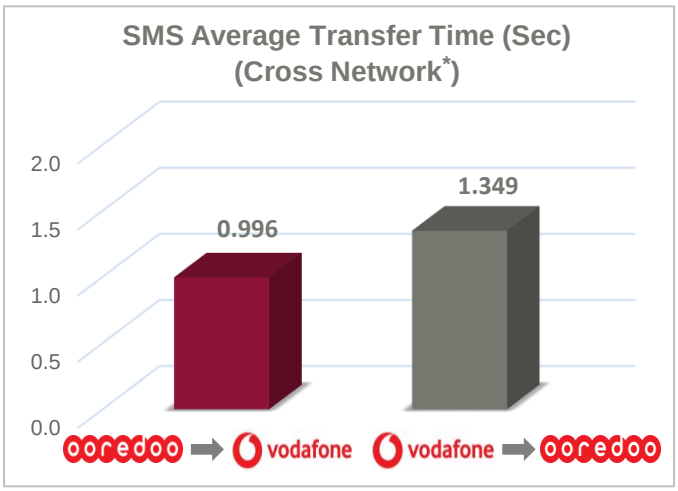


Statistical Accuracy	±0.24%	±0.46%



Statistical Accuracy	±0.47%	±0.09%



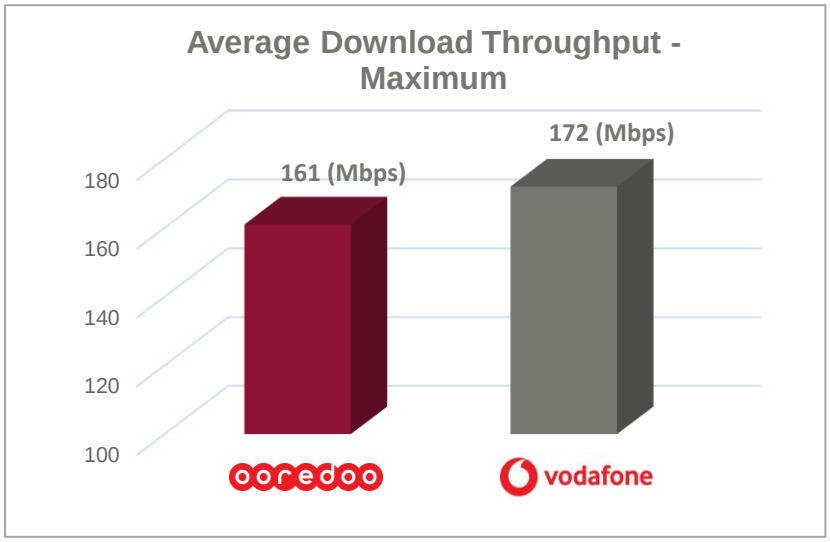


Note: The originating operator's does not have absolute control on Cross network KPI's which are terminated in the other network.

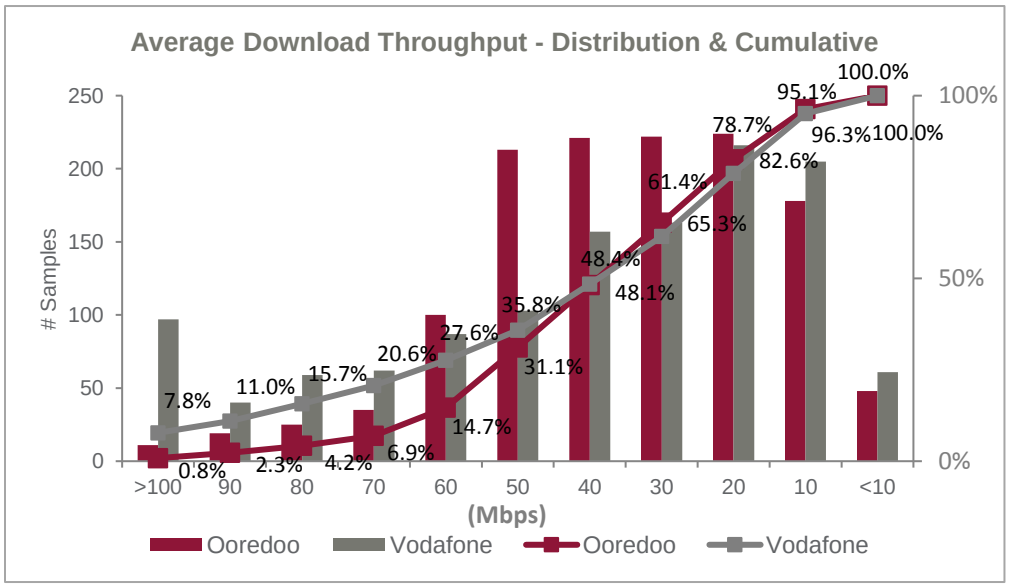
3.7. Data Services to Operator's Server

KPI	Definition
Data Download Throughput	Downloading a file via FTP & HTTP (1:1). The Average throughput to download the entire session is calculated.

3.7.1. Average Download Throughput – Maximum

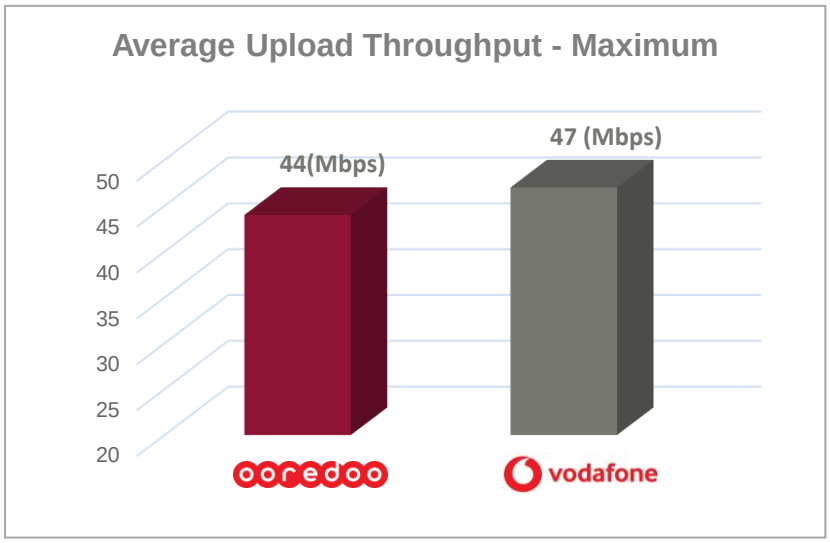


3.7.2. Average Download Throughput – Distribution & Cumulative

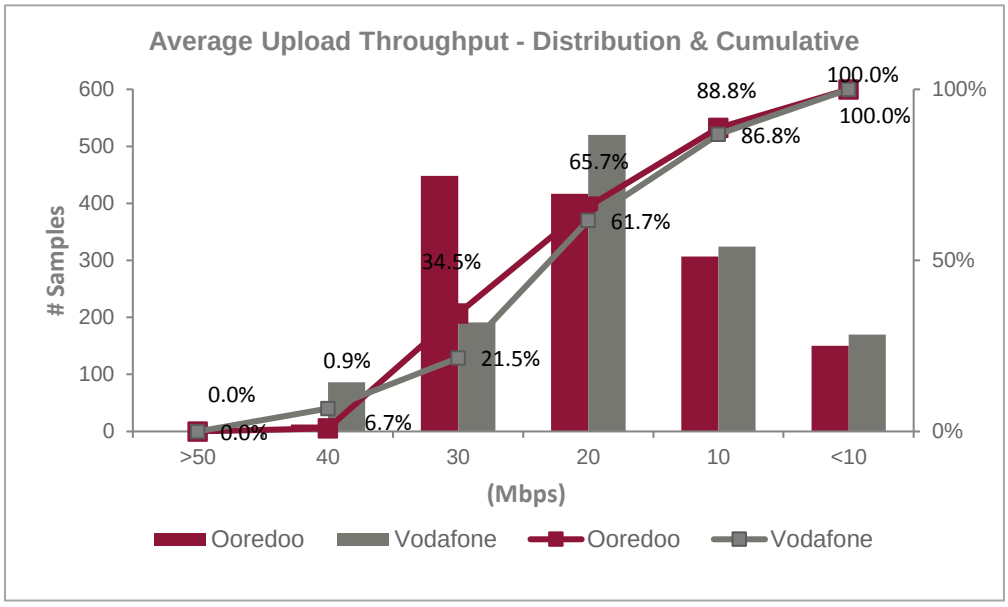


KPI	Definition
Data Upload Throughput	Uploading a file via FTP & HTTP (1:1). The Average throughput to upload the entire session is calculated.

3.7.3. Average Upload Throughput – Maximum

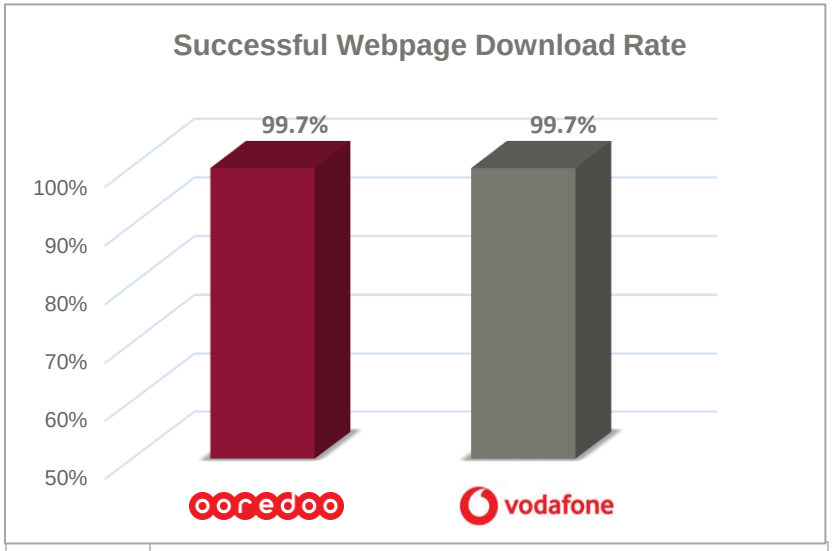


3.7.4. Average Upload Throughput – Distribution & Cumulative



3.7.5. Webpage Download Success Rate

KPI	Definition
Successful Webpage Download Rate	Successful webpage download rate = (Number of completed download session / Number of session started successfully) x 100

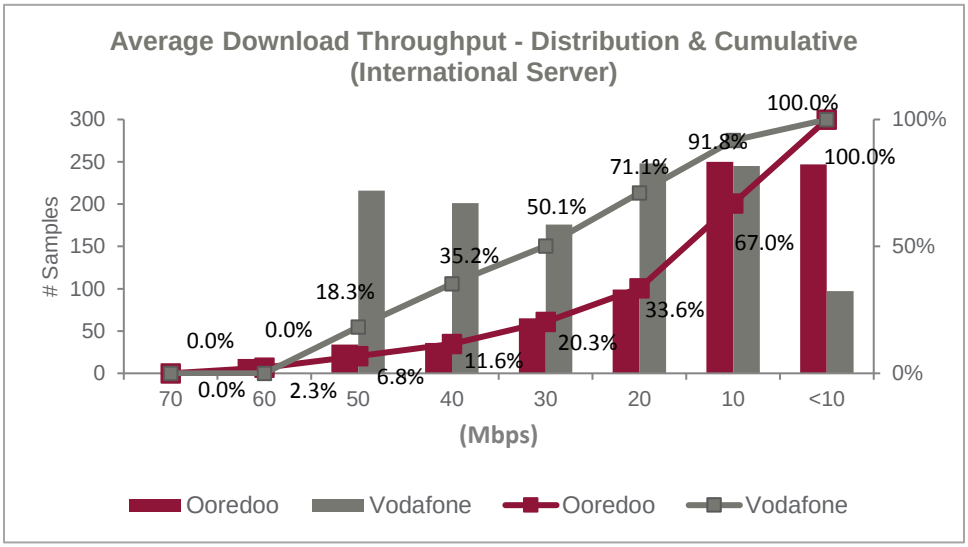


Statistical Accuracy	±0.05%	±0.05%

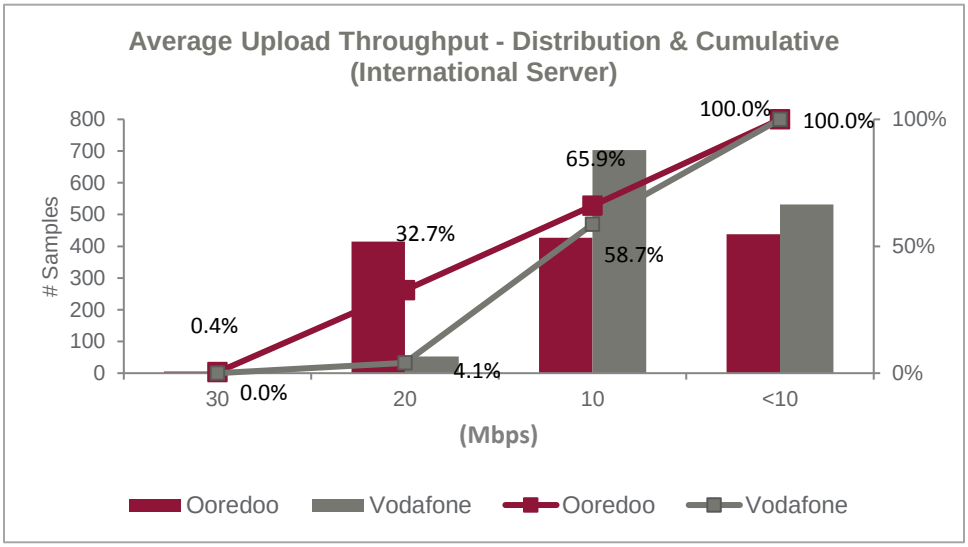
3.8. Data Services to International Server

CRA conducted tests to portrays the user experience of throughputs for data sessions to servers outside Qatar. The results are summarized as follows.The average throughputs are indicative and indicates throughputs to the particular International server, chosen by CRA, the identity of the location of which are kept anonymous to both service providers. The throughput rates can vary depending on various factors for e.g. location of the server which may be beyond the operator's absolute control.

3.8.1. Average Download Throughput – Distribution & Cumulative



3.8.2. Average Upload Throughput – Distribution & Cumulative



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