CITRA
الهيئة العامة للاتصالات وتقنية المعلومات
COMMUNICATION & INFORMATION TECHNOLOGY REGULATORY AUTHORITY

MOBILE NETWORK OPERATORS AUDIT REPORT

2021

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INTRODUCTION

The availability and quality of mobile services are critical factors for Digital Transformation plan in line with Kuwait 2035 Vision.

Furthermore, the performance of a mobile network is determined by user's satisfaction with the quality of their services.
Smartphones are no longer considered as just voice and text messaging devices, today they are predominately used for over-the-top (OTT) data services as well such as IPTV, Video streaming services, accessing social media, Video Conferencing, etc.

It is therefore important for national regulators to evaluate the technical performance of mobile operators' networks, grade and benchmark them against their peers to understand the overall country position, promote healthy competition among MNOs, safeguard customers rights through providing full visibility and transparency about country's telecom industry.

MSI - Mobile Systems International, a leading company with 32 years of excellence in delivering consultancy, solutions, services and products in technology, telecommunications, platforms and regulatory, was chosen by the regulatory authority to conduct this assessment using international test methodologies designed to gather qualitative records from the end users' points of view.

The goal of this study is to audit the mobile network provider in Kuwait with respect to the services provided to subscribers by the operators in the country.

Tests were conducted for the following set of services: Telephony (Voice and SMS), Video streaming, Data throughput (Web surfing, file transfers) and interactive services (such as online gaming, social media) in designated geographical areas that cover a major part of the country.

Certain KPIs of each mobile operators were benchmarked against the thresholds that have been set by CITRA in the "Quality of Service (QoS) Regulation".

Collected results were weighted individually as well as cumulatively and summarized into an overall network performance score.

This benchmark study has been conducted using ETSI TR 103 559 standard (Speech and multimedia transmission (STQ); Best practices for robust network quality-of-service audit).

ETSI (European Telecommunications Standards Institute) is an independent standards organization which supports the development of global technical standards (i.e., LTE and 5G NR). Although ETSI has a European focus, its influence is global in nature with members spanning the globe.

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Readers should keep in mind that mobile operators are constantly modifying and upgrading their networks (possibly even while the benchmark was running), performance may have changed by the time a reader read the report. The measured KPIs provided in the report have been taken during busy and non- busy hours. The measurements covered the entire network traffic time span, including peak hours at the specified times. Peak times for outdoor testing has been considered from 20:00 to 23:00 hrs. However, as a result of Covid-19 pandemic occurred during the project implementation, network traffic and consumption patterns have changed, with less mobility and higher static mobile service usage, particularly during working hours.

These pattern changes were taken into account during the testing.

TEST METHODOLOGY

MSI's audit study, including data collection processing is based on ETSI TR 103 599 -Speech and multimedia Transmission Quality (STQ) – that covers the construction and methods of countrywide measurement campaigns, with respect to the covered area and population, the collection and aggregation of the test results and the weighting of the various tested aspects.

The methodology considers and weights the key performance indicators (KPI) for a wide range of services that are essential for representing the service quality and combining it into an overall performance score.

This score can be calculated for individual regions such as governorates, highways, and popular areas. The scores of the individual regions are then aggregated in an overall network performance score.

The scoring mechanism allows very efficient comparison of multiple operators in a market, for different measurement campaigns in regions and countries, or prior and post deployment of a new technology or digital applications. The transparent structure of the score allows efficient drilldown to the region, service or even the KPIs responsible for a non-optimal overall score.

Equipment Setup

To avoid QoS prioritization within mobile operators' networks and to ensure benchmark independence by avoiding operator intervention, CITRA & MSI have anonymously obtained all required SIM cards directly from local sales points for each tested MNO.

OPERATORS	PACKAGES
zain	Unlimited Voice and Data
ooredoo	Unlimited Voice and Data
stc	Unlimited Voice and Data

Table 1 - SIM packages used for testing.

In respect to top mobile devices popular brands used in the country, the following mobile devices were selected to execute the test .

Telephony (Voice, SMS) & Data (4G,5G)
In Samsung Galaxy FE S20 / Model: SM-G781B/DS / OS: Android 10 Chipset: Qualcomm Snapdragon 865

Table 2 - Mobile handsets used for testing.

- All equipment set-ups were consistent across networks, platforms, and devices
- The same device models were used for comparative ("like for like") benchmarking
- The equipment run in proper conditions, as described by the test equipment vendor
- Device's performance were tested and calibrated to ensure measurement accuracy
- Devices were constantly swapped between operators to introduce further randomness in data collection

Service Testing

The network performance score structure is transparent and consists of several weighting and accumulation layers. One of the dimensions of layering consists of the service side, a score which is based on telephony and data service classes; each is scaled separately from 0 % to 100 %. Weighting for telephony services is 40 % and 60 % for data services.

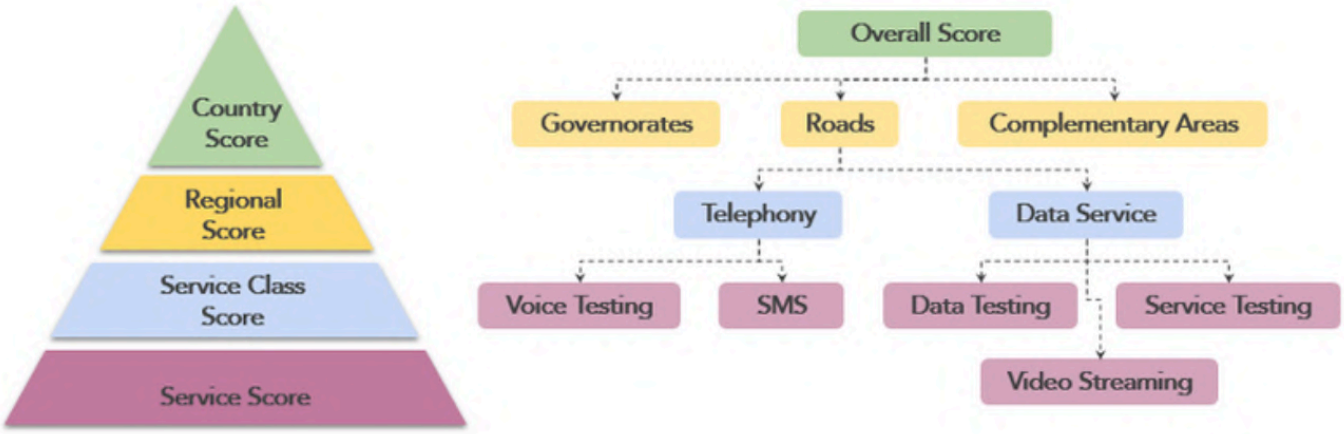


Figure 1 - Service and regional dimensions of NPS scoring

Geographic is another dimension that enhances NPS scoring, it brings additional regional layers with different weightings for individual regions and categories such as governorates, highways, hotspots, and rural areas.

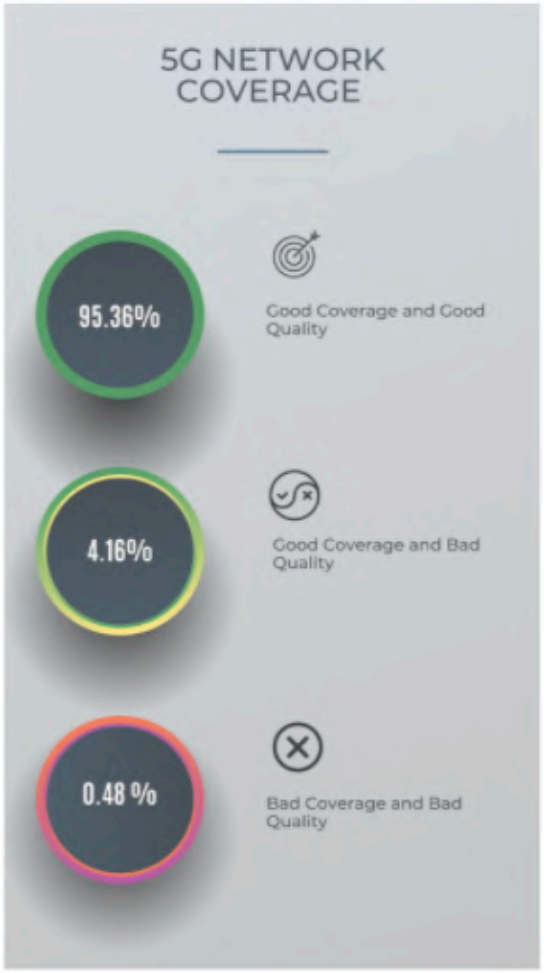
The number of geographic categorization and weighting is flexible and can be defined to meet regional or national needs.

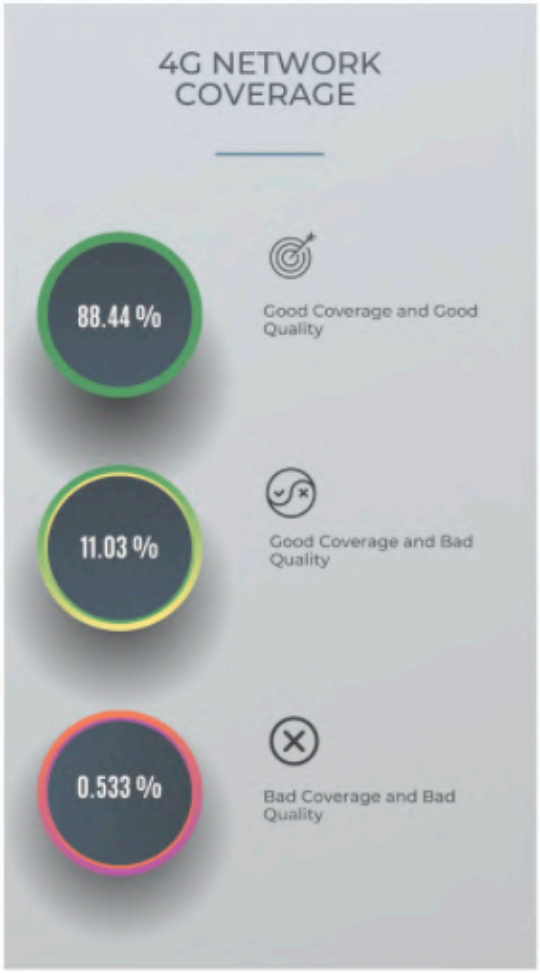
KEY OBSERVATIONS

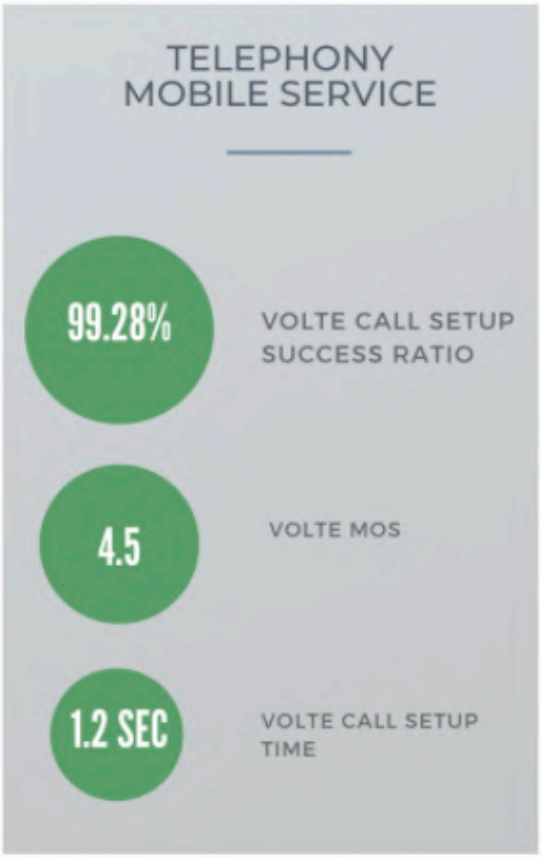
A total number of 380,055 samples were collected to measure the Quality and Performance for Voice and Data Services:

- 89,654 samples for Telephony Services
  - Voice Over LTE (VoLTE)
  - Traditional 2G and 3G calls
  - Short Messages SMS
- 290,401 samples for Data Services
  - 4G/5G HTTP DL/UL
  - 4G/5G HTTP Browsing
  - 4G/5G Social Media
  - 4G/5G Latency/Ping
  - 4G/5G Video Streaming
  - 4G/5G Gaming

Major Key Performance Indicators (KPIs)







OVERALL FINDINGS – STATE OF KUWAIT

328 Mbps

5G Average Download speed

110 Mbps

5G Average Upload speed

70 Mbps

4G Average Download speed

32 Mbps

4G Average Upload speed

1.3 Sec

YouTube Average access time

6 to 9 Sec

HTTP Average Browsing time

99.99%

SMS Average Success Ratio

Gaming

Average Ping Time Fortnite (65 [ms])

Average PUBG (60 [ms])

Average FIFA (120 [ms])

GAME SCORE

FORTNITE

Fortnite is an online video game developed by Epic Games and released in 2017. It is available in three distinct game mode versions that otherwise share the same general gameplay and game engine.

qosping-aws-me-southl-.ol.epicgames.com

LATENCY

65 ms

PUBG

PlayerUnknown's Battlegrounds (also known as PUBG: Battlegrounds) is an online multiplayer battle royale game developed and published by PUBG Corporation, a subsidiary of Bluehole. PUBG is one of the best-selling, highest-grossing and most-played video games of all time.

dynamodb.me-southl-.amazonaws.com

LATENCY

60 ms

FIFA

FIFA 21 is an association football simulation video game published by Electronic Arts as part of the FIFA series. It is the 28th installment in the FIFA series, and was released on 9 October 2020 for Microsoft Windows, Nintendo Switch, PlayStation 4 and Xbox.

utas.fut.ea.com

LATENCY

120 ms

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TESTED AREAS

More than 10,000 km roads and a significant number of indoor locations were tested in 138 areas.

Figure 5 – State of Kuwait

36 areas in Al Asema

1.6k kilometres.

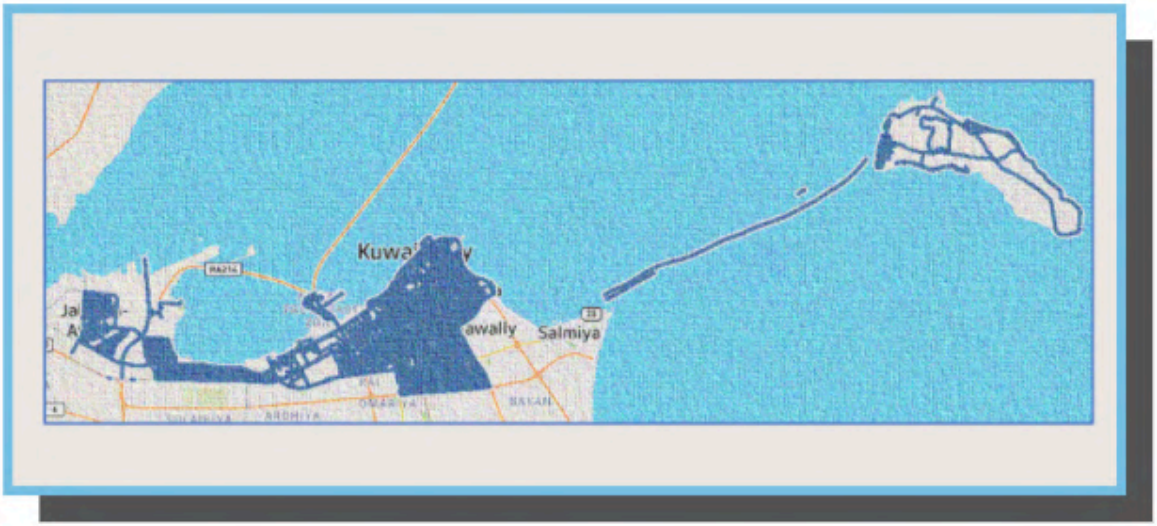


Figure 6 – Al Asema

20 areas in Al Farawaneya

1.1k kilometres.

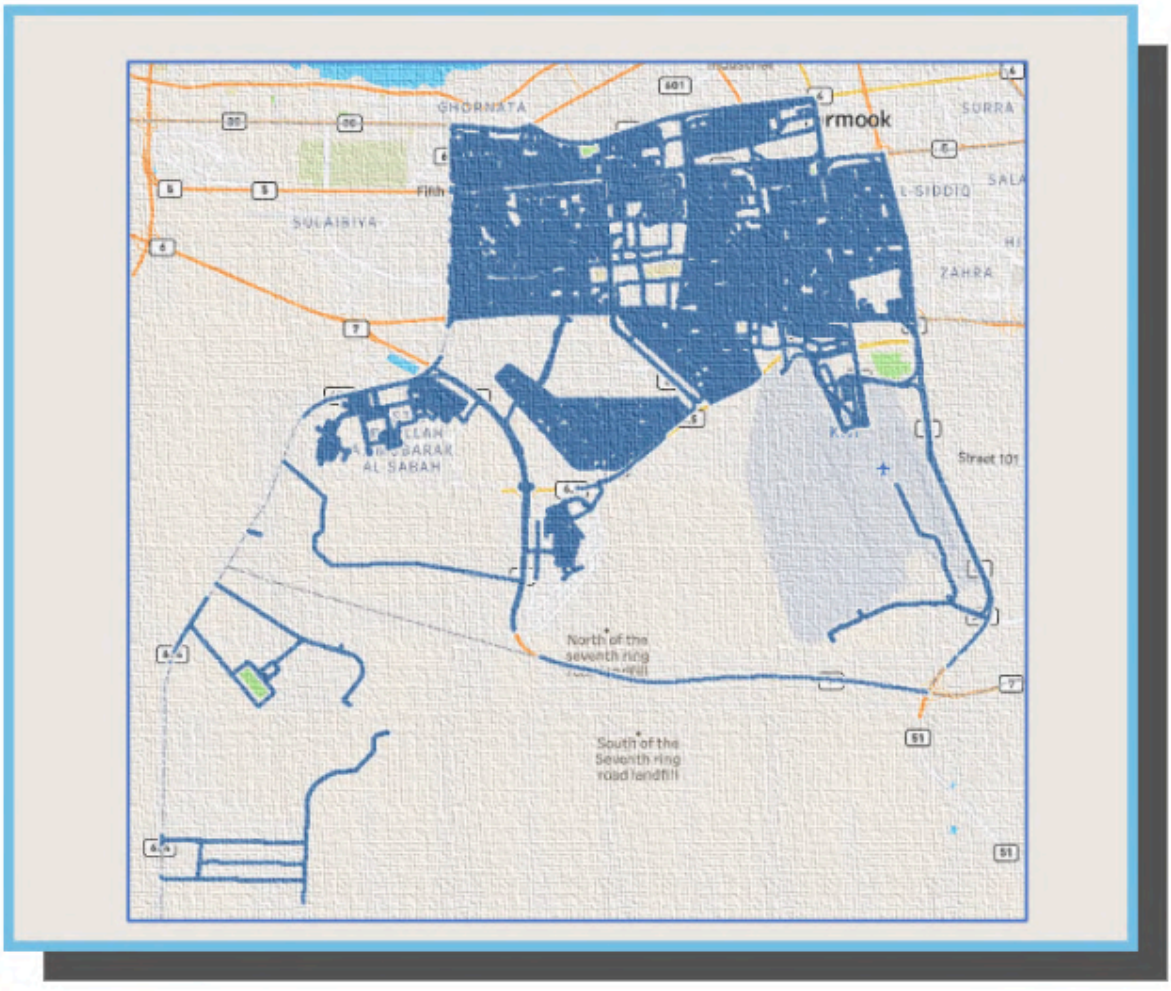
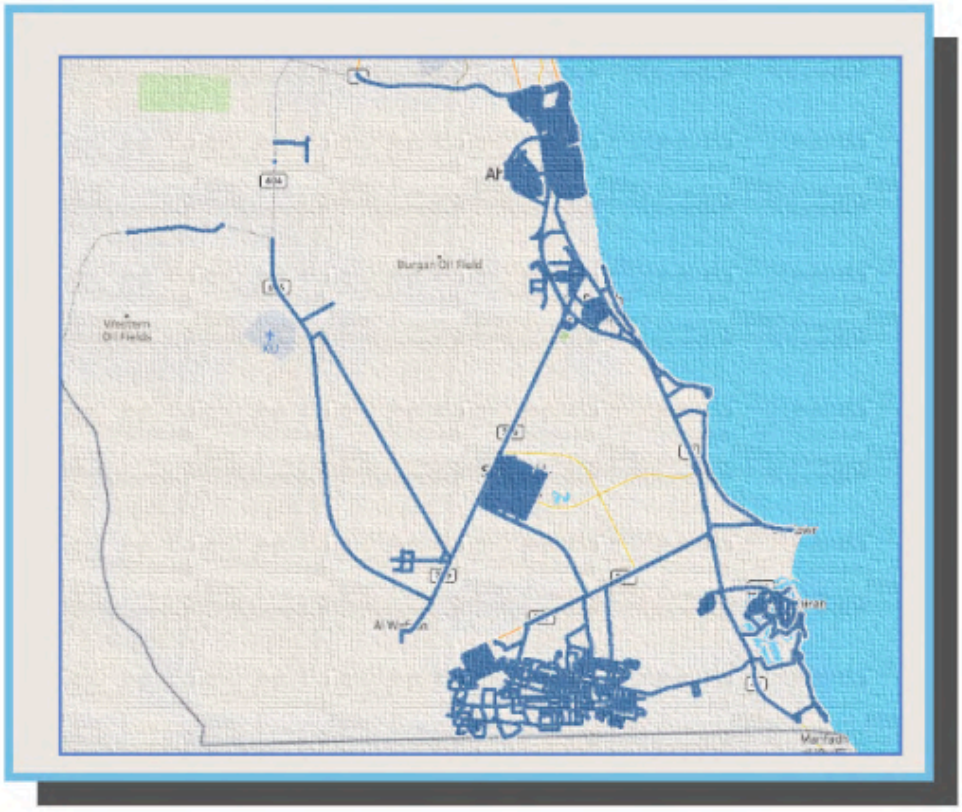


Figure 7 – Al Farawaneya

29 areas in AlAhmadi

1.4k kilometres

Figure 8 – AlAhmadi



26 areas in AlJahra

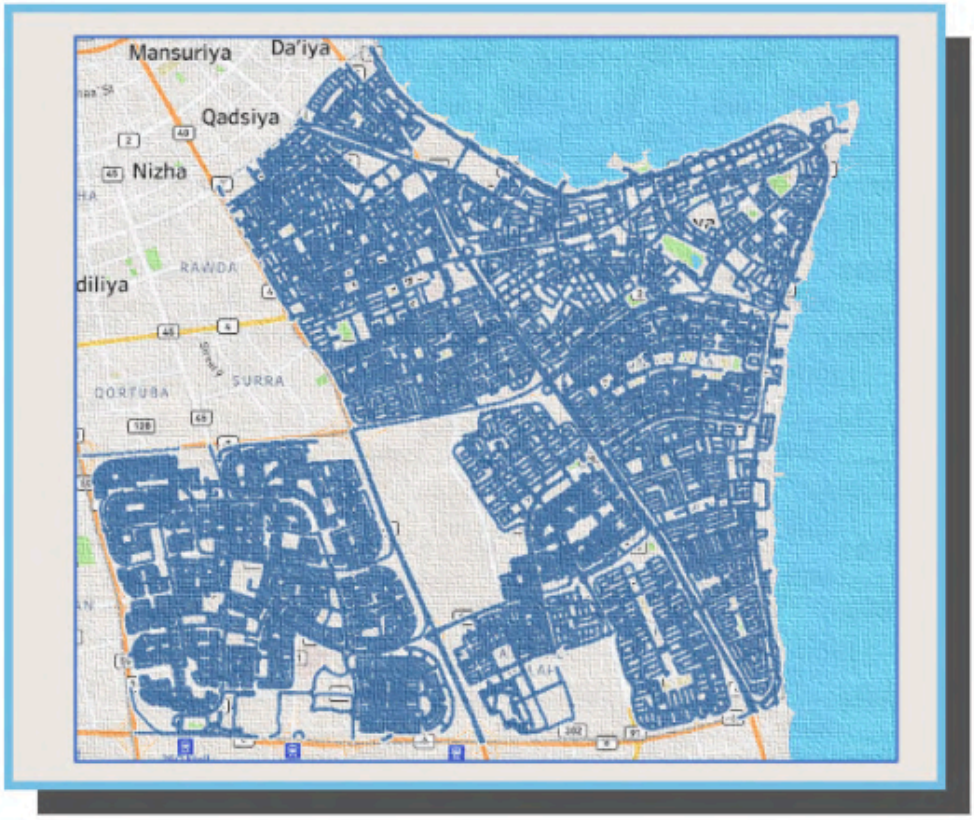
3.3k kilometres

Figure 9 – AlJahra

15 Areas in Hawalli

1.9k kilometers

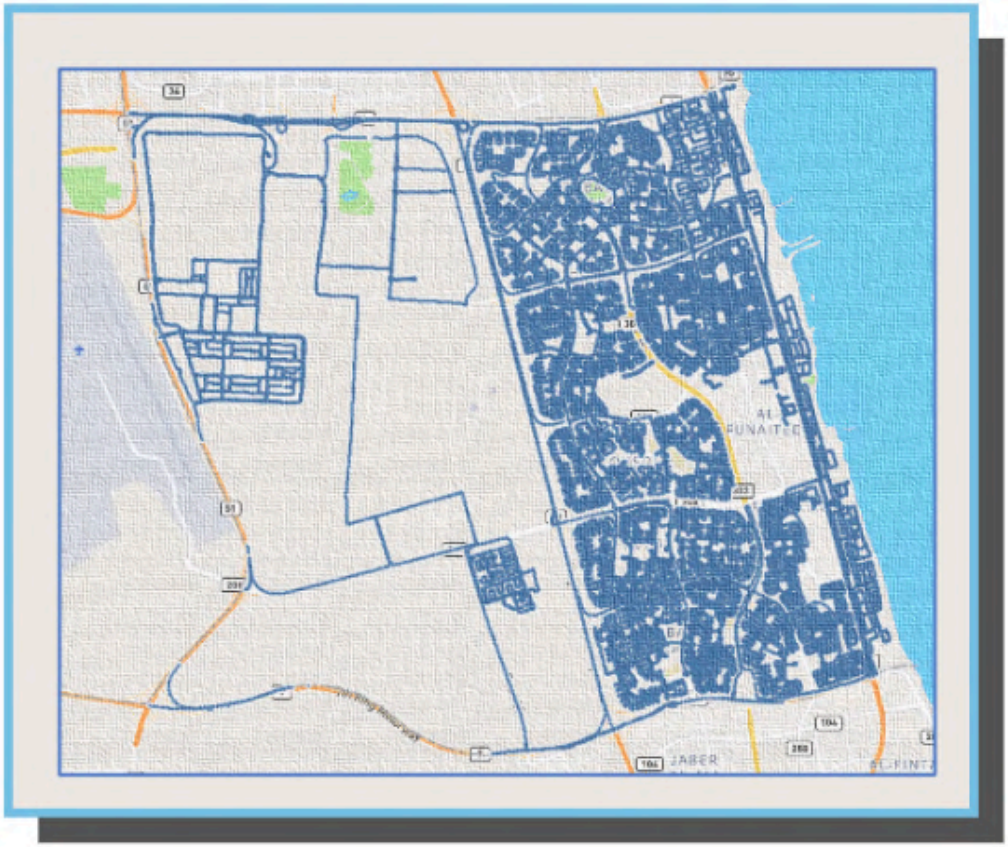
Figure 10 – Hawalli



12 areas in Mubarak Al Kabeer

0.7k kilometers

Figure 11 – Mubarak Al Kabeer



Highways

0.3k kilometers

Figure 12 – Highways

KPI DESCRIPTIONS

Voice KPI Descriptions

- Call Setup Success Ratio (CSSR) - is the percentage of all attempts to make a call that results in a connection to the dialled number. Typical ratios are between 90 % and 100 %.
- Call Drop Ratio (CDR) is the percentage of telephone calls that were cut off due to technical reasons before the users ended their conversations and intentionally hanged up. This KPI is measured as a percentage of all successfully established calls. Typical scores are < 10 %.
- Call Setup Time (CST) is main KPI at the application layer. The CST is the time interval of when the user starts dialling until the call is reported as connected to the user. Call setup time (CST) average is calculated as the average of all measured CSTs for all completed and dropped calls.
- CST > 15s Ratio is a KPI used to identify poor performers. This KPI contribution is important because users have a very negative perception when something is not functioning while they expect exceptional service as the norm.
- CST 90th Percentile is the threshold above which the shortest 10 % of CST values fall. This score rewards best performers and gives an indication of the shortest CST reachable in a technology or region.
- Voice MOS Average measures the overall, average speech quality performance of a network or a selection of measurements. This KPI is the plain average of all considered POLQA scores without any further preselection, exclusion, or weighting. MOS measurement is based on ITU P.863.1 recommendations
- Voice MOS < 1.6 ratio is the ratio of very bad speech samples. Considering the strong negative perception of low quality, this score explicitly penalizes high ratios of bad samples.
- Voice MOS 90th Percentile is the threshold above which the best 10 % of voice MOS values fall. It rewards good performers, keeping in mind that users perceive very good performance very positively. It also gives an indication of the MOS scores that are attainable with a given setup or technology.

SMS Measurement

- Tests are conducted simultaneously on all Mobile Networks.
- SMS messages used for testing are > 26 characters long including an index.
- Messages not received after 2 minutes elapsed time are marked as failed.

Data KPI Descriptions

- The HTTP UL/DL Success Ratio measures the data service availability/accessibility. It is the ratio of successfully completed tests (completed downloads and uploads) to all started tests. It rates in one score unavailability and incomplete uploads and downloads.
- Data Throughput is the users experience while using a data service. As an indicator of the average data throughput, the mean data rate (MDR) is calculated. For an HTTP transfer test, the MDR is calculated as the sum of all transferred bytes during the test's active transfer period divided by the transfer time.
- HTTP DL/UL Throughput 10th Percentile is a KPI that measures the poor performance of a network, i.e. the data rate below which the worst 10% of transfers fall. It is used to consider the negative perception if there is a very slow transfer that is not well considered in the average throughput.

Video KPI Descriptions

- Video Success Ratio considers all tests that achieve the video defined display time. These tests are classified as completed. The typical display time applied for live YouTube streams is 90 s.
- Video Access Time Average is the average value of all measured times to first picture (TTFP) for all completed and dropped tests. It quantifies the average length of the video access phase.
- Video Setup > 10 s ratio is the ratio of attempts where TTFP lasts longer than 10 s. This performance is considered to have a negative impact on the user experience and the perceived degradation.

HTTP Browsing

- HTTP Browsing Test's involves accessing public websites, which could be static or dynamic, such as commercial websites. HTTP browsing quality depends on the performance of the mobile network, and on the individual CDN.
    - Accordingly, the 10 most visited websites in Kuwait were tested to deliver credible web browsing and page loading test results whilst ensuring a representative performance comparison.

- Browsing Success Ratio is the ratio of data tests with status OK to all tests. The status OK is given when an entire website is completely downloaded and does not exceed the time limit (typically set to 15 Sec.).

- Browsing Duration Average is a KPI that measures network performance in HTTP browsing tests. It is the average of the download times for all successfully downloaded pages.

Social Media

- The Social Media Operation Success Ratio is calculated as the ratio of test results with status OK to all test results. When the social media website has been downloaded completely without exceeding the time limit (typically set to 15 seconds), it is given the status OK.

Services Classes	Services
Voice Service Quality	Voice Call Service SMS Service
Data Service Quality	HTT P Capacity | Web Browsing ICMP Ping | Gaming Services
Video Service Quality	YouTube Streaming
App Service Quality	Facebook | WhatsApp Twitter | Instagram

ABBREVIATIONS

- STATE – State of KUWAIT
- CITRA - Communication and Information Technology Regulatory Authority
- MSI – Mobile Systems International
- OTT – Over The Top
- IPTV – Internet Protocol Television
- MNO - Mobile Network Operator
- SMS – Short Message Service
- QoS – Quality of Service
- ETSI – European Telecommunications Standard Institute
- ITU – International telecommunication Union
- LTE – Long Term Evolution
- 5G NR – New Radio
- CS – Circuit Switched
- VoLTE – Voice over LTE
- DL/UL – Downlink/Uplink
- MOS – Mean Opinion Score
- QoE – Quality of Experience
- NPS – Network Performance Score
- KPI – Key Performance Indicator
- HTTP – Hyper Text Transfer Protocol
- POLQA – Perceptual Objective Listening Quality Analysis
- CSSR – Call setup success ratio
- CDR – Call drop ratio
- CST – Call setup time
- CDN – Content Delivery Network
- SLA – Service Level Agreement
- ICMP – Internet Control Message Protocol
- TCP/IP – Transmission Control Protocol / Internet Protocol
- SS-RSRP - Synchronization Signal reference signal received power
- SS-RSRQ - Synchronization Signal reference signal received power
- RSRP - reference signal received power
- RSRQ - reference signal received power
- WCDMA - Wideband Code Division Multiple Access

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