United Arab Emirates

هيئة تنظيم الاتصالات TRA
TELECOMMUNICATIONS REGULATORY AUTHORITY

Regulatory Policy

Quality of Service (QoS) Policy

Version 2.0

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QoS KPIs – MONITORING POLICY

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Version control:

Version	Issue date	Reason for issuance
2.0	24 Sep. 2019	Issuance of revised QoS Policy
1.3 (Reporting specifications)	27 September 2010	Further clarifications on reporting requirements and definitions
1.2 (QoS Policy)	28 December 2009	Administrative changes and addition of Annex 2 indicators
1.1	26 November 2008	Addition of Annex 1 indicators
1.0	30 April 2005	Issuance

1 Introduction

1.1 In 2005, the TRA issued a Regulatory Policy with respect to Quality of Service (QoS) to the telecommunications Licensees in the United Arab Emirates (UAE), Etisalat Telecommunications Corporation (Etisalat) and Emirates Integrated Telecommunications Company PJSC (EITC).

1.2 The objective of the QoS Policy is to implement a Quality of Service framework, which allows the quality of service delivered by Licensees to be measured, reported and published based on defined parameters and measurement methodologies as provided in this QoS Policy.

1.3 The TRA is reviewing and revising its QoS Policy in 2019, to reflect significant developments in the UAE telecommunications market and keep abreast of the latest international best practice.

2 Terms and definition

2.1 Any definitions that are given in the TRA's legal framework carry the same definition when used within this QoS Policy. The following terms shall have the definition assigned to them as outlined below, unless the context requires otherwise.

Figure 2.1: Definition of key terms

Term / expression	Definition
Busy hour	The continuous 60 minutes within a 24-hour period for which the traffic (i.e. voice, data) is the greatest (ITU-T recommendation E.600)
Client Software	Software residing within the Consumer environment (e.g. desktop or laptop computer, tablet, mobile phone or hardware probe)
Customer	Any person who has made arrangements with the Licensee to receive services from the Licensee under the Licensee's general terms and conditions
Circuit Switched Fall Back (CSFB)	Technology whereby voice and SMS services are delivered to LTE devices through the use of 2G/3G circuit-switched network. Circuit Switched Fall Back is needed because LTE is a packet-based all-IP network that cannot support circuit-switched calls.
End-user	Any person who uses the retail telecommunication services supplied by the Licensees[1]
Indicator / Key Parameter Indicator (KPI)	Measurable data that reflect the effectiveness of systems and network performance to achieve the key objectives of quality of service
Licensee	An entity which can carry out regulated activities, as specified by the Federal Law by Decree No. 3 (2003) and the entity's public telecommunications licence
Operation support system/ business support system (OSS / BSS)	Two systems used by the Licensees to support the running of the telecommunication network. They support functions such as service provisioning, network configuration, fault management, Customer management, billing and order management.
Publish	The release of data and/or information to the public
Quality of Experience (QoE) indicators	Indicators that reflect the quality of the End-user experience (i.e. service or operational experience)
Quality of Service (QoS) indicators	Indicators that reflect the quality of network systems performance
Third party	An independent company not affiliated with the TRA or any Licensee
Telecommunications Regulatory Authority (TRA)	The general authority for regulating the telecommunications sector in The United Arab Emirates

1 An End-user may or may not be a customer. For example, if the End-user is the person who has signed the contract with the Licensee then it is also considered to be a customer. However, if, for example, the End-user is a member of a family who has not signed the contract with the Licensee (e.g. child), it is not considered to be a customer.

3 Legal Reference

3.1 In this section, we provide the legal background for the proposed changes to the QoS Policy in the UAE. The legal background for the QoS Policy places obligations on the Licensees to provide quality of service data in the context of the QoS Policy.

3.2 The Federal Law by Decree No. (3) of 2003 states the following:

- Article 13 (3) of Federal Law by Decree No. (3) of 2003, as amended, stipulates that the TRA shall exercise its powers in order to, "…*ensure that Licensees meet quality standards of performance and adhere to the terms and conditions of the License granted to them*…"
- Article 14 of the Federal Law by Decree No. 3 2003, as amended, grants the TRA the jurisdiction to issue "*regulations, instructions, decisions and rules*".
- Article 14 (3) and (5) of Federal Law by Decree No. (3) of 2003, as amended, grants the TRA the authority to issue Regulations with respect to:
    - *"the conditions, level and scope of services provided by the Licensees to subscribers, universal service and emergency services including the standards and quality of the provided services, terms of supply, the handling of subscriber complaints and disputes, provision of information to subscribers, usage of subscriber personal information and the provision of bills to subscribers"*
    - *"requesting any information required for the activities of the Authority"*

3.3 Licence 1 and 2 of 2006 state the following:

- Articles 3.5 of both Etisalat's and EITC's Licenses provides that "Quality of service for all Services offered by the Licensee shall meet or exceed the quality of service obligations contained in the Regulatory Framework in effect at the time".

4 Key principles

Delivery of the best possible QoS/QoE in the UAE

4.1 The TRA acknowledges that Licensees have historically delivered good QoS and QoE to End-users. To maintain the UAE's position at the forefront of ICT across the globe, the TRA has selected QoS and QoE indicators with the primary focus of enhancing End-user experience within the UAE. Where applicable, the TRA has set indicative minimum acceptable levels of performance for Licensees to adhere to. The indicators included within the QoS Policy complement the wider TRA QoS Regulatory Framework.

Enhance End-user knowledge through transparency

4.2 A principal aim of the TRA is to promote the interest of the End-users of telecommunications services. One of the key ways that the TRA achieves this goal is through improving End-user knowledge by ensuring that Licensee performance has greater transparency. Therefore, the TRA reserves the right to publish any and all QoS data provided through this QoS Policy, so that comparative evaluation is available to End-users. This activity is aimed at encouraging Licensees to enhance QoS/QoE, which in turn, will lead to an increase in competition.

Enhance collaboration with Licensees through transparency

4.3 Another objective of the TRA is to further enhance collaboration with the Licensees through transparency. The TRA aims to provide full visibility of the KPIs it uses to monitor the Licensees' network performance including definitions, measurement methology and potential threshold values. The aim of explaining the definitions for these indicators is to ensure that Licensees understand how these KPIs are measured by the TRA and to make sure that indicators can be compared with the Licensees own measurements on a like-for-like basis.

Monitoring compliance of Licensees

4.4 The TRA reserves the right to audit any Licensee QoS data or reports that are submitted in relation to QoS/QoE, as referenced within this QoS Policy. As part of the QoS Policy, Licensees are obliged to maintain any and all records and supplementary information necessary for the TRA to substantiate the submissions for a period of five (5) years.

5 QoS Policy scope

Overview of scope

5.1 This QoS Policy shall apply to Licensees' QoS performance as offered to End-users, based on the indicators defined within the QoS Policy. The QoS Policy will apply across the whole of the UAE, on all technologies that are herewith defined, unless otherwise specified.

5.2 This QoS Policy is not an exemption from, or waiver of, any obligations stipulated elsewhere in the TRA's Regulatory Framework.

5.3 This QoS Policy is an update of the QoS Policy, Version 1.2, published 28 September 2009, which was supplemented by QoS Policy Reporting Specification (V.1.3), published 27 September 2010.

5.4 In addition to defining a number of indicators which are to be reported by Licensees (defined in Annexes A and B), this QoS Policy also provides standard definitions for the indicators that are used (or planning to be used) by the TRA. These indicators are included in the QoS Policy to improve the transparency of the overall QoS regulatory framework put in place by the TRA. The definitions for these indicators may change from time to time and consequently be updated in the Annexes of this policy document.

Telecommunications services included within scope

5.5 This QoS Policy covers the following services:

A. Fixed telecommunications services
   i. Fixed voice services
   ii. Fixed broadband services / internet services
B. Mobile telecommunications services
   i. Mobile voice services
   ii. Mobile broadband services / internet services.

Geographical area within scope

5.6 The scope of this QoS Policy applies to the whole UAE. Indicators should be reported at a country-wide level, unless otherwise specified.

Time periods for monitoring and reporting

5.7 The reporting period is from the first day of a calendar month until the last day of that calendar month, unless specified otherwise in the indicator definition. Licensees are required to record data on a monthly basis and then report QoS

data to the TRA each quarter, unless specified otherwise in the indicator definition. Licensees are obliged to meet indicator thresholds (where defined) each quarter. Licensees shall report QoS data to the TRA no later than thirty (30) calendar days following the end of the reporting quarter.

6 QoS Policy key performance indicators

Overview

6.1 In determining QoS/QoE indicators for the QoS Policy, the TRA has taken into consideration international best practice and the recommendations of international organisations. The TRA has also considered the relevance of the indicators for End-users and the compatibility of the indicators with the TRA's objectives of maintaining a high quality of service across all technologies.

6.2 The QoS Policy includes a range of indicators for fixed voice, fixed broadband, and mobile voice. These indicators are outlined in detail in annexes, in the following manner:

- **Annex A** presents the Type 1 QoS indicators, which Licensees are required to report to the TRA on a regular basis as per the legal background presented in Section 3.
- **Annex B** presents the Type 2 QoS indicators, which Licensees are required to report to the TRA on a regular basis as per the legal background presented in Section 3.
- **Annex C** defines current and possible future indicators that the TRA may use to measure the performance of mobile networks. Unless referenced in Annex A and/or B or explicitly requested by the TRA, Licensees are not obligated to report KPIs listed in Annex C to the TRA.
- **Annex D** defines indicators that may be used in any fixed and/or mobile end-user monitoring introduced by the TRA. Unless referenced in Annex A and/or B or explicitly requested by the TRA, Licensees are not obligated to report these indicators to the TRA.

The following sections presents the Type 1 and Type 2 QoS indicators.

QoS indicators – Type 1

6.3 Details of the indicators referenced below are found in Annex A. For reference, each indicator has a unique code, which is also shown below (i.e. [T1(1a)]).

Fixed services (fixed voice and broadband services)

A. Order delivery intervals [T1(1a)]
B. Held orders (waiters) [T1(1b)]
C. Total average order deliver time [T1(1c)]
D. Time to resolve reported faults on services [T1(1d)]
E. Reported faults per 1000 lines [T1(1e)].

Call centre

A. Average queue time for calls to the call centre [T1(2a)].

QoS indicators – Type 2

6.4 Details of the indicators referenced below are found in Annex B. For reference, each indicator has a unique code, which is also shown below (i.e. [T2(1a)]).

Fixed net voice services

A. Network availability [T2(1a)]
B. Network effectiveness ratio (NER) [T2(1b)]
C. Point of Interconnection Congestion [T2(1c)]

Mobile net-based voice services

A. Network availability [T2(2a)]
    a. Core network[2]
    b. Access network[3]
B. Call completion success rate[4] [T2(2b)]
C. Call drop rate[4] [T2(2c)]
D. Point of Interconnection Congestion [T2(2d)]

Fixed and mobile international links

A. International bandwidth utilisation [T2(3a)].

Indicators thresholds

6.5 In this QoS Policy, minimum acceptable levels of performance (threshold with a target value) have been defined as a guide for Licensees to adhere to. The threshold target values have been defined based on the review of international benchmarks and best practice, the historical performance of indicators in the UAE and the review of the overall UAE telecoms market. Target values for the different types of indicators are provided in Annexes A, B, C and D.

6.6 The indicator thresholds that have been defined are indicative and primarily allow the TRA to monitor the performance of the QoS and QoE across the UAE. However, if the TRA sees evidence of a sustained degradation of particular

[2] Licensees shall report separately the availability of the 2G/3G core network and of the Evolved Packet Core (4G) core network

[3] Licensees shall report separately the availability of each type of access networks (e.g. 2G, 3G, 4G, etc)

[4] Licensees shall report separately the QoS Indicators for each type of network (e.g. 2G, 3G, 4G, etc)

indicators over a period of time, it reserves the right to enforce particular KPIs (i.e. mandate Licensees to reach the defined minimum threshold).

Changes to indicators

6.7 The TRA may, at its discretion, modify the criteria described in the Annexes to this QoS Policy as well as any other reporting-related aspect.

6.8 The TRA may, at its discretion, impose performance-level obligations for any and all indicators upon the Licensees.

7 Measurement and auditing tools

Measurement specifications

7.1 The TRA reserves the right to conduct any test on a Licensee's network (e.g. fixed, wireless) and the TRA can and may request for any test to be conducted by the Licensees for any reason (e.g. following a Customer complaint).

7.2 The measurement period is from the first day of the calendar month until the last day of that calendar month. Indicators related to 'order delivery intervals' (i.e. indicator T1(1a) as defined in the Annexes to this QoS Policy) shall be calculated as a rolling average and measured on the final calendar day of the month. All other indicators shall be calculated by calendar month (using a monthly average).

7.3 For Type 1 QoS Indicators, the following applies for the purpose of calculations:

- a reporting period shall be divided into calendar months
- a calendar week consists of five (5) working days, excluding planned public holidays
- a reference to an 'hour' means a working hour
- a working day contains 24 hours
- a reference to a 'day' means a working day
- a reference to 'orders' means orders requiring technician involvement
- a reference to a 'line' means a working line.

7.4 Indicator-specific measurement specifications, where applicable, are presented in the Annexes of this QoS Policy.

7.5 The TRA may oblige the Licensees to directly provide the raw data (e.g. counters provided by the OSS/BSS systems) used to calculate the KPIs.

Auditing tools

7.6 The TRA reserves the right to appoint an independent third-party company to conduct auditing activities related to QoS/QoE measurements, within the UAE. An example of the techniques that the TRA can employ include, but are not limited to:

- Drive testing for mobile measurements (both in-house and third-party companies)
- Crowdsourcing (i.e. measuring QoS indicators through End-user experiences)

- End-user probes[5] (i.e. measurements provided by third-party probes embedded within End-user premises).

5 An End-user probe is a device that connects to a customer's home broadband connection (usually to the home router) and then carries out measurements as prescribed by a test schedule, which can be programmed remotely.

8 Reporting and publishing

Reporting specifications

8.1 The reporting period is from the first day of a calendar month until the last day of that calendar month, or as otherwise directed by the TRA. The required QoS data shall be recorded monthly and reported to the TRA on a monthly & quarterly basis. The QoS data shall be reported to the TRA no later than thirty (30) calendar days following the end of the reporting quarter, unless otherwise specified by the TRA.

8.2 If a '0' is reported in any field it shall be interpreted as meaning the value zero (0).

8.3 The formal public holiday calendar in the UAE, as determined at the beginning of the year, will be used in all calculations. Unexpected holidays or mourning days are included in the reporting. As these unexpected days will impact the reported figures, Licensees will mention the occurrence of those unexpected days in a footnote in the report where relevant.

8.4 Licensee's respective reports will report data in a format as required by the TRA. The TRA reserves the right to modify reporting formats to ensure compatibility with internal TRA procedures.

8.5 In reporting QoS and QoE indicators defined in this Policy, the Licensee shall differentiate between broadband services provided using its own access network and services provided using a wholesale access product from another Licensee (e.g. bitstream).

8.6 The TRA may, at its discretion, request additional information from the Licensees.

Publication specifications

8.7 At the TRA's discretion, the TRA may publish any and all QoS/QoE data related to this QoS Policy.

9 Compliance and audit

Effective date

9.1 This QoS Policy shall be effective on the data of issuance

Audit methodology

9.2 The TRA may conduct, or instruct a Licensee or a third party to conduct, an audit to review QoS data submitted by the Licensees, to ensure accuracy and compliance. Audits can be conducted at the TRA's discretion.

9.3 The particular audit methodology will be determined by the TRA on a case-by-case basis.

Compliance and penalties

9.4 If a Licensee fails to comply with any item within this QoS Policy, the TRA reserves the right to issue penalties/administrative fines to the Licensee that is in breach of its obligations, as per the regulatory framework.

9.5 As referenced in Section 6, the TRA has introduced performance-level thresholds for indicators defined within this QoS Policy. These indicative thresholds are guides for Licensees on the minimum acceptable level of QoS and QoE delivered to End-users and are therefore primarily for monitoring. However, if the TRA sees evidence of a sustained non-compliance for particular indicator(s) over a period of time, it reserves the right to enforce particular KPI(s) (i.e. mandate Licensees to provide a quality above the defined minimum threshold).

Annex A QoS indicators – Type 1

A.1 For indicators T1(1a, 1b, 1c) measuring starts either at application date or at the future start date as requested by the Customer. The measuring stops at the time and date the service is provisioned to the Customer.

A.2 However, for consistency, the following orders are excluded from the calculations:

- Orders where delivery exceeds seven (7) days due to customer-related issues[6] are excluded in the calculation of indicators T1(1a, 1c) and T1(2a, 2c).
- Orders where delivery exceeds sixty (60) days due to customer-related issues are excluded from the calculation of indicators T1(1b) and T1(2b).

Fixed services (fixed voice and broadband services)

Figure A.1: Type 1 indicators related to fixed services

Reference	Indicator	Definition	Target value
T1(1a)	Order delivery intervals	% of orders delivered within seven (7) days of application. Calculated as: *(Orders completed within 7 working days of application date) ÷ (Total orders completed)*	>95%
T1(1b)	Held orders (waiters)	Number of orders not yet completed with application date at least sixty (60) working days prior to last calendar day of the month	<1% of total annual orders
T1(1c)	Total average order delivery time	Average number of days to deliver orders to Customers. Calculated as: *(Total number of days required to complete all orders in that month) ÷ (Total number of orders completed that month)*[7]	<2 days (average)
T1(1d)	Time to resolve faults	Average elapsed hours to resolved reported faults on services. Calculated as: *(Total number of working hours taken for all faults cleared during that month) ÷ (Total number of cleared faults)*[8]	<24 hours (average)
T1(1e)	Reported faults per 1000 lines	Calculated as: *(Total number of faults reported on services * 1000) ÷ (Total number of lines)*	<80 per 1000 lines per year

6 Issues such as (but not limited to) Customer not being present at the appointment time and location agreed between the Customer and the Licensee, or the Customer not providing adequate access to its property to the Licensee to deliver an order or fix a fault.

7 These shall exclude cases where customer appointment was required and when the customer was not present at the appointment.

8 These shall exclude scheduled maintenance.

Call centre

Figure A.2: Type 1 indicators related to call centre services

Reference	Indicator	Definition	Target value
T1(2a)	Average queue time for calls to the call centre	Average time (seconds) spent waiting from the time the Customer has selected the IVR choice to speak to an agent until the Customer is connected to an agent (called 'Average Speed of Answering' and 'Average Waiting Time until being answered' in Licensees' call centre systems)	<2 mins (average)

Annex B QoS indicators – Type 2

B.1 As far as possible, indicators shall be measured on the monthly averaged data, which includes the largest possible statistical representation.

Fixed net voice services

Figure B.1: Type 2 indicators related to fixed voice services

Reference	Indicator	Definition	Target value
T2(1a)	Network availability	Determines the probability of a fixed network performing all its required functions. This will be calculated for the fixed network in such a way that affected lines are considered to be the weighting factor in the following formula: $Network\ availabilty\ per\ month = 1 - \sum_{i=1}^{i=n} Ti * (Na)i \div (30 * 24 * 60 * 60 * TN)$ Where: Ti = duration of the outage in seconds, where I = 1 to n (Na)I = number of affected subscribers during the outage TN = total number of subscribers for the fixed network This method sums the amount of lines connected to an affected network node * outage time and divides this 'affected line time' by the total available lines * available time.	>99.9%
T2(1b)	Network effectiveness ratio (NER)	NER shall be calculated as: *(All the answered calls + unanswered calls for release cause ID (1,16,17. 18, 19, 20, 21, 27, 31 and 102)) ÷ (Total calls * 100)* The description for each release cause is: 1 – unallocated number 16 – normal call clear 17 – user busy 18 – no user response 19 – no answer from user 20 – subscriber absent 21 – call reject 27 – destination out-of-order 31 – normal unspecified 102 – recovery on timer expiry The scenarios considered for national calls are: fixed net voice services (fixed to fixed) and (fixed to mobile)	>98.0%

Reference	Indicator	Definition	Target value
		The above indicator is relevant to signalling system no. 7; future signalling protocols shall be considered in due course.	
T2(1c)	Point of Interconnection Congestion	The ratio of calls failed over the POI (between two network operators) due to unavailability of free circuits to the total call requests for seizure of POI circuit.	<0.5%

Mobile net voice services

Figure B.2: Type 2 indicators related to mobile voice services

Reference	Indicator	Definition	Target value
T2(2a)	Network availability	Determines the probability of a mobile network performing all its required functions. The mobile networks are split into a core network and an access (radio) network. **For the mobile core network**, network availability is calculated in such a way that affected subscribers are considered to be the weighting factor in the following formula: $Network\ availabilty\ per\ month = 1 - \sum_{i=1}^{i=n} Ti * (Na)i \div (30 * 24 * 60 * 60 * TN)$ Where: Ti = duration of the outage in seconds, where I = 1 to n (Na)I = number of affected subscribers during the outage TN = total number of subscribers for the mobile network This method sums the amount of lines connected to an affected network node * outage time and divides this 'affected line time' by the total available lines * available time. **For the mobile access (radio) network**, the reports shall be calculated for the total downtime of the RNC and BSC. $Network\ availability\ per\ month = 1 - \sum_{i=1}^{i=n} Bi * (Cells)i \div (Total\ Time * Cells)$ Where: Total time = (# calendar days in month) * 24 hrs * 60 minutes * 60 seconds Bi = BSC/RNC outage in seconds (Cells)I = number of cells connected to (BSC)i and/or (RNC)i	>99.9% for mobile core >99.5% for mobile access

Reference	Indicator	Definition	Target value
T2(2b)	Call completion success rate	The call completion success rate is calculated as: *(Call setup success rate) * (1- call drop rate)* Alternatively, it can also be thought of as the percentage of call attempts that result in a normal call termination. The reporting will be calculated separately for the 2G and 3G and will also be calculated separately for VoLTE and VoWiFi when applicable.	>98.5%
T2(2c)	Call drop rate	The call drop rate of the system is simply the percentage of successful initiations that dropped (i.e. call dropped after TCH/RAB assignment). *Number of dropped calls / Number of successful assignments* 2G = (2G CDR * 2G traffic) / (2G traffic) 3G = (3G CDR * 3G traffic) / (3G traffic)	<1.0%
T2(2d)	Point of Interconnection Congestion	The ratio of calls failed over the POI (between two network operators) due to unavailability of free circuits to the total call requests for seizure of POI circuit.	<0.5%

*Note on 2G reporting: The TRA is cognizant of Licensees re-farming 2G spectrum for use with 3G and 4G and understands that performance of 2G network may consequently be impacted. However, the TRA still expect Licensees to report data related to 2G networks as it allows the TRA to monitor the transition between 2G voice and 3G voice/VoLTE.

Fixed and mobile international links

B.2 For the indicator 'international bandwidth utilisation', Licensees are obliged to record daily measurements (as specified in Figure B.3) and provide monthly reports to the TRA. The monthly reports should include an average bandwidth utilisation value for the month being reported. All other obligations relating to data reporting apply (i.e. data should be reported within thirty (30) calendar days of the end of the reporting period).

Figure B.3: Type 2 indicators related to fixed and mobile broadband

Reference	Indicator	Definition	Target value
T2(3a)	International bandwidth utilisation	This indicator should be calculated as: $International\ bandwidth\ utilisation = \left(\left(\sum_{i=1}^{i=n} PBWi\right) \div n\right) \div CL$ Where:	Less than 80% (see paragraph B.3)

Reference	Indicator	Definition	Target value
		i represents each day over which the peak bandwidth is measured n=20 represents the 20 most busy days in the month PBW_i=peak bandwidth for day i (in Mbit/s) CL: maximum capacity of the measured link (in Mbit/s)	

B.3 The international bandwidth utilisation shall be measured, on a per-link basis, as the average of the peak bandwidth used during the Busy hour of all working days in a month.

Annex C Mobile network monitoring: KPI definitions

C.1 The Licensees have no reporting obligation to provide KPIs listed in Annex C (unless these are also listed in Annex A or in Annex B or the TRA request such explicitly). The indicator definitions provided in Figure C.1 and **Error! Reference source not found.** are solely to improve transparency of the overall QoS regulatory framework put in place by the TRA. This is to ensure that Licensees understand how these KPIs are measured by the TRA and to make sure that KPIs can be compared with the Licensees' own measurements on a like-for-like basis.

- Figure C.1 provides a definition, the measurement methodology and indicative thresholds (where appropriate) for KPIs used by the TRA to measure mobile network performances (across all relevant mobile technologies).
- Figure C.2 provides a definition, the measurement methodology and indicative thresholds (where appropriate) for KPIs which are likely to be used by the TRA in the future, depending on the introduction of VoIP technology such as Voice Over LTE (VoLTE) and Single Radio Voice Call Continuity (SRVCC). For the avoidance of doubt, KPIs presented in Figure C.2 are not currently measured by the TRA but could be introduced when VoLTE and SRVCC technologies become prominent in the UAE.

Figure C.1: Mobile network KPI definition, measurement methodology and recommended threshold

Indicator	Definition	Formula	Measurement methodology	Target value
Data-related KPIs				
Average HTTP download throughput (Mbits/s)	• HTTP download throughput measures the volume of data (in bits) downloaded by a Client Software from an HTTP	HTTP download throughput = total data volume/download timeframe	• The Client Software fetches (using HTTP GET request) a portion of a large binary payload hosted on an HTTP	No recommended threshold[9]

9 A threshold may be added by the TRA based on observed trends.

	server in a fixed timeframe (in seconds) • The average HTTP download throughput test measures the download rate for the entire duration of the test and excludes the initial warm-up period		server on the target test server • The download speed test is typically run using 8 parallel TCP sessions for a fixed duration of 10 seconds, with a warm-up period of 2 seconds at the start of the test	
Average HTTP upload throughput (Mbits/s)	• HTTP upload throughput measures the volume of data (in bits) uploaded from a Client Software to a server in a fixed timeframe (in seconds) • The average HTTP upload throughput test measures the upload rate for the entire duration of the test and excludes the initial warm-up period	HTTP upload throughput = total transferred data volume/upload timeframe	• The Client Software generates a binary payload and sends it to a server (using HTTP POST request) • The measure of upload throughput may be optionally carried out on the server side in the upload test • The upload speed test is typically run using 8 parallel TCP sessions for a fixed duration of 10 seconds, with a warm-up period of 2 seconds at the start of the test	No recommended threshold[9]
HTTP cut-off rate (%)	• HTTP cut-off rate relates to the number of tests that were aborted and where a 'connection reset' error has been received	HTTP cut-off rate = aborted tests/total volume of tests carried out	• See methodology for average HTTP download throughput	No recommended threshold[9]
Average FTP download	• FTP download throughput measures the total volume of data (in bits) downloaded by a	FTP download throughput = total transferred data volume/download timeframe	• The measurement is conducted between a Client	No recommended threshold[9]

throughput (Mbit/s)	Client Software from an FTP server in a fixed timeframe • The average FTP download throughput test measures the download rate for the entire duration of the test		Software device and a nearby test server • FTP measurement uses TCP port 21 • FTP measurement is carried out using a single TCP session • In the download test, the FTP test Client Software will perform a 'RETR' command to download a portion of large test file (for typically 10 seconds)	
Average FTP upload throughput (Mbit/s)	• FTP upload throughput measures the total volume of data (in bits) uploaded to an FTP test server by a Client Software device in a fixed timeframe (typically 10 seconds) • The average FTP upload throughput test measures the download rate for the entire duration of the test	FTP upload throughput = total transferred data volume/upload timeframe	• See methodology for average FTP download throughput • In the upload direction, the FTP test Client Software will perform a 'STOR' command.	No recommended threshold[9]
FTP drop rate (%)	• FTP drop rate relates to the number of tests that were aborted and where a 'connection reset' error has been received.	FTP drop rate = aborted tests/total volume of tests carried out	• See methodology for average FTP download throughput	No recommended threshold[9]

Round-trip latency (ms)	• The time taken for a Client Software to send a data packet to a server and for the server to then send an acknowledgement back to the Client Software (or vice versa)	Not applicable	• The ICMP test measures the mean round-trip time (RTT) of ICMP echo requests in microseconds from the probe to a target test node • The Client Software sends 5 ICMP echo requests of 56 bytes to the target waiting up to three seconds for a response to each • Packets that are not received in response are treated as lost	No recommended threshold[9]
Voice-related KPIs				
Average call setup time(s)	• The time period between initiation and establishment of a call (in seconds)	Call setup time = time at which calling party receives alerting tone – time at which user pressed call button	• As per standard *ETSI TR 103 219*	No recommended threshold[9]
Average CSFB call setup time(s)	• The time period between initiation and establishment of a call (in seconds)	Call setup time = time at which calling party receives alerting tone – time at which user pressed call button	• As per standard *ETSI TR 103 219*	No recommended threshold[9]
Call setup success rate (CSSR)	• Percentage of call attempts which resulted in a successful call initiation (i.e. not SDCCH blocking and TCH successful assignment for 2G and RRC and successful RAB assignment for 3G)	2G CSSR = (1-SDCCH drop rate) * (1-TCH assignment failure) 3G CSSR = (RRC Conv success rate) * (AMR RAB setup success rate)	• As per standard *3GPP TR 32.814*	>99%

Point of Interconnection Congestion	• The ratio of calls failed over the POI (between two network operators) due to unavailability of free circuits to the total call requests for seizure of POI circuit	POI congestion = Total number of calls failed over the POI due to unavailability of free circuits / total call requests for seizure of POI circuit	• As per standard ITU-T E.847	<0.5%
SMS success rate	• Ratio of received and sent test SMS from one mobile to another mobile, excluding duplicate received and corrupted test SMS	SMS success rate = (successful received test SMS – duplicate received test SMS – corrupted test SMS) / (number of all send test SMS)	• As per standard *ETSI TS 102 250-2*	>99%[10]
Coverage and handover related KPIs				
2G outdoor coverage – received signal strength indicator (RSSI)	• 2G coverage measured using RSSI as defined in standard *ETSI TS 125 225*	As per standard *ETSI TS 125 225*	• As per standard *ETSI TS 125 225*	• Excellent: >= –70dBm • Good: –85dBm to –70dBm • Fair: –95dBm to –86dBm • Poor: –110dBm to –96dBm • Marginal to no coverage: < –111dBm
3G outdoor coverage – received signal code power (RSCP)	• 3G coverage measured using RSCP as defined in standard *ETSI TS 125 225*	Refer to standard *ETSI TS 125 225*	• Refer to standard *ETSI TS 125 225*	• Excellent: >= –65dBm • Good: –80dBm to –66dBM • Fair: –95dBm to –81dBm

10 This excludes End-user behaviour (i.e. if the receiver's phone is switched off, the SMS transfer attempt is not accounted for).

				• Poor: –110dBm to –96dBm • Marginal to no coverage: < –111dBm
4G outdoor coverage – received signal received power (RSRP)	• 4G coverage measured using RSRP as defined in standard *ETSI TS 136.214*	Refer to standard *ETSI TS 136.214*	• Refer to standard *ETSI TS 136.214*	• Excellent: >= –70dBm • Good: –85dBm to –71dBm • Fair: –110dBm to –86dBm • Poor: –120dBm to –111dBm • Marginal to no coverage: < –121dBm

Figure C.2: Future KPI definition, measurement methodology and recommended threshold

Indicator	Definition	Formula	Measurement methodology	Target value
CSFB failure ratio (calling party)	This indicator measures the probability that the CSFB procedure is not executed successfully by the calling party	CSFB failure ratio = unsuccessful CSFB attempts (calling party)/all CSFB attempts	Refer to standard *ETSI TR 103 219* To be introduced when VoLTE and SRVCC technology becomes available in the UAE	Monitoring required before setup threshold
VoLTE session setup failure ratio	This indicator is the probability that the VoLTE terminal cannot setup a session	VoLTE session setup failure ratio = unsuccessful VoLTE session setup attempt/all VoLTE session setup attempt	Refer to standard *ETSI TR 103 219*	Monitoring required before setup threshold

Indicator	Definition	Formula	Measurement methodology	Target value
			To be introduced when VoLTE and SRVCC technology becomes available in the UAE	
VoLTE session setup time	This indicator is the time needed to initialise a VoLTE session	VoLTE session setup time = time of calling party receives notification – time that calling party initiates call session	Refer to standard *ETSI TR 103 219* To be introduced when VoLTE and SRVCC technology becomes available in the UAE	Monitoring required before setup threshold
VoLTE session cut-off ratio	This indicator is the probability that a successfully started call is ended by a cause other than intentional termination by calling or called party	VoLTE session cut-off ratio [%] = unsuccessful completed VoLTE session/all successful started VoLTE sessions	Refer to standard *ETSI TR 103 219* To be introduced when VoLTE and SRVCC technology becomes available in the UAE	Monitoring required before setup threshold
IMS registration success ratio	This indicator is the probability that the user equipment successfully registers to IMS	IMS registration success ratio = successful IMS registration attempts/all IMS registration attempts	Refer to standard *ETSI TR 103 219* To be introduced when VoLTE and SRVCC technology becomes available in the UAE	Monitoring required before setup threshold
IMS registration success ratio	This indicator is the time needed for successful registration to IMS	IMS registration time= time at which network confirms IMS registration – time at which user equipment requested registration	Refer to standard *ETSI TR 103 219* To be introduced when VoLTE and SRVCC technology becomes available in the UAE	Monitoring required before setup threshold
SRVCC success ratio	This indicator is the probability that the user equipment successfully hands over an IMS anchored call to UMTS	SRVCC success ratio = successful SRVCC handovers/all SRVCC invocations	Refer to standard *ETSI TR 103 219*	Monitoring required before setup threshold

Indicator	Definition	Formula	Measurement methodology	Target value
			To be introduced when VoLTE and SRVCC technology becomes available in the UAE	
SRVCC time	This indicator is the time taken to successfully hand over an IMS-anchored call to UMTS	SRVCC time = time at which SRVCC handover is successfully completed – time at which SRVCC handover is invoked	Refer to standard *ETSI TR 103 219* To be introduced when VoLTE and SRVCC technology becomes available in the UAE	Monitoring required before setup threshold
5G outdoor coverage – channel state information – received signal received power (CSI-RSRP)[11]	5G coverage measured using CSI-RSRP as defined in standard *ETSI TS 138.215 V15.2.0 (2018-07)*	Refer to standard *ETSI TS 138.215 V15.2.0 (2018-07)*	Refer to standard *ETSI TS 138.215 V15.2.0 (2018-07)*	To be finalised

11 Please note that 5G standards and minimum signal thresholds are still being finalised throughout 2019 (https://www.etsi.org/technologies/5g). The TRA reserves the right to update this indicator based upon the finalised standards and thresholds.

Annex D End-user monitoring: QoS/QoE KPI definitions

D.1 The Licensees have no reporting obligation to provide the KPIs listed in Annex D (unless these are also listed in Annex A or in Annex B or the TRA explicitly asks them to do so). The indicator definitions provided in this Annex are solely to improve transparency of the overall QoS regulatory framework put in place by the TRA. This is to ensure that Licensees understand how these KPIs are measured by the TRA and to make sure that KPIs can be compared with the Licensees' own measurements on a like-for-like basis.

- Figure D.1 provides a definition, the measurement methodology and indicative thresholds (where appropriate) for QoS KPIs associated with fixed and mobile end-user monitoring (all mobile technologies). All QoS KPIs are equally applicable for both the fixed and the mobile End-users

- Figure D.2 provides a definition, the measurement methodology and indicative thresholds (where appropriate) for QoE KPIs associated with fixed and mobile End-user monitoring. All QoE KPIs are applicable for the fixed End-users but only the Webpage Loading Time and Video Streaming tests are usually used for mobile End-users.

Figure D.1: QOS KPI for fixed and mobile End-user monitoring

Indicator	Definition	Formula	Measurement methodology	Target value
Download throughput (Mbit/s)	See definition provided in Figure C.1 for average and peak HTTP download throughput	See formula provided in Figure C.1 for average and peak HTTP download throughput	See measurement methodology provided in Figure C.1 for average and peak HTTP download throughput	No recommended threshold[9]
Upload throughput (Mbit/s)	See definition provided in Figure C.1 for average and peak HTTP upload throughput	See formula provided in Figure C.1 for average and peak HTTP upload throughput	See measurement methodology provided in Figure C.1 for average and peak HTTP upload throughput	No recommended threshold[9]

Indicator	Definition	Formula	Measurement methodology	Target value
Latency (ms)	See definition provided in Figure C.1 for round-trip latency	See formula provided in Figure C.1 for round-trip latency	See measurement methodology provided in Figure C.1 for round-trip latency	• Typically, <50ms for local target server and for xDSL access technology[12] • Typically, <25ms for local target server and for FTTH access technology[12] • Typically, <300ms for international target server[12]
Jitter (ms)	The variation in latency between the measurement device at premises location and a target test server	As per standard RFC 5481	Based on latency measurements described above and calculated using standard RFC 5481	• No recommended threshold[9]
Packet loss (%)	Percentage of packets sent but not received by the target within a given time window	Packet loss= total number of packets successfully received/total number of packets transmitted	Typically conducted using the same UDP test as the one used for the latency test	• Typically, <0.5% packet loss for 95% of tests on FTTH networks[12] • Typically, <2% packet loss for 95% of tests on xDSL networks[12]

Figure D.2: QOE KPI for fixed and mobile End-user monitoring

Indicator	Definition	Formula	Measurement methodology	Target value
Webpage loading time	• Assessment of the quality of experience associated with the download time of webpages • Total time to download a webpage including associated resources such	Not applicable	• Selected test websites are usually the 10 most visited sites in the country.	No recommended threshold[9]

12 Threshold only applicable to fixed End-user monitoring (i.e. not applicable to mobile End-user monitoring).

Indicator	Definition	Formula	Measurement methodology	Target value
	as images, JavaScript, and Stylesheets. • Tests undertaken for real website in the country, allowing for content distribution networks (CDN) and other performance enhancing factors to be considered in the QoE measurement • Test typically record total data volume downloaded per page (in Bytes) and time to download the webpage and associated resources (in seconds)		• The results typically include the time taken for DNS resolution. • The test typically uses up to eight concurrent TCP connections to fetch resources from website. • The test typically pools TCP connections and utilises persistent connections where the remote HTTP server supports them.	
DNS lookup resolution time/lookup failure rate	• Measures the DNS resolution time/ lookup failure of a selection of common website domain names	Not applicable	• The measurement typically performs an "A" record query for each domain name against the DNS servers provided by auto-configuration (e.g. DHCP) to the Client Software. • The measurement typically records the time	No recommended threshold[9]

Indicator	Definition	Formula	Measurement methodology	Target value
			taken in milliseconds to retrieve a successful response. • A successful response is one where at least one A record is returned and the response does not have an error code set	
Video streaming quality	• Assessment of the quality of experience associated with streaming video • Application of specific tests such as bitrate reliably streamed, TCP connection time etc. to determine quality • Tests undertaken for real services (e.g. Netflix, Youtube) in the country, allowing for content distribution networks (CDN) and other performance enhancing factors to be considered in the QoE measurement • Typical recorded KPIs include the average throughput and TCP connection time	Not applicable	• Video streaming measurements are typically conducted on popular over-the-top video services (e.g. YouTube, Netflix) that are representative of the services that real Customers use. • The measurement typically takes into consideration that video services deliver content at multiple bitrates and capturing the best quality video that a user can reliably watch without experiencing stalls is crucial.	No recommended threshold[9]

Indicator	Definition	Formula	Measurement methodology	Target value
Gaming	• Assessment of the quality of experience associated with real live online games • Application of specific tests such as round-trip latency and packet loss to game servers used during gameplay	Not applicable	• Measurements typically made at the application layer protocols used by the games (e.g. UDP on the specific gaming port) • When application layer application layer protocols cannot be measured, ICMP can be used instead. • Average latency typically measured using a minimum of 5 UDP packets.	No recommended threshold[9]
Voice quality	• Assessment of the quality of experience associated with IP voice services • Indicators such as round-trip latency, one-way jitter, one-way packet loss are typically measured • Mean Opinion Score (MOS) is then calculated from the above indicators using the E-Model as specified in ITU-T Rec. G.107.	Not applicable	• The measurement typically conducted using a real VoIP call using a signalling protocol and codec that are representative of real calls (e.g. SIP and G.711). • Measurement consists in measuring UDP traffic in each direction independently. • When using simulated voice, a 64kbit/s stream using 160-byte packets	No recommended threshold[9]

Indicator	Definition	Formula	Measurement methodology	Target value
			with 20ms spacing is typically used. • The measurement should record one-way jitter, one-way loss, and round-trip latency.	
Online storage	• Assessment of the quality of experience associated with the download and upload speed from several popular online file storage services • Tests undertaken for real online storage services such as Dropbox, Box, Google Drive, Microsoft OneDrive) in the country used by End-users using the real protocols that these application uses (e.g. HTTP over TLS for both downloading and uploading content)		• Measurements typically consist in the transfer of data for a minimum of 5 seconds (in both downstream and upstream directions independently). • Measurements typically record downstream throughput, upstream throughput and the TCP connection establishment time.	No recommended threshold[9]