



INFORMATION COMMUNICATION TECHNOLOGIES QUALITY OF SERVICE AND QUALITY OF EXPERIENCE GUIDELINES

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PART I - INTRODUCTION

The Botswana Communications Regulatory Authority (“BOCRA or the Authority”) is a statutory body established under the Communications Regulatory Authority Act of 2012 (The Act). The Authority is mandated to apply the provisions of the Act in a manner which promote efficient provision of communications services throughout the country. The Act is available from Government Printers in Gaborone, Botswana or may be obtained at the following website: <http://www.bocra.org.bw>.

In accordance with Section 6 of CRA Act, BOCRA is mandated to amongst other things to undertake the following.

- a. Protect and promote the interests of consumers particularly in respect of the prices charged for, and the availability, quality and variety of services and products and where appropriate, the variety of services and products offered throughout Botswana, such as will satisfy all reasonable demands for those services and products; and
- b. Monitor performance of regulated sectors in relation to the levels of investment, availability, quantity, quality and standards of services, competition, pricing, cost of services, efficiency of production, and distribution of services and any other matters decided upon by the Authority.

EXPLANATORY NOTE

1. The primary object of these Guidelines is to establish a framework within which Telecommunication Service Providers can report on network quality of service performance.
2. All Telecommunication Service Providers shall comply with the terms of these guidelines.
3. The Guidelines are divided into Nine parts. A summary of each Part of the proposed Guidelines is provided below.
4. Part I sets out the background to the Guidelines, objectives of the Guidelines and provides definitions of technical and non-technical terms used in the Guidelines. This part deals with the responsibility of the Authority under the Communications Regulatory Act. The idea is to

show the legal basis for the work of the Authority and its legal right and or power to enforce compliance to the set standards of Quality of Service

5. Part II is dedicated to the abbreviation and definition of terms used in these document
6. Part III gives the communication license obligation
7. Part IV details compliance to the guidelines
8. Part V discusses how the service providers should report, how they should keep the performance records, how auditing will be carried out and requirement for publication of performance
9. Part VI gives information in terms of reporting planned and unplanned interruption of service
10. Part VII gives information on how frequently these guidelines will be reviewed.
11. Part VIII this part describes the implementation/the come into effect date
12. Part IX discusses the different schedules for the different Key Performance Indicators for fixed (voice and data), mobile data (voice and data), interconnection, Voice over LTE and parameters for no technical key performance indicators which quality of experience from consumers.

The review of this guidelines is intended to incorporate technological changes, how service providers should report network interruption and how performance should be reported across different areas and technologies.

These guidelines will be available for public comment until 30th of June 2022. All comments, questions and clarity should be forwarded to:

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Ms Cynthia Jansen at jansen@bocra.org.bw

PRELIMINARY PROVISIONS

The Authority means Botswana Communications Regulatory Authority (BOCRA).

In these Guidelines, unless the context requires otherwise, the Act means the Communications Regulatory Authority Act (CRA Act) of 2012.

These Guidelines maybe referred to as the current Information and Communications Technologies Quality of Service (ICT QoS) and Quality of Experience (QoE) Guidelines of 2022.

These Guidelines shall apply to all Licensees offering Internet, and Telecommunications services in Botswana.

The authority in consultation with industry stakeholder may from time to time review the guidelines to cater for the ever-changing landscape of the telecommunications industry and to align to the National Broadband Strategy.

OBJECTIVES

The objectives of these Guidelines are to:

- (a) Protect and to promote the interest of consumers of Internet and Telecommunications services.
- (b) Provide measurement options for quality of service.
- (c) Monitor quality of experience; and
- (d) Promote competition amongst the service providers

PART II

ABBREVIATIONS

5G	-	Fifth Generation Network
CSR	-	Call Success Rate
CSSR	-	Call Set Up Success Rate
CST	-	Call Setup Time
DCR	-	Drop Call Ratio
DCR	-	Drop Call Ratio
DNS	-	Domain Name System
DSR	-	Delivery Success Rate
FTP	-	File Transfer Protocol
GSM	-	Global System for Mobiles
HSR	-	Handover Success Rate
HTTP	-	Hypertext Transfer Protocol
ISSR	-	Internet Setup Success Rate
LTE	-	Long Term Evolution
MCS	-	Mobile Coverage Strength
MOS	-	Mean Opinion Score
MTTR	-	Mean Time To Repair
NA	-	Network Availability
NER	-	Network Efficiency Ratio
PDD	-	Post Dialing Delay
POI	-	Point Of Interconnection
QoE	-	Quality of Experience
QoS	-	Quality of Service
RSR	-	Registration Success Rate
RSR	-	Resolution Success Rate
SMS	-	Short Message Service
UMTS	-	Universal Mobile Telecommunications Service
WWW	-	World Wide Web

DEFINITIONS

Access Network Utilization - is the total traffic between access node to aggregation node.

Billing Accuracy (BA) – is the same duration in seconds used for a call should be used for charging.

Billing Complaint Rate (BCR) - is the percentage of customer billing related complaints per the reporting period. Both the level of quality of service offered to the consumer and the perceptions and/ or experience of the quality of service offered are critical factors in monitoring quality of service.

Call Centre Operator Response (CCOR) - is the duration between sending a request to speak to the Operator to the time that the Operator's response is heard.

Call Connection Failure (CCF) – is the percentage of unsuccessful calls.

Call Set-up Success Rate (CSSR) - is the ratio of total number of successful calls to the total number of all call attempts made on the network during a specified period.

Call Setup Time (CST)- is the duration from when a call is made to the time of receiving a ring back tone.

Complaint Resolution Time (CRT) - is the time taken for a service provider to resolve a complaint.

Data Access Success Rate - is the probability of success in connecting to the public server.

Data Transmission Rate - is the speed of data travelling from user to a network and back.

DNS Resolution Success Rate - is the likelihood for a domain name to be converted into an IP address successfully by DNS resolver.

DNS Resolution Time – is the time taken for a DNS domain name to translate website names into IP addresses.

DNS Resolver - also known as a resolver, is a server on the internet that is responsible to convert domain names to IP addresses.

Drop Call Ratio (DCR) - is the percentage of calls connected to intended recipients that ended without the intervention of any of the users.

FTP - is the standard network protocol used for computer file transfer between a client and a server

FTP Drop Rate - is the percentage of incomplete data transfers that were started successfully.

FTP Mean Data Rate [Mbit/s] - is the average data transfer rate measured through the entire connect time to the service.

FTP Set-up Time - is the duration to access the service successfully, from starting the dial-up connection to the point of time when the content is sent or received.

Handover Success Rate (HSR) - is the ratio of successful handover calls to the total number of handover call attempts made. Handover is the process by which a mobile telephone call is transferred from one base station to another as the subscriber passes the boundary of a cell. *[Recommendation ITU-T Q.1005].*

HTTP - is the underlying protocol used by the world wide web that defines how messages are formatted and transmitted and what actions the WEB server and browser should take in response to various commands

HTTP Drop Rate – is the percentage of incomplete data transfers that were started successfully.

HTTP Mean Data Rate - is the average data transfer rate measured through the entire connection time to the service.

HTTP Set-up Time – is the duration between the instant when the request of the web page is sent to the instant when the beginning of the web page is received.

Interconnection Route Utilization (IRU) – is the percentage of provisioned interconnection route(s) that carry traffic.

Latency – is the round-trip time taken by standard packet to travel across network from end user to the test equipment and back to the user.

Mean Opinion Score (MOS) - is a numerical value that measures user experience and the factors that influence voice quality. [*Recommendation ITU-T P.863*].

Mean Time To Repair (MTTR -) - is the duration between a reported fault to service restoration.

Mobile Coverage Strength - is the transmitter power output as received by a reference antenna at a distance from the transmitting antenna.

Network Availability (NA) - is the degree to which the network is operable and not in a state of failure or outage at any point in time.

Network Efficiency Ratio (NER) - is the ability of the network to deliver calls to the furthest terminal. It expresses the relationship between the number of seizures and the sum of number of seizures resulting in either an answer message, or a user busy or a no answer ring. [*Recommendation ITU-T E.425*]. [the ability of the network to deliver calls]

Packet Loss - is the percentage of data packets transmitted from the source but fail to arrive at their destinations.

Point of Interconnection Congestion - is the percentage of congestion at point of interconnection. [*Recommendation ITU-T E847*].

Post Dialing Delay (PDD) - is the Time interval in seconds between the end of dialing by the caller and the reception of the network response. Equivalent to Call Setup Time, as defined in [*Recommendation ITU-T E.800*].

Provision of Service - is the time taken to provide service to a location where it is required.

Quality of Experience (QoE) - is the consumer perception, or experience of the quality of the service offered.

Quality of Service (QoS) - is the statement of the level of quality of the service as offered to the consumer by a service provider. *[ITU-T Recommendation G.100]*.

Quality of Service Guidelines - is a set of standards and measures that define applicable quality measures.

Registration Success Rate (RSR) - is the ratio of the number of successful established terminating sessions to the number of attempted established terminating sessions. *[ETSI TR 103 219]*.

Service Availability (SA -) - is the percentage of time the network shall be available to the subscribers.

SMS Delivery Success Rate - is the percentage of sent messages that are received by the intended recipient(s).

SMS End to End Delivery Time - is the duration from when an SMS is sent to the time of receiving the SMS by the intended recipient(s).

SMS Service Accessibility - is the probability that a user can access the SMS centre for sending SMS.

Throughput - is the speed of uploading and downloading data in Megabits per second between end-user and test equipment.

Web Radio Reproduction Cut-off Ratio -is the percentage that a subscriber cannot successfully complete stream reproduction from a given web radio station for a given period.

Web Radio Tune-in Success Rate - is the percentage that a subscriber can obtain the tune-in information for a web radio streaming server successfully.

Web Radio Tune-in Success Time – is the duration needed to obtain the tune-in information for a web radio streaming server successfully.

A. TECHNICAL PARAMETERS

FIXED VOICE SERVICES

The following parameters as defined under definitions are applicable to fixed services: -

Call Setup Success Rate (CSSR)

Call Setup Time (CST)

Drop Call Ratio (DCR)

Network Availability NA)

MOBILE VOICE SERVICES

The following parameters as defined under definitions are applicable to mobile services: -

Mean Opinion Score (MOS)

Call Setup Time (CST)

Call Set-up Success Rate (CSSR)

Drop Call Ratio (DCR)

Handover Success Rate (HSR)

Mobile Coverage Strength (MCS)

Network Availability (NA)

SMS Delivery Success Rate

SMS End to End Delivery Time

SMS Service Accessibility
Network Efficiency Ratio (NER)

Post Dialing Delay (PDD)

Registration Success Rate (RSR)

Service Availability (SA)

FIXED INTERNET SERVICES (WIRED AND WIRELESS)

The following parameters as defined under definitions are applicable to fixed internet services both wired and wireless. Copper and fiber connection are considered as fixed connections: -

Call Setup Success Rate (CSSR)

Call Session Drop Rate

Call Setup Time

DNS Resolution Success Rate

DNS Resolution Time

Data Transmission Rate

Access Network Utilization

Throughput

Latency

Packet Loss

MOBILE INTERNET SERVICES

The following parameters as defined under definitions are applicable to mobile internet services. Where applicable, different KPI target will be set for different mobile technologies as different technologies have different capabilities: -

Call Setup Success Rate (CSSR)

Call Session Drop Rate

Call Setup Time

FTP Drop Rate

FTP Mean Data Rate [Mbit/s]

FTP Set-up Time

HTTP Drop Rate

HTTP Mean Data Rate

HTTP Set-up Time

Average user Throughput (Download and Upload)

Access Network Utilization

Latency

WEB RADIO STREAMING SERVICE

The following parameters as defined under definitions are applicable to web radio streaming services: -

Web Radio Tune-in Success Rate

Web Radio Tune-in Success Time

Web Radio Reproduction Cut-off Ratio

INTERCONNECTION

The following parameters as defined under definitions are applicable to interconnection:

Interconnection Route Utilization

Point of Interconnection Congestion

B. NON-TECHNICAL PARAMETERS

The following parameters as defined under definitions are applicable to non-Technical Services

Service Availability

Provision of Service

Call Centre Operator Response

Mean Time To Repair (MTTR)

Billing Complaint Rate

Billing Accuracy

Complaint Resolution Time (Technical complaints)

PART III

COMMUNICATION SERVICE LICENSEE OBLIGATIONS

The ICT service providers shall: -

- (a) provide communication services that meet quality of service parameters as set forth by these Guidelines.
- (b) support the intervention of the regulator by allowing access to the network for purposes of collecting network performance data when requested.
- (c) continuously measure network performance and keep records of the results of the measurements as per Part V; and
- (d) report the same as per Part V of these guidelines.

PART IV

COMPLIANCE

Section 6 (2) (a and c) of the CRA Act, mandates the Authority to: -

“(a) protect and promote the interests of consumers, purchasers and other users of the services in the regulated sectors, particularly in respect of the prices charged for, and the availability, quality and variety of services and products, and where appropriate, the variety of services and products offered throughout Botswana, such as will satisfy all reasonable demands for those services and products;

and

(c) monitor the performance of the regulated sectors in relation to levels of investment, availability, quantity, quality and standards of services,

competition, pricing, the costs of services, the efficiency of production and distribution of services and any other matters decided upon by the Authority;” .

Service Level Agreements

The Service Providers shall establish well-defined Service Level Agreements (SLAs) with consumers to ensure end to end QoS.

In general, the SLA shall state, among others, the following: -

- Level of performance: The minimum level of service performance offered to the customer, not the average level to be achieved for all customers.
- The compensation: if the minimum service level is not achieved, the compensation should at least be commensurate to the degree of failure; and
- The mechanism for claiming compensation: this should be done automatically without requiring the customer to file for a claim.

Monitoring

The Authority shall: -

- (a) carry out network monitoring, and validate the data against network performance data from the operators
- (b) monitor the adherence to Quality-of-Service measurements procedures; and
- (c) direct its officers or agents (third party) to carry out investigations on Quality-of-Service measurements.

Inspection

The Authority or any person authorized in writing by the Authority may, upon furnishing reasonable notice, enter upon the premises of the licensee and request access to the network management servers for purposes of ascertaining compliance with these Guidelines.

Enforcement

The Authority shall take appropriate measures to enforce these Guidelines in conjunction with penalties as stipulated in the BOCRA Penalty Framework.

PART V

REPORTING

Reporting

The Licensee shall, submit Quality of Service reports as may be required by the Authority from time to time.

Submit to BOCRA network performance raw data for the purpose of analysis and reports generation.

Record Keeping

All Licensed Service Providers shall:

- (a) maintain documented processes of data collection as per the KPI Formulas for each parameter contained in these Guidelines and submit the same to the Authority as required from time to time.
- (b) complete and maintain accurate records of its compliance for each QoS parameter specified in such a manner and in such a format, as may be prescribed by the Authority from time to time.
- (c) The Authority may, from time to time, either by order or by direction, specify uniform record keeping procedures and formats including guidelines on measurement methodology for various QoS parameters; and

- (d) The Authority may, if it considers it expedient to do so, at any time, direct any of its officers or employees or an agency appointed by the Authority to inspect the records or to get such records audited.

Auditing

The Authority shall:

- (a) audit some or all the Quality-of-Service data.
- (b) opt to use a **third party** to perform audits on behalf of the Authority.
- (c) audit Quality of Experience based on Customer Satisfaction Surveys undertaken by the Authority; and
- (d) vary the frequency of the audits, reporting areas and reporting periods that require auditing.

Publication

The Authority shall publish, on print media or on the Authority's website or any applicable digital platform, the Quality of Service/ Quality of Experience Report as may be decided by the Authority as follows:

- (a) the compliance reports of each Quality of Service and Quality of Experience parameter reported/submitted to it by the service providers under these Guidelines.
- (b) the results of the audit and assessment of the Quality of Service and Quality of Experience undertaken by the Authority or its authorized agent.
- (c) the Authority may request licensees to publish Quality of Service and Quality of Experience parameter information on their websites, or any digital platforms; and
- (d) If so, requested in terms of (c) above, Operators shall publish on their websites, or any applicable digital platform, a Coverage Map showing their network coverage and network availability.

PART VI

SERVICE INTERRUPTIONS

Notwithstanding that no subscriber should experience service interruption and not be accorded prompt response, Interruptions affecting at least 5% of the operator's subscriber base, or affect site(s) and disconnecting communities from network, **MUST** be considered critical and reported as prescribed below.

Planned Service Interruptions

Licensees shall:

- (a) issue public notices in advance of any planned interruption of services by publishing such notice in a widely read electronic media or print media at least **48 hours** before the planned interruption of service and send the notice through the Short Messaging System (SMS), any applicable digital platform.
- (b) issue public notices stating the number and type of subscribers that will be affected by the planned interruptions; and
- (c) provide the information for such service interruptions to the Authority at least 48 hours before the planned interruption of service.

Unplanned Service Interruptions

In the event of any unplanned service interruption a licensee shall:

- (a) within an hour of the event, notify the Authority via email of the occurrence of the event, including details on areas affected and numbers of end users affected where possible.
- (b) continue to provide updates to the Authority via email every one-hour detailing progress in resolving the issue; and
- (c) within 24 hours of resolution of the issue, provide the Authority with a formal report detailing the circumstances attributing to the interruptions of the service, and the action taken to remedy the situation.
- (d) send the public notice through the Short Messaging System (SMS) or through any available digital platform.

PART VII

REVIEW

The Authority may review the Quality of Service and Quality of Experience targets and parameters under these guidelines as and when required.

PART VIII

IMPLEMENTATION

These Guidelines shall come into effect on the 1st of September 2022.

SCHEDULES

The licensee providing services above shall be required to meet targets on Quality-of-Service parameters as specified in **Schedule 1 to 7** of these Guidelines

SCHEDULE 1

QUALITY OF SERVICE PUBLIC SWITCHED TELEPHONE SERVICES

TABLE 1: QUALITY OF SERVICE PUBLIC SWITCHED TELEPHONE SERVICES

Parameter Name	Formula	Measurement Mechanism (standards)	Measurement Tool	Target
Network Availability	$Network\ Availability = [(Total\ Operational\ minutes - Total\ minutes\ of\ service\ downtime) / Total\ operational\ minutes] * 100\%$	Test traffic. ETSI EG 202 057-3	Performance Monitoring System Test Stations	>99%
Call Set-up Time	$Call\ Set-up\ Time = Time\ of\ Call\ Alerting - Time\ of\ receiving\ Dial\ tone$	Test traffic	Performance Monitoring System Test Stations	<3sec (local call) <5sec (Toll)
Call Setup Success Rate	$Call\ Set-up\ Success\ Rate = (Total\ number\ of\ successfully\ connected\ calls / Total\ number\ of\ attempts) * 100\%$	Test Traffic	Performance Monitoring System Test Stations	<2%
Drop Call Ratio	$Drop\ Call\ Ratio = (Number\ of\ Calls\ disconnected\ without\ intervention\ by\ any\ user / Number\ of\ Calls\ connected\ to\ intended\ recipient) * 100\%$	Real Traffic from OSS and or Test traffic. ETSI ES 202 765-2, clause 7.4	Performance Monitoring System Test Stations	≤ 2%
Voice Quality	Mean Opinion Score is expressed in one number from 1-5, 1 being the worst and 5 being the best. Recommendation ITU-T P.800, ITU-T P.862 and ITU-T P.863.1	Test traffic	Performance Monitoring System Test Stations	≥3.5

SCHEDULE 2

QUALITY OF SERVICE PARAMETR FOR MOBILE SERVICES

TABLE 2: QUALITY OF SERVICE PARAMETR FOR MOBILE SERVICES

Parameter Name	Formula	Measurement Mechanism	Measurement Tool	Target
Network Availability	$Network\ Availability = [(Total\ Operational\ minutes - Total\ minutes\ of\ service\ downtime) / Total\ operational\ minutes] * 100\%$	Test traffic.	Performance Monitoring System Test Stations, Crowdsourcing systems	>99% for class 1 locations >98% for class 2 locations >97% for class 3 locations
Call Set-up Time	$Call\ Set-up\ Time = Time\ of\ Call\ Alerting - Time\ of\ receiving\ Dial\ tone$	Test traffic	Performance Monitoring System Test Stations	<5 sec for GSM <4 sec for UMTS (intra network normal traffic) <8 sec (mobile to fixed to normal traffic)
Drop Call Rate	$Drop\ Call\ Ratio = (Number\ of\ Calls\ disconnected\ without\ intervention\ by\ any\ user / Number\ of\ Calls\ connected\ to\ intended\ recipient) * 100\%$	Real Traffic from OSS and or Test traffic.	Performance Monitoring system Test Stations	≤ 2%

Call Set-up Success Rate	<i>Call Set-up Success Rate</i> = (Total number of successfully connected calls / Total number of attempts) *100%	Real Traffic from OSS and or Test traffic.	Performance Monitoring system Test Stations	≥98% for all calls
Handover Successful Rate	Handover Successful Rate = (Total number of Successful handovers / Total number of handover requests) *100%	from OSS and or Test traffic	Performance Monitoring system Test Stations	≥96%
Mobile Service Coverage Signal Strength	Mobile Service Coverage signal strength = Field strength measurements	Field strength measurements	Test Stations	GSM ≥ -85dBm ((in- vehicles) ≥ -95dBm (outdoors) UMTS ≥ -90dBm ((in- vehicles) ≥ -100dBm (outdoors)
SMS Delivery Success Rate	SMS Delivery Success Rate = (Number of SMS received by intended recipients/ number of SMS sent) *100%	Real Traffic from OSS and or Test Traffic	System/ Test Stations	SMS 97% (Excluding Bulk SMS services)
SMS End to End Delivery Time	SMS End to End Delivery Time = Time SMS received – time SMS sent	Test traffic	Test Stations	SMS should be delivered in less than <5 seconds (Excluding Bulk SMS services)
SMS Service Accessibility	SMS Service Accessibility = (Success access to SMS centre /over total Number of SMS attempts) * 100%	Test traffic	Performance Monitoring system Test Stations	≥ 97%
Mean Opinion Score (MOS)	Mean Opinion Score is expressed in one number from 1-5, 1 being the worst and 5 being the best.	Test traffic	Test Stations	≥3.0

SCHEDULE 3

QUALITY OF SERVICE PARAMETERS FOR FIXED INTERNET SERVICES

TABLE 3: QUALITY OF SERVICE PARAMETERS FOR FIXED INTERNET SERVICES

Parameter Name	Formula	Measurement Mechanism	Measurement Tool	Target
DNS Host Name Resolution Time	<i>DNS Host Name Resolution Time</i> = Time for standard query response received – time standard query sent. [ETSI TS 102 250-2 & ITU-T Y.1540]	Real Traffic from OSS and or Test traffic	Performance Monitoring System Test Stations	< 10 ms
DNS Host Name Resolution Success Rate	<i>DNS Host Name Resolution Success Rate</i> = (Successful DNS host Name resolution requests/ Total DNS Host name resolution requests) *100 % [ETSI TS 102 250-2]	Real Traffic from OSS and or Test traffic	Performance Monitoring System Test Stations	< 99%

<i>Data transmission Rate</i>	Data transmission rate = Size of test file/ The transmission time required for a complete and error free transmission	Test Traffic	Performance Monitoring System Test Stations	At least 75% of the advertised speed during peak time
Access Network Utilization	<i>Access Network Utilization</i> = Total traffic between access node / aggregation of traffic at the node	Test Traffic	Performance Monitoring System Test Stations	uplink utilization must not be more than 75% of uplink bandwidth provided
Throughput	Throughput = Number of test samples greater than or equals QoS throughput) /Total number of test samples)) *100%	Test Traffic	Performance Monitoring System Test Stations	Throughput must not be less than: a) 75% of subscribed level of bandwidth for 90% of the time for Contended Fixed Connections (xDSL) b) 90% of subscribed level of bandwidth for 90% of the time for Contended Fixed Connections (Fiber). c) 95% of the subscribed bandwidth for 100 % of the time for Dedicated services (ALL).

Latency	Latency = (Number of test samples less than or equal to 85 ms / Total number of test samples) *100%	Test Traffic	Performance Monitoring System Test Stations	≤ 85 ms 95% of the time
Packet Loss	<i>Packet Loss = (Total no of packet lost / Total no of packets sent) *100%</i>	Test Traffic	Performance Monitoring System Test Stations	≤ 1%

SCHEDULE 4

QUALITY OF SERVICE PARAMETERS FOR MOBILE INTERNET SERVICES

TABLE 4: QUALITY OF SERVICE PARAMETERS FOR MOBILE INTERNET SERVICES

Parameter Name	Formula	Measurement Mechanism	Measurement Tool	Target
Call Session Set-up Time	$Call\ Session\ Set-up\ Time = \frac{Time\ Content\ Received}{Time\ Content\ requested}$	Real Traffic from OSS and or Test traffic	Performance Monitoring System Test Stations	100% within 5 seconds
Call Session Success Rate (CISSR)		ETSI TS 102 250-2	Performance Monitoring System Test Stations	>98%
Call Session Drop Rate	$Call\ Session\ Drop\ Rate = \frac{Number\ of\ incomplete\ data\ transfers}{Number\ of\ transfers\ started\ successfully} * 100\%$	Real Traffic from OSS and or Test traffic	Performance Monitoring System Test Stations	< 2% < 1% (for 5G)
Average User throughput	$Call\ Session\ Mean\ data\ Rate = \frac{User\ data\ transferred\ (Kbit)}{(Time\ Data\ transfer\ Complete - Time\ Data\ Transfer\ Start)}$	Real Traffic from OSS and or Test traffic= user data transferred [Kbits]/ Time data transfer is completed-time data transfer start	Performance Monitoring System Test Stations	UMTS >5 Mbps LTE >15 Mbps (2022-2023) >25 Mbps (2023-2024) >35 Mbps (2024+) 5G >100Mbps (202/23) >150Mbps (2023/24) >200 Mbps (2024+)

FTP {download upload} Set-up Time	$FTP \{download upload\} \text{ Set-up Time} = \text{Time Service Access Successful} - \text{Time Service Access Start}$	Real Traffic from OSS and or Test traffic	Performance Monitoring System Test Stations	< 2 seconds
FTP Drop Rate	$FTP \text{ Drop Rate} = (\text{Number of incomplete data transfers} / \text{Number of transfers started successfully}) * 100\%$	Real Traffic from OSS and or Test traffic	Performance Monitoring System Test Stations	< 1%
FTP {download upload} Mean Data Rate [Mbit/s]	$FTP \{download upload\} \text{ Mean Data Rate [Mbit/s]} = \text{User data transferred (Mbits)} / (\text{Time Data transfer Complete} - \text{Time Data Transfer Start})$	Real Traffic from OSS and or Test traffic	Performance Monitoring System Test Stations	UMTS 2Mbps LTE 10Mbps 5G 75Mbps
FTP {download upload} data transfer success ratio [%]	$FTP \{download upload\} \text{ data transfer success ratio [\%]} = (\text{completed data transfers} / \text{successfully started data transfers}) * 100\%$	Real Traffic from OSS and or Test traffic	Performance Monitoring System Test Stations	95%
Web Radio Tune-in Success Rate	$Web \text{ Radio Tune-in Success Rate} = (\text{Number of Successful tune-in} / \text{Total attempts}) * 100\%$	Test traffic	Test Stations	>98%
Web Radio Tune-in Success Time	$Web \text{ Radio Tune-in Success Time} = \text{Time attempt Tune-in} - \text{Time Successful Tune-in}$	Test Traffic	Test Stations	< 2 seconds
Web Radio Reproduction Cut-off Ratio	$Web \text{ Radio Reproduction Cut-off Ratio} = (\text{Number of Unsuccessful listening attempts} / \text{Total attempts}) * 100\%$	Test Traffic	Test Stations	< 2%
Data Packets Latency		Test Traffic	Performance Monitoring System Test Stations Crowdsourcing	<100ms for Local IXP <300ms for International IXP 5G <50ms for Local IXP <100ms for International IXP

SCHEDULE 5

QUALITY OF SERVICE FOR VoLTE SERVICES

TABLE 5: QUALITY OF SERVICE FOR VoLTE SERVICES

Parameter Name	Formula	Measurement Mechanism	Measurement Tool	Target
Registration Success Rate	<i>Registration success rate</i> = (Successful Registration attempts/ Total number of Registration attempts) *100 (ETSI TR 103 219)	Test traffic	Performance Monitoring System Test Stations	≤ 98%
Post Dialing Delay (PDD)	<i>Post Dialing Delay (PDD)</i> = Time of ringing tone - time of dialing.	Test traffic	Performance Monitoring System Test Stations	≤4s
Drop Call Rate	Drop Call Rate = (Total number of calls terminated unwillingly/ total number of successfully established calls) *100% ITU-T Recommendation E.804 (Section7.3.6.5(Test traffic	Performance Monitoring System Test Stations	≤2%
Network Efficiency Ratio	Network Efficiency Ratio = Number of seizures resulting in answer message, user busy, no answer / Total number of seizures attempt) *100%	Test traffic	Performance Monitoring System Test Stations	≥ 95%

SCHEDULE 6

QUALITY OF SERVICE FOR INTERCONNECTION

TABLE 6: QUALITY OF SERVICE FOR INTERCONNECTION

Parameter Name	Formula	Measurement Mechanism	Measurement Tool	Target
Interconnection Route Utilization	$\text{Interconnection Route Utilization} = \frac{\text{Capacity in use}}{\text{Capacity Provisioned}} * 100\%$	Real Traffic	Performance monitoring system	< 80%
Point of interconnection Congestion	$\text{Point of interconnection Congestion} = \frac{\text{Number of blocked call attempts}}{\text{total number of call attempts}} * 100\%$	Real traffic from OSS and or test Traffic (ITU-T Recommendation E.847-201703)	Performance Monitoring system Test stations	<0.5%

SCHEDULE 7

QUALITY OF EXPERIENCE (NON-TECHNICAL PARAMETERS)

TABLE 7: QUALITY OF EXPERIENCE (NON-TECHNICAL PARAMETERS)

Parameter Name	Formula	Measurement Mechanism	Measurement Tool	Target
Service Availability	Service Availability = [(Total Operational minutes - Total minutes of service downtime) / Total operational minutes] x 100%	Test traffic	Performance Monitoring System Test Stations Consumer satisfaction survey	≥ 98% >90%
Provision of Service	Provision of Service = the time the customer pays for service to the time the customer is provided with service	Complaints	Trouble ticket system	5 business Days
Call Centre Operator Response	<i>Call Centre Operator Response</i> = Time Operator Assistance Pick up - Time Making Operator request.	Test traffic	Test Stations	< 30 seconds
<i>Mean Time To Repair (MTTR)</i>	Mean Time To Repair (MTTR) = Time Service Restored- Time Reported	Complaints	Trouble ticket system	MOBILE Class 1 locations: 2 hrs Class 2 locations :8 hrs. Class 3 locations 24 hrs FIXED: < 5hours INTERCONNECTION <1 hrs

ANNEXURE A

SITE CLASSIFICATIONS

The following shall describe the population size per the reporting category

Class 1: Serving a location/locality with population of more than 5,000

Class 2: Serving a location/locality with population between 750 and 5,000

Class 3: Serving a location/locality with population of less than 750