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Chapter 1: Preliminary

1.1 Title and Commencement

These Standards shall be called as “Standards for Fixed and Mobile Broadband Quality of Service (QoS)” in Bhutan and shall come into force on the 2022 corresponding to theday of themonth of the Bhutanese Iron Female Tiger Year.

1.2 Scope of Application

These Standards shall apply for the monitoring and maintenance of fixed, mobile broadband and Cable television quality of service in the country and it shall be applicable to all service providers who provides the following:

- a. Mobile/Cellular broadband services
- b. Fixed broadband services
- c. Fixed telephony services
- d. Cable Television Services

1.3 Amendment

Amendment to these Standards shall be made according to the needs and changes in national priorities, policies and industry trends. The amendment of these Standards by way of addition, variation or repeal may be affected by the Authority as and when required.

1.4 Interpretation

The power to interpret these Standards shall be vested with the Authority who may issue such instructions as may be necessary to give effect to and carry out the provisions of these Rules and Regulations.

1.5 Objectives

The objectives of these Standards are to:

- a. To create an environment for consumer satisfaction by making known the Quality of Services (QoS) which the service provider is required to provide and the user has a right to expect;
- b. To measure the QoS provided by the service providers from time to time and to compare them with the benchmarks so as to assess the level of performance;
- c. To promote competition among the service providers in order to ensure high-quality fixed, mobile broadband and cable television services;

1.6 Definitions

In addition to the following terms, or unless the context requires otherwise, the words and terms used in these guidelines shall have the same meaning as assigned in the Act.

Customer service performance: Customer service performance standards dictate the ways in which customers are to be treated and efficiency of the customer services and resolution during formal customer complaints.

Fixed broadband services: Is a high-speed data transmission to a residence or a business in a fixed location using a variety of technologies, including cable, DSL, fiber optics, and wireless. Essentially, it refers to high speed internet connections that are always in fixed locations.

Fixed telephony services: Is an establishment providing voice services through physical media such as wire or fiber optic cable instead of wireless transmission. These services are also referred to as landline or dedicated telephone line services.

Force Majeure: means fire, strikes, or other labor action or dispute, acts of God, or any circumstances beyond the reasonable control of the licensee.

Locality: means the part of the licensed area that is served by a licensed network resource. The licensed network resource may be the switching or radio equipment that serves the User.

Mobile/Cellular broadband services: Wireless Internet access delivered through cellular towers to mobile handsets and other digital devices. It uses 3G, 4G or 5G to connect directly to the internet via a mobile operator's network.

Network performance: The analysis and review of collective network statistics, to define the quality of services offered by the underlying telecommunication network. It is a qualitative and quantitative process that measures and defines the performance level of a given network.

Non-network performance: The collective network statistics which cannot be measured using the monitoring tools but can be system generated at source and are an important aspect for the quality of services such as network downtime time, repair time, connection time etc.

Operation Support System (OSS): is a set of programs that help a communications service provider monitor, control, analyze and manage a telephone or computer network.

Quality of Experience: The overall acceptability of an application or service, as perceived subjectively by the end-user.

Quality of Service: The definition as per the International Standardization Organizations such as International Telecommunication Union (ITU), International Organization for Standardization (ISO) and European Telecommunication Standard Institute (ETSI) are as:

- a. ITU-T Rec.E.800: “Totality of characteristics of a telecommunications service that bear on its ability to satisfy stated and implied needs of the user of the service”.
- b. ETSI-TR102157: “Quality of Service (QoS): the ability to segment traffic or differentiate between traffic types in order for the network to treat certain traffic differently from others”.
- c. ISO-8402: “The totality of characteristics of an entity that bear on its ability to satisfy stated and implied needs”.

Chapter 2: General Provisions

2.1 The service providers shall comply with the specified Quality of Service (QoS) standards mentioned in the Annexures.

2.2 The service providers shall also comply with the directives and notifications issued by the Authority from time to time.

2.3 The QoS standard parameters are classified into Network performance standard, Non-network performance standard and Customer service performance standard as specified in the Annexures.

2.4 The Authority shall prescribe any additional QoS parameters and its standards as and when required upon consultation with the service providers.

2.5 The Authority, on a random basis or according to complaint(s) shall verify and assess the performance of service providers against the QoS standards.

2.6 The service providers shall not have any liability of failure in maintaining the quality of service, if the failure due to damage of infrastructures is caused by circumstances that are beyond the reasonable control such as war, invasion, military operations, earthquake, riots, and any other event of force majeure, provided that such exemption for liability is limited to a period equivalent to the duration of force majeure.

2.7 The service providers shall measure their QoS parameters from time to time and take remedial action to maintain the QoS standards.

2.8 The service providers shall resolve the shortcomings or deficiencies informed by the Authority and submit a compliance report to the Authority within 15 days after getting notification from the Authority.

2.9 The Service Provider shall allow the Authority to inspect its system and reports for monitoring whenever required.

Chapter 3. Record Keeping and Reporting

3.1 The service providers shall maintain the system records of the QoS performance data to its customers including the complaints and action taken reports.

3.2 The service providers shall be obliged to submit the following reports:

- a. Monthly Operation Support System (OSS) report as prescribed in Annexure.
- b. Quarterly report of Fixed Broadband Service and Leased line internet service
- c. Reports of non network performance
- d. Quarterly report of customer service complaints and action taken reports.
- e. Any QoS performance reports which the Authority requires on an ad-hoc basis.

3.3 In the event of any planned disruption of service or network maintenance, the service providers shall inform the Authority and customers of such incidence not later than three (3) days prior to the occurrence of planned disruption.

3.4 In the event of a sudden or unplanned disruption of network services, the service providers shall notify the Authority and affected customers in any locality within an hour (1) or may extend beyond an hour of any service degradations or with valid reasons.

3.5 For the clause 3.3 and 3.4, the service providers shall provide the following information to the Authority and to its affected customers during the events.

- a. Affected Service
- b. Period of disruption
- c. Reason(s) of disruption
- d. Areas of disruption
- e. Estimated time for service restoration

Annexures

Annexure I. Network Performance Standards for Mobile Broadband Service

A. Mobile Voice Services

Sl. No	Type/QoS Parameters	Benchmark	Description	Monitoring Methodology
1.	Network Availability			The service provider shall submit the monthly OSS report of all these parameters.
a.	Voice Quality: Mean Opinion Score (MOS)	>= 3.5	<p>Is a numerical measure of quality of human speech at the destination end of the circuit and will determine the voice quality of user experience (QoE) while talking over the phone.</p> <p>The MOS is expressed as a single number in the range 1 to 5, where 1 is the lowest perceived quality and the 5 is the highest perceived quality.</p> <p>MOS =</p> $\frac{\sum_{n=1}^N R_n}{N}$ <p>N = no. of test R_n = individual rating for a given stimulus by the device.</p>	The test and measurement will be carried out through a physical drive test using QoS monitoring equipment.
2.	Network Accessibility			The service provider shall submit the monthly OSS report of all these parameters.
a.	Call Setup Success Rate	>= 97%	The number of successfully connected calls to the number of call	The test and measurement will be carried out through a physical drive test using QoS

			<p>attempts. It means for every 100 call attempts, 97 or more call attempts should be successful.</p> <p>CSSR(%)=(Number of successful call establishments/Number of call attempts)*100</p>	<p>monitoring equipment.</p>
b.	Call Setup Time (CST)	<= 7 Seconds	<p>The overall duration required to establish a circuit-switched call between users which means it is the time taken from the moment the calling party presses the call send button and the hearing of the call alert ringtone. The call setup time should be less than or equal to 7 seconds.</p> <p>CST = $t_2 - t_1$ Where t_1 = point of time where the user presses the send button on mobile equipment, And t_2 = point of time where connect is established (<i>for example: alerting subscriber is busy</i>)</p>	<p>The test and measurement will be carried out through a physical drive test using QoS monitoring equipment.</p>
c.	CSFB Setup Time	<= 8 Seconds	<p>Circuit Switch Fallback setup time is considered when a mobile device in an LTE network is used to make or receive a voice call. In such cases, the device falls back from the LTE network to the circuit-switched network</p>	<p>The test and measurement will be carried out through a physical drive test using QoS monitoring equipment.</p>

			<p>(3G or 2G) to complete the call.</p> <p>Therefore, the CSFB is the overall duration required to establish a call between users including the fallback time from LTE network to the circuit-switch network.</p> <p>CSFB = (($t_2 - t_1$) + fallback time)</p> <p>Where t_1 = point of time where the user presses the send button on mobile equipment, And t_2 = point of time where connect is established (<i>for example: alerting subscribe</i>)</p>	
3.	Network Retainability			The service provider shall submit the monthly OSS report of all these parameters.
a.	Call Drop Rate	$\leq 2\%$	<p>For every 100 calls made, not more than 2 calls should be dropped due to technical reasons.</p> <p>Once the network is accessed, the call session is made to run for a certain duration and if the call session does not run for that duration, then such a call session is considered as a call drop.</p>	The test and measurement will be carried out through a physical drive test using QoS monitoring equipment.

			Call drop rate = (Number of call drop /Number of call attempts) * 100	
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B. Mobile Data Services (3G)

Sl. No	QoS Parameters	Benchmark	Description	Monitoring Methodology	
1.	Network Retainability and Integrity			The service provider shall submit the monthly OSS report of all these parameters.	
a.	PS Drop Rate	<= 2%	This indicator will measure the % maintained for packet drop as per international standards <= 2%. Packet drop refers to the ratio of dropped packets (either upload or download) to the total number of attempts made. PS drop rate = (Number of packets sent - no. of packets received /Number of packets sent) * 100	The test and measurement will be carried out through a physical drive test using QoS monitoring equipment.	
b.	Data Throughputs (HTTP)	>= 1.5 Mbps (Downlink)	>= 1 Mbps (Uplink)	This indicator will measure the quality of data throughput of the 3G network. Data throughput refers to the actual amount of data transmitted or transferred in a period of time, thus is measured in how many Mb per	The test and measurement will be carried out through a physical drive test using QoS monitoring equipment.
c.	Data Throughputs (FTP)	>= 2 Mbps (Downlink)	>= 1 Mbps (Uplink)		

				<p>second (Mbps).</p> <p>The data file will be based on both local and international servers.</p> <p>HTTP/FTP Mean Data Rate (download/upload mean data rate [Kbit/s])=$\frac{\text{user data transferred (kbit)}}{(t_{\text{data transfer complete}} - t_{\text{data transfer start}})[s]}$</p>	
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C. Mobile Data Service (4G)

Sl. No	QoS Parameters	Benchmark	Description	Monitoring Methodology	
1.	Network Retainability and Integrity			The service provider shall submit the monthly OSS report of all these parameters.	
a.	PS Drop Rate	$\leq 2\%$	<p>This indicator will measure the % maintained for packet drop as per international standards $\leq 2\%$. Packet drop refers to the ratio of dropped packets (either upload or download) to the total number of attempts made.</p> <p>PS drop rate = $(\text{Number of packets sent} - \text{no. of packets received} / \text{Number of packets sent}) * 100$</p>	The test and measurement will be carried out through a physical drive test using QoS monitoring equipment.	
b.	Data Throughputs (HTTP)	≥ 6 Mbps	≥ 2 Mbps	This indicator will measure the quality of	The test and measurement will be carried out through

		(Down link)	(Uplink)	data throughput of the 4G network. Data throughput refers to the actual amount of data transmitted or transferred in a period of time, thus is measured in how many Mb per second (Mbps).	a physical drive test using QoS monitoring equipment
c.	Data Throughputs (FTP)	≥ 7 Mbps (Down link)	≥ 2 Mbps (Uplink)	<p>The data file will be based on both local (and international servers).</p> <p>HTTP/FTP Mean Data Rate (download/upload mean data rate [Kbit/s]) = $\frac{\text{user data transferred (kbit)}}{(t_{\text{data transfer complete}} - t_{\text{data transfer start}})[s]}$</p>	

D. Mobile Data Service (5G)

Sl. No	QoS Parameters	Benchmark	Description	Monitoring Methodology
1.	Network Retainability and Integrity			The service provider shall submit the monthly OSS report of all these parameters.
2	PS Drop Rate	$\leq 2\%$	This indicator will measure the % maintained for packet drop as per international standards $\leq 2\%$. Packet drop refers to the ratio of dropped packets (either upload or download) to the total number of attempts made.	The test and measurement will be carried out through a physical drive test using QoS monitoring equipment

				PS drop rate = (Number of packets sent - no. of packets received / Number of packets sent) * 100	
3	Data Throughputs (HTTP)	100 Mbps (Downlink)	50 Mbps (Uplink)	This indicator will measure the quality of data throughput of the 5G network. Data throughput refers to the actual amount of data transmitted or transferred in a period of time, thus is measured in how many Mb per second (Mbps). The data file will be based on both local and international servers. HTTP/FTP Mean Data Rate (download/upload mean data rate [Kbit/s])= user data transferred (kbit)/(t _{data transfer complete} - t _{data transfer start})[s]	The test and measurement will be carried out through a physical drive test using QoS monitoring equipment
4	Data Throughputs (FTP)	100 Mbps (Downlink)	50 Mbps (Uplink)		

E. Mobile Network Coverage (Signal Strength)

Sl.No	QOS Parameters	Benchmark	Description	Monitoring Methodology
1	Rxlev (GSM)	-95 dBm	RxLev represents the received signal strength level measured in dBm units. -110dBm represents the weakest signal and -48	The test and measurement will be carried out through a physical drive test using QoS monitoring equipment and

			<p>dBm the strongest.</p> <p>To receive a good and usable GSM network, the minimum signal strength that should be received by the user is greater than -95 dBm.</p>	Speed Test Application
2	RSCP (UMTS)	-105dBm	<p>In the UMTS cellular communication system, received signal code power (RSCP) denotes the power measured by a receiver on a particular physical communication channel. It is used as an indication of signal strength. -115 dBm represents the weakest signal and -25 dBm represents the strongest signal.</p> <p>To receive a good and usable UMTS network, the minimum signal strength that should be received by the user is greater than -105 dBm</p>	
3	RSRP (LTE)	-110dBm	<p>Reference Signal Received Signal. This is the measured power of the LTE reference signals spread across the broadband and narrowband portions of the spectrum.</p> <p>-140 dBm represents the weakest signal and -44 dBm represents the strongest.</p>	

			To receive a good and usable LTE network, the minimum signal strength that should be received by the user is greater than -115 dBm	
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Annexure II Network Performance Standards for Fixed Service

A. Fixed Broadband (Leased Line Internet) Services

Sl.No	Parameter	Benchmark	Description	Monitoring Methodology
1.	Ratio of Packet Loss (Upload and Download)	≤ 3% Packet loss	This indicator will measure the % maintained for packet loss. Here the packet loss refers to the ratio of dropped packets to the total number of packets attempted to be sent.	The service provider shall submit to the Authority the quarterly report on all these parameters for their network performance. And the Authority will review the analysis of the report.
2.	Throughput (Internet Speed)	The subscribed internet speed based on the agreement/subscription document	If the subscribed internet speed in 'x'Mbps, then the customer should obtain 'x'Mbps at the local server at all times.	Besides, the Authority will also carry out the ad-hoc monitoring visiting the clients of the service providers and determine the quality of services provided by the customers. The monitoring at the clients end will be carried out through the dedicated point of connection.
3.	Latency	≤ 150ms	The latency is the amount of time taken for a packet of data to be sent and then received at its destination. For the fixed broadband network, the latency should not be more than 150ms.	
4	Contention ratio	1:1	Service providers shall provide internet leased	

			line service with contention ratio 1:1 (Actual speed as subscribed by consumers)	
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Annexure III. Non-Network Performance Standards

Sl.No	Parameter	Benchmark	Description	Monitoring Methodology
1.	Network Availability			
a.	Service Availability of a BTS	$\geq 99\%$	<p>It means that the available service of each BTS should be more than 99% in a year.</p> <p>Availability = $[1 - (\text{total down time in seconds} / 31,536,000 \text{ seconds})] * 100$</p> <p>Where: Down Time = Time to repair + Testing time + Waiting, Movement & Coordination time.</p> <p>1 year is = 365 days = 8760 hours = 525,600 minutes = 31,536,000 seconds.</p>	<p>The service provider shall submit to the Authority the averaged/individual BTS service availability report whenever required by the Authority.</p> <p>Besides, the Authority will also carry out the ad-hoc monitoring of the service availability in the operator's system premises.</p>
b.	Fault repair time for fixed broadband internet services	≤ 2 days	<p>Here it refers that for any fixed broadband internet services (broadband and leased line services), the</p>	<p>The service provider shall submit to the Authority the report on the action taken for the fault repair including the time taken for any complaints received directly by the service providers or through</p>

			<p>service provider shall fix the fault submitted by the customer within 2 days.</p> <p>Fault Repair Time is the difference between the time a Service Provider receives a fault report complaint and the time at which service is fully restored.</p>	<p>the Authority. The report should be submitted whenever the Authority requires.</p>
2.	Service Activation/Installation			
a.	<p>Fixed Broadband: Fixed broadband and leased line Installation connection time.</p>	<= 5 days	<p>Here it refers that for any activation/installation of fixed broadband and installation, it shall not take more than 5 days from the date of customer applications received by the service provider. It shall also be subjective with the technical feasibility.</p>	<p>The service provider shall submit to the Authority the report on the time taken for the service activation for any service activation complaints received by the Authority.</p>

Annexure IV. Customer Care Standards

	Parameters	Benchmark	Description	Monitoring Methodology
1.	Customers complaints redressal			
a.	Percentage of formal complaints addressed	>= 95%	Here it means, from an average of 100 complaints made by the customers through formal channels, 95 or more complaints should be addressed.	<p>The service provider shall submit to the Authority the quarterly report on the complaints received and action taken.</p> <p>Besides, the Authority will also carry out the ad-hoc monitoring of the service provider's complaints database as well as the Authority will keep record of the public complaints lodged directly to the Authority and shall include in the assessment.</p>

Annexure V. KPI OSS Report Format

SL.No	Location of Core Areas	CS Drop Rate (%)	PS Drop Rate(%)		CS Success Rate (%)	PS Success Rate(%)		Throughputs (3G)		Throughputs (4G)	
			3G	4G		3G	4G	Down link	Uplink	Down link	Uplink
1	Thimphu										
2	Paro										
3	Haa										
4	Chukha										
5	Tsirang										
6	Dagana										
7	Wangdue										
8	Punakha										
9	Bumthang										
10	Mongar										
11	Lhuentse										
12	Tashigang										
13	Trashiyangtse										
14	Samdrup										

	Jongkhar										
15	Sarpang										
16	Pema Gatshel										
17	Zhemgang										
18	Samtse										
19	Gasa										
20	Trongsa										