Consultation Paper on Review of network-related Quality of Service standards for Cellular Mobile Telephone Service

Preamble

We are grateful to the Authority for providing us the opportunity to share our views on the consultation paper. In this consultation paper, TRAI is proposing to redefine Quality of Service (QoS) parameters at the granular level of LDCA/City/DHQ/BTS. The emergence of mobile services as the primary enabler for voice and data communication has led to increased expectations from telecom service providers to provide a satisfactory level of communication experience. We believe that to have a meaningful discussion on QoS parameters, it is of foremost importance to deliberate the technical constraints and enablers for maintaining the required quality of cellular mobile services.

Availability of harmonized and interference free spectrum: The cellular network is a distributed network consisting of a large number of cells/BTSs which require spectrum for over-the-air interface between the end user and the telco's network. Therefore, the availability of adequate spectrum is of utmost importance. The availability of harmonized spectrum in a larger chunk is important to drive spectral efficiency. Further, interference free spectrum is also critical for operating a good quality network.

Availability of space/sites for installing antennas/towers: The most densely populated areas require more network resources. However, in these areas it is difficult to install new antennas, masts or base stations, due to the lack of space or restrictions by municipal authorities. The network infrastructure deployment is facilitated through policies which boost installation of antennas, masts etc. Removal of municipal barriers, use of public buildings and space & Infrastructure sharing for In-Building Solution (IBS) provides a much-needed boost to network investments to cover the uncovered areas.

Support from local administration for continuous operation of networks: Telecom operations are running on a 24*7 basis and hence, continuous operations require state support through timely municipal permissions and no coercive action in the larger interests of the public. The misinformation and myths about the adverse effects of electromagnetic waves on health also need to be dispelled to aid infrastructure deployment. Uninterrupted power supply also needs to be ensured.

Technical constraints of a wireless network: Despite the availability of spectrum as well as space and power for sites, the coverage is dependent on the following uncontrollable factors due to the inherent physical properties of radio waves propagation:

- ➢ Varying number of users in a cell
- ➢ Variation in traffic
- ➢ Variation in number of users per cell and consumption pattern
- ➢ Obstacles, both natural and man-made

Due to such inherent limitations of wireless network, any amount of investment in network resources cannot ensure a zero percent call drop rate.

International benchmarks for QoS regulation: On account of the inherent characteristics of the cellular network, globally, the QoS for a cellular network is defined at the macro level so as to average out the impact due to technical vulnerabilities. The competitive scenario, transparent disclosures of QoS on the website and the implementation of mobile number portability have begun to influence

the policy on Quality of Service globally. Thus, countries such as Australia, Hong Kong, UK and USA have moved towards self-regulation regime for the telecom sector.

Assessment of wireless network QoS enablers in India: Let us analyze how India as a country has been able to work upon the key enablers enumerated above, and required to deliver state-of-the-art Quality of Service for a mobile network.

> ➢ India has been a competitive market with 7 to 8 operators per service area. This has resulted in lower spectrum allocation per operator as compared to the global average. Although, of late, the policies on spectrum auction and spectrum trading /sharing have reduced this gap.

> ➢ Despite paying market rates through auction, the service providers continue to face interference issues in many circles, which leads to degradation of QoS in the affected circles.

> ➢ In addition, the problem of illegal repeaters, boosters and jammers being installed without any check has accentuated the problem of interference in telcos' network.

> ➢ The smooth running of telecom operations is often disturbed in many cities on account of municipal issues, which lead to sealing of sites. Municipal permissions are rarely given in some cities. Uniform RoW policies on fibre, tower installation are urgently required.

> ➢ In many states the reliable and continuous power required to sustain round-the-clock telecom operations is not available.

> ➢ Stricter policies on EMF radiation, with the radiation norms being $1/10^{th}$ of the globally accepted ICNIRP norms, results into shrinkage of area coverage.

> ➢ Due to the fear of EMF in the mind of the general public, the operational sites are getting regularly sealed/shut down in many states. However, the regulators and the Government have started campaigns to dispel these myths.

> ➢ The effects of global trends on transparent disclosures are visible in our country as well. For example, the QoS analytics portal, EMF portal, TRAI's MySpeed portal and Open Network by Airtel clearly indicate these trends.

In view of the above, it can be inferred that although India has taken some steps to provide a fillip to network investments and deliver state-of-the-art services to customers in terms of policy-level enablement, a lot more needs to be done to ensure that customers are provided with quality services.

Airtel's commitments to maintain Quality on continuous basis: Despite the impediments, Bharti Airtel continues to invest in its 2G, 3G and 4G networks.

> ➢ Bharti Airtel is investing Rs. 60,000 Cr over the next three years under the "Project Leap" initiative.

> ➢ We have adopted state-of-the-art network quality tools to drive test methodologies and optimization techniques. Further, regular capacity augmentation, operational corrections, periodic automatic frequency planning exercises and coverage augmentation by adding new sites is being done to meet the QoS benchmarks.

> ➢ Airtel has voluntarily imposed a network benchmark which is 25% more stringent than TRAI's benchmark on call drop, i.e., 1.5% for overall mobile call drops versus TRAI-prescribed norm of 2% under the Quality of Service regulations. Open Network is another bold initiative by Airtel.
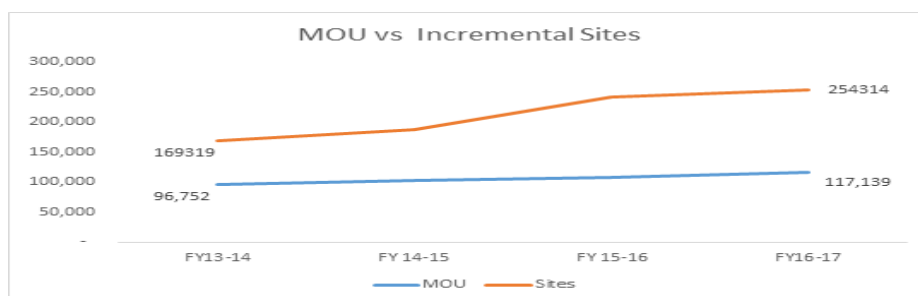
Sufficient investments are being made to maintain QoS: It seems that our efforts to deliver best-in-class Quality of Service have not been appreciated in their entirety. TRAI has quoted a paragraph from the Hon'ble Supreme Court Judgment, which is as follows:

> *"It is always open to the Authority, with the vast powers given to it under the TRAI Act, to ensure in a reasonable and non-arbitrary manner, the service providers provide the necessary funds for infrastructure development and deal with them so as to protect the interest of the consumer."*

It is an erroneous assumption that sufficient investments are not being made by service providers. Despite the rollout impediments, Airtel has made a substantial amount of investment in our 2G and 3G networks. It is completely untrue that investments have not kept pace with the subscriber addition. In fact, the growth in infrastructure has far outpaced the growth in Minutes of Usage (MoUs) over the last 3 years, as is evident from the table shared below:

Year	Minutes of Usage (in Cr) (Incoming + Outgoing)	2G + 3G sites
FY13-14	96,752	169,319
FY14-15	102,958	188,281
FY15-16	108,009	241,520
FY16-17	117,139	254,314

The graphical representable of the table is as follows:

(MoU: in Cr (Incoming and outgoing); Sites: in numbers)

From the above graph, it is clear that with the growth in MoUs, we have made much higher investments to grow and improve our networks to meet the surge in traffic and QoS benchmarks. A large part of additional investments have gone solely into improving the QoS of our existing network.

Thus, it is evident that sufficient investments have been infused into the network. However, due to an inherent limitation in the wireless network, even a huge investment in resources cannot ensure a 0% call drop % level of QoS benchmarks.

Observations by Hon'ble SC in call drop matter: It is worth mentioning here that the Honorable Supreme Court has made the following observations on the Call Drop Regulation, which would be relevant for reviewing QoS parameters as well:

a) A Regulation framed by TRAI should be 'Reasonable', i.e., framed with intelligent care and deliberation i.e. choice of a course which reason dictates and that the Regulation must be the result of that reason. (Page 50 para 29)

b) That while public interest is important, but it is not enough that the Regulation is in the interest of general public alone. (Page 51-52 para 31) That a balance must be achieved for orderly growth of telecom sector between protecting the interest of consumers as also of Service Providers. (Page 46 para 24).

We hope that the Authority will take into account the above observations from the Hon'ble Supreme Court while reviewing the network-related QoS standards.

On account of the technical constraints of a wireless network and the lack of an enabling environment, we suggest that TRAI should not define the Network QoS at a micro level – be it at the LDCA, District or BTS level. However, in order to provide better network experience to the customer, TRAI may tighten the benchmark for the QoS parameter, that is reduce the permissible call drop rate from the existing level of ≤2% to ≤1.5%.

Our detailed response to the questions posed in the consultation paper is as follows:

Question 1: In case QoS is mandated at a sub-service area level, which option (LDCA-wise or District Headquarter/ city/ town-wise or BTS-wise) you would recommend? Please comment with justifications.

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Question 3: How should the benchmark for the parameters be revised? Should it be licensed service area wise or district wise or BTS-wise or a combination? In such cases what should be the benchmarks? How should the benchmarks be measured? Please give your views on each parameter, with justification.

 Bharti Airtel's Response:

At present, the QoS is measured and reported at the service area level and at the city level for 63 cities. This measurement, reporting and monitoring is adequate and should continue at the service area level. On account of differences in location of BTSs installed by different operators, the performance will not be comparable. Even if the cluster of BTS at the district level is considered, there will be issues as the performance may be impacted due to extraneous reasons, viz., no permission for cell sites, sealing of sites by local administration, EMF-related issues etc. QoS should continue to be measured at the service area level on account of the following factors:

(I) **Technical constraints in fixation of QoS parameters at granular level for wireless networks**

a) **The QoS norms/framework has to be designed in line with the inherent characteristics of a wireless network:**
The wireless networks operate on electromagnetic waves. The electromagnetic wave propagation through the environment is governed by the laws of physics which cannot be overcome completely by any technology-level initiatives. TRAI, in its technical paper issued in November 2015, has acknowledged that predicting the quality of service in a wireless network is very complex due to several extraneous factors impacting the signal strength. The relevant extract from the technical paper (Annexure V) is reproduced below:

"Radio propagation varies from region to region and should be studied carefully, before predictions for both coverage and capacity are made. The signal that is transmitted from the transmitting antenna (BTS/MS) and received by the receiving antenna (MS/BTS) travels a small and complex path. This signal is exposed to a variety of man-made structures, passes through different types of terrain, and is affected by the combination of propagation environments. All these factors contribute to variation in the signal level, so varying the signal coverage and quality in the network."

On account of such variability in the wireless network, which is its inherent characteristic and hence beyond the control of an operator, defining wireless QoS at a granular level would not be appropriate. Taking the aforesaid into consideration, the current QoS Benchmarks are defined at a broader level so as to average out the impact. Any approach to define network QoS at a micro level, such as BTS, District or LDCA level, would amount to completely ignoring the variability aspect of wireless network and would also be inconsistent with globally adopted technical principles for defining QoS in wireless networks.

b) **Interference issues:** TSPs continue to face network issues on account of spectrum interference and illegal radio repeaters, etc. At present, the interference testing is done only on the basis of complaints and the interference is not getting monitored on a proactive basis. Further, the proliferation of illegal repeater continues to be on the rise.

c) **EMF Radiation Norms**: The EMF radiation norms for BTS in India are 10 times more stringent than the ICNIRP norms, which are the standard EMF radiation norms across the world. In fact, most of the developed countries such as USA, Canada, Japan and Australia have radiation benchmarks that are far more liberal than in India. The prevailing radiation norms in India, necessitate the lowering of power levels of BTS which results in shrinkage of the coverage, most importantly indoor coverage.

d) **QoS benchmarks are defined at higher levels based on averaging out factor**: At present, the benchmarks for QoS parameters get averaged out as they are measured over a service area level. By factoring the averaging out of QoS Benchmarks across the service area, the benchmarks have been defined at a very high value. In case the parameters have now to be

re-defined at a granular level, the same benchmarks cannot be observed. The <u>average benchmark cannot be made the minimum benchmark</u> in any case. In case of wireless networks, while the average call drop is below 2% (or 1.5%), one cell can have 0.5% call drop rate while another could have 5% on account of extraneous factors. Therefore, the BTS-wise parameters would require a significantly higher benchmarking. The consultation paper has not dealt with this aspect. Therefore, in case of BTS-wise QoS KPI reporting, the benchmarks would have to be reduced five-fold.

e) **Measuring at a BTS level can provide a misleading value:** For example, a BTS carrying just 10 calls will show a 10% call drop rate even if just one call fails. Hence, measurements at BTS level do not make sense. Further, BTS-wise information may not be comparable amongst operators as it would not give exact area information, since the BTSs of different operators may have distinct coverage grid patterns.

II. International Practice:

The QoS parameters and benchmarks of some countries reflect that they have defined the parameters/benchmarks keeping in mind the inherent qualities of Radio networks. ITU-T specifies a benchmark of 3% for call drop rate, while a more stringent benchmark of 2% has been adopted by TRAI. A majority of countries define QoS at a macro level. Few examples are given below:

➢ South Africa has defined their QoS at the province level.
➢ Malaysia also measures QoS at a broader level for designated routes and areas.
➢ In Singapore, IDA also measures and publishes the QoS nationally.
➢ In Colombia, QoS indicators are defined according to area. For example, call drop rate is benchmarked at less than 3% for densely populated areas (Zone 1) and less than 6% for other areas (Zone 2) on a three-month average basis.
➢ In the US, FCC reports mobile coverage based on rural and non-rural areas.
➢ In the UK, Ofcom measures QoS for rural/Urban areas.

III. Enabling policy environment for maintenance of Quality of Service:

a) It is typical of cities to have congested zones such as business districts, wherein it is difficult to get space for the installation of additional towers needed to cater to the additional traffic requirements during busy hours. There are restrictions in various states regarding the installation of towers near airports, schools, hospitals, prisons, colleges and historical monuments etc.; which are public places with a high footfall. In such places, inadequate mobile network, both from coverage and capacity perspective, is the reason for the failure to meet QoS benchmarks and customer expectations.

b) Notwithstanding with a very supportive role played by both TRAI and DoT for dispelling myths regarding EMF radiation, the fear of radiation hazard still looms large in the minds of the general public. As a result, the tower and telecom companies continue to face severe resistance from the general public regarding the installation of towers. Even, municipalities and local administration do not grant permission to install towers due to this public perception.

c) Despite intervention from DoT, there are no uniform guidelines or policies for the installation of towers and Right of Way (RoW) for laying fibre in various states. Many a time, the RoW costs of laying fibre are prohibitive in cities.

d) The availability of power on a 24*7 basis continues to be an issue in many states. This is despite the fact that the telecom industry has been accorded the infrastructure status in March 2012.

e) In-Building Solution: The implementation of dedicated in-building coverage enables offloading of the macro system in areas with overlapping in-building and macro network coverage. This leads to an increase in overall system coverage and capacity. Providing connectivity to the IBS is difficult due to complex procedures for granting RoW permissions. Such connectivity requires permission to lay cable into a building which is the bottleneck.

IV. QoS parameters for OTT players:

TRAI has sought feedback from the stakeholders on the QoS-related aspects of the wireless network, whereas it has not raised any question on the OTT Voice Communication Services. Since the OTT Voice services have been used extensively by Indian customers over the last few years, we suggest that any rule applicable to the cellular network should be equally applicable to the OTT Voice Services to maintain a level playing field and in keeping with the spirit of "same service, same rules".

In view of the above, it is submitted that the technical constraints of a wireless network, the policy-level impediments and various International examples for QoS regulations suggest that the Cellular Mobile QoS should continue to be measured at a service area (LSA) level as per the current practice.

Question 2: How should the call drop rate calculated – either at the Licensed service area level calculated during TCBH, or calculated during the Cell Bouncing Busy Hour (CBBH) at BTS level should be the benchmark? Please give your views on each parameter, with justification.

Bharti Airtel's Response:

As submitted in the response to Question 1, we would like to state that the QoS of a network should be averaged at a network level only, for the following reasons:

➢ Network level TCBH and cell level CBBH, are both appropriate parameters to measure network performance. The TCBH QOS parameters reflect the network's busiest hours and maximum traffic conditions, so it is necessary to check network behavior during peak load conditions. The CBBH QoS parameters reflect the individual cell's busiest hour when the cell is at maximum traffic condition, and hence it is equally important to check cell behavior during its peak load conditions.

➢ It would not be advisable to replace the call drop rate at the LSA level with the call drop rate at the BTS level during CBBH. This is because the TCBH represents the period when the network is fully loaded and there is maximum traffic at the network level. For satisfactory performance of the network during full load conditions, TCBH would be a more relevant period than CBBH. Further, calculation and reporting of the CBBH for every cell itself is a challenging task in a network which consists of lakhs of cells.

➢ We believe that the present framework of keeping both the parameters – worst-affected cells having more than 3% call drop rate during CBBH, which is the parameter measured at the BTS level; along with the measurement of the call drop rate during TCBH at LSA level is sufficient and adequate. Hence we feel no amendment or modification is required in the current benchmarks for the calculation of call drops.

➢ **However, keeping in mind the interests of the customers and in order to meet the heightened expectation, it is suggested that the existing benchmark for call drop rate may be further tightened to ≤1.5% from the existing benchmark of ≤2%.**

Question 4: How could the network parameters be technology agnostic? What are the parameters and benchmarks that are required to be defined? Please give your views with justifications.

Bharti Airtel's Response:

Technology upgradation has become a norm in case of Cellular Mobile Services. Thus, there is a need to have technology agnostic network parameters. The customer would not be able to tell the difference on account of a difference in technology. Therefore, common technology agnostic parameters would be required from a customer perspective. The underlying formulas and calculation methodology can be different, but the benchmarks should be the same. For voice, there can be the following categories:

(i) Circuit switched (CS) based voice;
(ii) Voice over IP (VOIP); and
(iii) Voice over LTE (VoLTE)

In 2G and 3G technology, existing QoS parameters are termed differently due to a difference in technology. However, the parameters still reflect the technology agnostic nature because they indicate the same QoS experience with the benchmark at the same level. Thus, these are technology agnostic parameters even though the calculation formula may be different.

Further, the call drop does not only happen in circuit switched networks, but also in 4G VoLTE and VoIP networks. In the packet switched network, packet drops result in long mutes during VoLTE/VoIP calls and packets are not transferred due to continuous transmission and retransmission. This may be caused due to radio link failure, lost LTE connectivity, in case SRVCC (Single Radio Voice Call Continuity) is not available as well as other factors such as connection reset or re-establishment. Such instances of packet drop or reconnection should be factored in while calculating the call drop for VoLTE network so as to bring in a technology agnostic approach in the measurement of QoS parameters.

Bharti Airtel's Response:

1. The GSM standards have built-in features such as radio link timer (RLT) to make the technology robust enough to handle sporadic variations in radio conditions. RLT is defined as per GSM standards (GSM 05.08, dated July 1996), ranging from 4 to 64. Since there is a dynamic variation in the quality of radio link due to clutter, traffic, fading, inherent noise etc., this counter helps to optimize the duration for which the device waits to decode the signaling on the radio link. Depending on the prevailing radio conditions, this counter is configured so that the customer experience is optimal to recover the link in case of sporadic bad radio transmission. Configuring a low value of counter would mean a highly intolerant system that does not give the RF link the opportunity to recover. While, having a very high value would mean tolerating bad quality for a longer duration which reflects in RX quality QoS parameter and, therefore, measuring two parameters for the same cause should be avoided. Hence, it is not essential to mandate any fixed RLT settings.

2. Further, RLT is very important in case of emergencies such as natural calamities that lead to massive outages in the network. In such cases, outage of a large number of base stations inserts holes in the consistency of radio connectivity. RLT helps to hold the calls in such difficult conditions.

3. Globally, the value of this parameter is set as follows:

Vodafone Germany	40
T Mobile US	40
AIS Thailand	40
SingTel	36
StarHub SG	36

4. In India, we have set this parameter at around 28-32 in urban towns and 32-36 in rural towns, which is significantly more stringent than the international benchmarks despite having much less spectrum and more user density. Considering the fact that the mobile operations act as lifeline services, the telecom operators take steps for varying the parameters only under extreme conditions for the benefit of the public and therefore, it would not be appropriate to set up RLT value as one of the QoS parameters. Further, there is no international precedent for setting up RLT as a QoS parameter. In fact, countries such as Singapore mandate benchmarks for only 4 parameters. South Africa monitors only 2 parameters: call drop rate and Call Setup Success Rate. (Refer to Annexure I).

In view of the above, we submit that RLT is just a configuration parameter amongst thousands of other configuration parameters to counter various dynamic conditions, and should be kept out of the ambit of regulatory framework. It should be left to the standard governing bodies such as 3GPP, ETSI and ITU-T to decide on these parameters.

Question 6: Do you think it will be appropriate to calculate call drop rate through CDR meta data analysis? If so, what should be the benchmarks for such call drop rates calculated? Please comment with justifications.

 Bharti Airtel's Response:

Call Data Record (CDR) is not the right mechanism to perform call drop analysis as it will only give notional information. For example, if Customer A calls Customer B and due to bad network conditions Customer A's network releases the call, it will be difficult to say whether Customer A is facing bad network or Customer B. Therefore, it is highly recommended to use radio network call drop counters as per the existing QoS framework.

Secondly, short duration calls can happen due to numerous reasons such as user-related behavior, the conversation itself being very short, low balance, handset quality issues, etc.

Though some cause code counters are available in the MSC CDRs, but these counters do not include all the reasons behind the call drop. Due to this, any study on the basis of cause codes from CDRs will not reflect the exact reasons and thus would not present a true picture. Radio Access Network (RAN) counters provide the true measure of a call drop, but these counters cannot be captured in CDRs.

Globally, there are no precedents for the measurement of call drop rate using CDRs, because CDRs are designed for billing purpose and have not been designed to measure the Quality of Service.

Question 7: Do you think calculation of customer satisfaction index will help in QoS of the consumer? If so elaborate the methodology of the calculation of such indexes. What are the latent variable that need to be defined and how are they to be calculated? Please comment with justifications.

Bharti Airtel's Response:

1. Network quality and customer service index are both different variables. Network quality could be controlled with network advancement modernization techniques, but customer satisfaction index is a perception that depends upon called party network (terminating network) conditions as well.
2. Network quality is quantitative and measurable, while customer satisfaction is a subjective matter. Therefore, an index on Quality of Experience will be very subjective and will be based on probability and dependent upon other phenomenon such as offering of tariff benefits by service providers, resolution of queries, etc.
3. Since the services offering, tariffs, coverage, customer profile and customer expectation of each operators will be different, the customer satisfaction level will also be different and

cannot be compared. Therefore we do not recommend inclusion of any parameter which is subjective and cannot be verified from the network parameters.

Question 8: What are your views on introducing a graded financial disincentives based on performance and what should be such quantum of financial disincentives for various parameters? Please comment with justifications.

Bharti Airtel's Response:

The financial disincentives have been revised recently in October 2015.

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Annexure I - International Examples

Singapore

Singapore has defined the following 3G mobile QoS parameters: defined.

QoS STANDARDS FOR 3G PUBLIC CELLULAR MOBILE TELEPHONE SERVICE (w.e.f. 1st April 2012)

A. Performance Indicator (for compliance)

(1) Service Coverage:

   I.   Nationwide outdoor coverage
   II. In-building coverage
   III. Tunnels coverage

(2) Success rate for PSTN/mobile originated calls during busy hour

   i.   Average monthly success rate across all cell localities > 99%
   ii. Average monthly success rate in the busiest cell locality > 95%
   iii. Average monthly success rate for each cell locality > 70%

(3) Drop call rate of PSTN and Mobile originated call

   I.   Average monthly drop call rate across the entire month: <1%
   II. Average monthly call drop rate during busy hour: <2%

III. Average monthly call drop rate during hour with worst performance: <2%

B. Performance Indicators (for monitoring)

1. Network availability

2. Network congestion during busy hour

3. Average call setup time

4. Complaints on coverage per 1000 subscribers

Malaysia: Current QoS regulation w.e.f. 1st January 2016.

   i. Call Setup Success Rate: >95%
  ii. Drop call rates (a) At designated routes: 2% (b) At other routes: 3%
 iii. Advance notice of scheduled downtime; customer to be informed 24 hours prior to the downtime
  iv. Service disruption: MSC not to have service disruption for more than 30 minutes

South Africa

   i. Drop call rate: < 3% -- Retainability
  ii. Call set up Success rate > 95% -- Accessibility

The measurement is done across the province.

Sri Lanka

Draft QoS regulation has been proposed. The parameters for Network QoS are as under:

   i. Call drop rate: <5%
  ii. Call Setup success rate: >95%
 iii. Network Availability: >99% (outage cell minutes of incident higher than 15 minutes each)
  iv. POI congestion
   v. The percentage of test route over which minimum on street signal strength is achieved is as follows:

GSM -92,-95 dbM; UMTS: 100 dbM, -102 dbM. No target has been specified at this stage.

Colombia

   i. Percentage of dropped calls by area: <3% for densely populated area; <6% for other areas
  ii. Indicators for delivery of SMS: <6% in a monthly period
 iii. Availability of network elements: >90% in a monthly period

iv.   Internet access indicators (ping, bit rate, SGSN availability, etc.)

Pakistan (2011 & 2012)

i.   Network downtime: <1% (incidents with no network indication)
ii.   Grade of service: <2% (total number of unsuccessful calls/total calls)
iii.   Call connection time: <5 Seconds
iv.   Call completion ratio: >98%
v.   End-to-end speech quality: MOS>3
vi.   SMS Success rate: >99%
vii.   SMS end-to-end delivery time: <8 Seconds (increased to <12 seconds vide amendment issued in 2012)

United Kingdom:

Ofcom does not direct or require UK telecommunications providers to meet particular levels of quality of service. That decision followed the research they undertook in 2009 in fixed-line, mobile, broadband and pay TV sectors, which concluded that generally, customers were content with the levels of service that they received. Moreover, Ofcom reasons that in competitive markets, customers have a choice if they wish to switch their service providers.

Until 2009, certain providers of fixed voice services were required by the regulator to collect and publish specific aspects of customer service information, such as complaints data or faults resolution times. However, following the 2009 review, Ofcom also decided to withdraw this requirement as it was decided that the information was not meaningful or comparable. As such, there is currently no requirement in place requiring mobile or fixed-line operators to publish information on QoS. However, in January 2013, Ofcom issued a consultation on "Measuring mobile voice and data quality of experience". It sought views from stakeholders on the following:

• What information would be valuable to consumers when purchasing mobile services?
• What data would be required to produce this consumer information?
• How could we best collect it?

In 2015, Ofcom published a report on QoS parameters for internet services, which was based on rural and urban areas.

France:

ARCEP's approach to regulate QoS does not rely on targets. ARCEP is only monitoring QoS and is of the view that competition will bring the best level of QoS to customers. Setting minimum QoS levels is seen as the ultimate regulatory tool.

As of now, if KPIs show a low level of QoS or show a discriminatory behavior, ARCEP holds a meeting with stakeholders to improve the situation. If discussions indicate that a new KPI should be defined, then a new KPI can be defined.

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To define KPI and measurement frameworks, ARCEP holds regular meetings (once a months or less) with operators, independent experts and customer associations.

KPI	Definition	Target	Actual QoS[69]	Measurement method
% of calls maintained more than 2 minutes	See name of KPI. 4 levels of QoS can be attributed to audio quality: very poor, poor, acceptable, perfect	No target	96.35% outdoor – 95.16% indoor – 95.46% in car	Tests are conducted with a Samsung SII phone in the following configurations: pedestrian outdoor, pedestrian indoor (room with window), in car and train.
% of calls maintained more than 2 minutes and perfect audio quality			95.49% outdoor - 93.77% indoor – 94.54% in car	Different cities are tested. Tests are conducted from 9 to 21 from Monday to Friday and busy hours have been preferred at 40% (12h-13h and 18h-21h).
% of calls maintained more than 2 minutes and acceptable audio quality			95.78% outdoor - 94.73% indoor – 94.90% in car	2/3 of tests are conducted in cities and 1/3 outside the cities. Operators are not aware of the locations and time of tests.
% of calls maintained more than 5 minutes			94,34% outdoor – 93.59% indoor – 91.88% in car	Test calls are 40% fixed to mobile and 60% to mobile to fixed (for audio quality, the lowest level of QoS attributed by the two callers is retained).
% of calls maintained more than 5 minutes and perfect audio quality			93,38% outdoor – 91.84% indoor –	Callers are trained, supervised. Tests are conducted before real tests. Callers are changed and
			90.56% in car	consistency of results if often verified.
% of calls maintained more than 5 minutes and acceptable audio quality			93,87% outdoor – 92.85% indoor – 91.04%	Operators are compared to each other.

Bahrain

No QoS targets have been set up in Bahrain. The following QoS parameters are measured:

Table 56 - KPI, targets and measurement methods related to Mobile Voice and SMS in Bahrain

KPI	Definition	Target	Actual QoS[45]	Measurement method
Voice - SHR	% of call set-up on first attempt and held for 2 minutes without drop	No target	Average 96.6%	See details above
Voice - PQR	% of call set-up on first attempt and held for 2 minutes without drop and marked 4 (ITU ref P.800 MOS)		Average 94.1%	
Voice – CQR	% of call set-up on first attempt and held for 2 minutes without drop and marked 3 or 4 (ITU ref P.800 MOS)		Average 96.2%	
RS 2	% of SMS not refused when sent out and received within 2 minutes without being altered – SMS with 26 characters		Average 99.6%	
RS 30	% of SMS not refused when sent out and received within 30 seconds without being altered – SMS with 26 characters		Average 99.3%	
RS 15	% of SMS not refused when sent out and received within 15 seconds without being altered – SMS with 26 characters		Average 96.5%	
Average reception SMS delay (sec)			Average 8 s	

Norway

Telecom regulator NPT is monitoring the market and its current regulatory policy can be summarized as follows:

    i.   Imposing targets on parameters in case of disputes only.
    ii.   Customer relationship is soft regulated by publishing call centre response times.
    iii.   Requirement would apply to all types of operators, but for providers with USO, there are specific requirements.

iv. Customers can stop their contract with the service provider in case of changes to the contract and the contract must include compensation and refund arrangements in the event of discrepancy concerning quality or non-delivery.

KPIs, measurements and targets:

There are no specific KPIs connected to operating communication services. It is simply a matter of registration with NPT. For MNOs, there are specific demands related to coverage, but for the last several years these have been fulfilled by their GSM Networks. Measurements as specified by legal context are not performed. This may change if NPT, while monitoring the QoS, comes to a conclusion that the QoS is decreasing. This practice is currently under review.

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