A public consultation document issued by the
Telecommunications Regulatory Authority of the
Kingdom of Bahrain

on the

Quality of Service Regulation

23rd February 2017
Reference number: TOD/ICT/0217/011

The address for responses to this document is:
The General Director Telecommunications Regulatory Authority
PO Box 10353 Manama Kingdom of Bahrain
Alternative, e-mail responses may be sent to gosrr@tra.org.bh

The deadline for responses is 26 March 2017

Purpose: to seek stakeholders’ views on a proposed amendment to the Quality of Service Regulation
adopted by the Telecommunications Regulatory Authority on 11 September 2008 and published in the
Official Gazette on 22 January 2009
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1. Instructions for submitting a response

1. The Telecommunications Regulatory Authority (the “Authority”) invites comments on this consultation document from all interested parties. Comments should be submitted no later than 4pm local time on 26 March 2017.

2. Responses should be sent to the Authority preferably by email (either Word or PDF format) or by fax or post to the attention of:

   The General Director  
   qosrr@tra.org.bh  
   Telecommunications Regulatory Authority,  
   P.O. BOX 10353, Manama, Kingdom of Bahrain Fax: +97317532125

3. Responses should include:
   - the name of the responding entity;
   - the name of the principal contact person;
   - full contact details (physical address, telephone number, fax number and email address);
   - in the case of responses from individual consumers, name and contact details; and
   - a brief statement explaining the interest of the responding entity.

4. The Authority seeks comments from stakeholders in the telecommunications industry, the business community and the general public on the proposed amendments to the Quality of Service Regulation of 2008 (the “revised QoS Regulation”) attached at Annex 1. All comments should be supported as much as possible by detailed explanations, including, where relevant, references to the specific provisions of the Telecommunications Law,¹ Licenses or other sources that the respondent is relying upon.

5. Further, the Authority invites respondents to provide comments to each of the questions included in Annex 2.

6. In the interests of transparency, the Authority will make all submissions received available to the public. Respondents may request confidential treatment of certain information contained in their comments. The Authority will evaluate a request for confidentiality in line with the relevant legal provisions² and the Authority’s published guidance on the treatment of confidential and non-confidential information³.

7. Respondents must clearly indicate which information included in their submission is considered confidential. Where such confidential information is included, respondents must provide both a

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¹ The Telecommunications Law of the Kingdom of Bahrain, promulgated by Legislative Decree No. 48 of 2002.
² Including Article 23 of the Telecommunications Law
confidential and a non-confidential version of their submission (in soft copies and not scanned copies). If part or all of the submission is marked confidential, reasons should be provided for the confidential treatment. The Authority may publish or refrain from publishing any document or submission at its sole discretion.

8. The Authority’s views as expressed in this consultation document are intended to provide an explanation and background to the revised QoS Regulation.
2. Introduction

2.1. Justification for this review

9. On 11 September 2008, the Authority issued the Quality of Service Regulation (the “2008 Regulation”) following a consultation process with stakeholders. The 2008 Regulation was published in the Official Gazette on 22 January 2009.

10. The Authority believes the 2008 Regulation has served Bahraini consumers and business well, allowing operators the flexibility to deliver increased quality of service (“QoS”). By following a light-handed approach, the Authority has successfully relied on market forces and competition to ensure good outcomes for consumers in this area. The Authority believes this approach and the principles underpinning it are sound and continue to be consistent with market developments in the Kingdom of Bahrain (“Bahrain”).

11. However, significant market and technology developments have taken place since the 2008 Regulation entered into force.

12. The deployment of ubiquitous high-bandwidth mobile data networks (LTE) and the upgrade of fixed networks to fiber based access are examples of trends that have reshaped the telecommunications landscape in Bahrain.

13. A shift in demand toward high-bandwidth, broadband applications and services has also taken root in Bahrain and today consumers and businesses expect reliable, high-quality broadband connectivity everywhere.

a. Over the last eight years, broadband Internet penetration in Bahrain increased over ten-fold, from 10% in 2008 to 145% at 2Q 2016.4

b. Mobile broadband was the key growth driver of broadband subscriptions, with the overwhelming majority of subscribers now using their mobile devices to access the Internet. By 2Q 2016, mobile broadband amounted to around 92% of all Internet connections, up from just over 14% at year-end 2008.5

c. Fixed broadband service throughput has increased from 1-2 Mbps in 2010 to 100 Mbps connections available in the market in 2016. Similarly, mobile broadband connections have increased from 1.7 Mbps connections in 2010 to over 35 Mbps in 2016.

14. In line with these trends, one of the key policy objectives of the Fourth National Telecommunications Plan (NTP4) is to promote a competitive mobile sector, ensuring that “the

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5 Id.
sector continues to deliver significant customer benefits and that sustainable competition is safeguarded while maintaining high quality of service standards for mobile voice and data.\textsuperscript{6}

15. These developments justify reviewing the 2008 Regulation.\textsuperscript{7} The aim of this review is to update and streamline the QoS framework to ensure that it:

a. focuses on the services that consumers and businesses value most; and

b. continues delivering high quality, dependable services to consumers and businesses over the coming years.

2.2. Main changes proposed

16. As noted in the following sections, the proposed amendments to the 2008 Regulation focus on the following issues:

a. updating and simplifying the QoS key performance indicators (KPIs) that are reported to and measured by the Authority.

b. clarifying the measurement methods and formulas for each updated QoS KPI;

c. identifying and streamlining the self-reporting requirements imposed on operators and the measurements to be conducted by, or on behalf of the Authority;

d. ensuring the Authority has sufficient enforcement powers to implement the QoS framework; and

e. including maintenance and critical issue reporting requirements within the QoS framework.

17. The following sections describe the Authority’s proposals and justifications for each of these proposed changes.


\textsuperscript{7} The Authority also notes that it first proposed to review the 2008 Regulation in 2014. See Public Consultation Ref. TOD/0414/002 of 20 April 2014, available at http://tra.org.bh/media/document/Public%20consultation%20on%20QoS%202014.pdf. Since that time, the Authority has reassessed some of its initial proposals in light on market developments and stakeholder inputs.
3. Conceptual approach for this review: placing the focus on the end user

3.1. Proposed approach

18. The Authority proposes to review existing QoS KPIs from an end user perspective, focusing on each phase of service usage. This approach is consistent with international practice and recommendations and will ensure that the revised QoS framework offers the best results for consumers.

3.2. Reasoning for the proposed approach

19. The term quality of service (QoS) is defined in Recommendation ITU-T E.800 as the “[t]otality of characteristics of a telecommunications service that bear on its ability to satisfy stated and implied needs of the user of the service.”

20. The ITU definition presented above focuses on end-to-end services from an end-user perspective. End-to-end QoS describes the interplay between various network components and its effect on the end-user experience. As shown in Figure 1, QoS contributions depend on these various network components. Operators can change various parameters within their networks, from the terminal equipment to core network components, in order to achieve the needs of the end-user and meet targets (if applicable).

Figure 1: Schematic Contributions to end-to-end QoS

NOTE 1 – The configuration illustrated above is for the conventional service with users at each end of a connection. However, the principle of this configuration may be applied to services offered by a service provider at one end and user(s) at the other end.
NOTE 2 – Terminal equipment: Contribution to the end-to-end QoS could depend on the variability of the performance of the terminal equipment.
NOTE 3 – Access network: The contributions of access network to the end-to-end QoS depend on the combination of the access medium and technology used for a particular service (e.g., wireless, cable, ADSL, etc.).
NOTE 4 – Core network: The core network may be a single provider or a concatenation of different provider’s networks. QoS contribution to end-to-end performance from the core network will be governed by the contributions from individual network components (whether single provider or multi providers); technology used (digital multiplexing, IP, etc.); transmission media (air, cable optical or metal) and other factors.
Source: Rec. ITU-T E.800 (09/2008)

21. It is thus important to distinguish between QoS and network performance. QoS is the result of experience and/or perception of the end user, while the operation of the network and terminals

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is determined by the operation of individual network elements or by the integral operation of the network, including terminals. Recommendation ITU-T I.350 highlights the following distinctions between QoS and network performance (Table 1):

Table 1: Distinction between quality of service and network performance.

<table>
<thead>
<tr>
<th>Quality of service</th>
<th>Network performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>User oriented</td>
<td>Provider oriented</td>
</tr>
<tr>
<td>Service attribute</td>
<td>Connection element attribute</td>
</tr>
<tr>
<td>Focus on user-observable effects</td>
<td>Focus on planning, development (design), operations and maintenance</td>
</tr>
<tr>
<td>Between (at) service access points</td>
<td>End-to-end or network connection elements capabilities</td>
</tr>
</tbody>
</table>

Source: Recommendation ITU-T I.350

22. In addition, in identifying QoS KPIs the Authority focused on the various consecutive phases of the relevant service following the model described by the European Telecommunications Standards Institute (ETSI). As shown in Figure 2, the sequence in time is the criterion that distinguishes each phase of service usage. Specifically, the aspects related to QoS can differ between the times of network access, service access and use of the service.

**Figure 2: QoS aspects related to different phases of the service**

![Diagram of QoS aspects related to different phases of the service]

Source: ETSI TS 102 250-1 V2.2.1 (2011-04), p. 19

a. **Network Availability**: Probability that the services are offered to a user via a network.

b. **Network Accessibility**: Probability that the user performs a successful registration on the network which delivers the service. The network can only be accessed if it is available to the user.

c. **Service Accessibility**: Probability that users can access the service they want to use. Network Accessibility is a precondition for this phase.

d. **Service Integrity**: Describes the QoS during service use and contains elements like the quality of the transmitted content, (e.g. speech quality, video quality or a number of bit errors in a transmitted file). Service Integrity can only be determined if the service has been accessed successfully.

e. **Service Retainability**: Describes the termination of services (in accordance with or against the will of the user). Examples for this are all kinds of cut-off parameters, e.g., the call cut-off ratio
or the data cut-off ratio. Again, a previously performed successful service access is a precondition for this phase.

Questions:

1. Do you agree with the proposed end user-centric approach for the review of existing QoS KPIs? If not, please provide a reasoned response.

2. Do you agree with identifying QoS KPIs based on the various consecutive phases of the service? If not, please provide a reasoned response.
4. Updating existing QoS KPIs

4.1. Proposed groupings and list of QoS KPIs

23. The Authority proposes to group KPIs into four categories:

a. **General KPIs**: These are horizontal KPIs that apply independent of the service and access technology. This group identifies a set of service and technology neutral KPIs that all providers of telecommunications services to the public must measure and report.

b. **Voice KPIs**: These apply to fixed and mobile voice services offered by licensed operators.

c. **Mobile KPIs**: These apply to mobile voice services as they exhibit certain technical characteristics that justify the adoption of specific KPIs to ensure an end-to-end, user-centric approach.

d. **Broadband KPIs**: These apply to fixed and mobile broadband services offered by licensed operators.

24. The specific KPIs proposed for each of the groups are presented in the tables below.

**Table 2: Summary table of proposed general KPIs**

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>G-1</td>
<td>Supply time for initial connection</td>
</tr>
<tr>
<td>G-2</td>
<td>Fault report rate</td>
</tr>
<tr>
<td>G-3</td>
<td>Fault repair time</td>
</tr>
<tr>
<td>G-4</td>
<td>Response time for call centre services</td>
</tr>
<tr>
<td>G-5</td>
<td>Response time for directory services</td>
</tr>
<tr>
<td>G-6</td>
<td>Billing correctness complaints rate</td>
</tr>
<tr>
<td>G-7</td>
<td>Billing correctness complaints resolution time</td>
</tr>
<tr>
<td>G-8</td>
<td>Availability of the “core” network</td>
</tr>
</tbody>
</table>

**Table 3: Summary table of proposed voice service KPIs**

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>V-1</td>
<td>Call set-up success rate</td>
</tr>
<tr>
<td>V-2</td>
<td>Call set-up time</td>
</tr>
<tr>
<td>V-3</td>
<td>Voice quality</td>
</tr>
<tr>
<td>V-4</td>
<td>Speech delay</td>
</tr>
</tbody>
</table>

**Table 4: Summary table of proposed voice service KPIs**

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-1</td>
<td>Dropped call rate</td>
</tr>
<tr>
<td>M-2</td>
<td>Coverage</td>
</tr>
<tr>
<td>M-3</td>
<td>Completion rate for SMS</td>
</tr>
</tbody>
</table>
### Table 5: Summary table of proposed voice service KPIs

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-1</td>
<td>Throughput</td>
</tr>
<tr>
<td>B-2</td>
<td>Latency</td>
</tr>
<tr>
<td>B-3</td>
<td>Web page loading time</td>
</tr>
</tbody>
</table>

25. A detailed definition of each KPI, its measurement method, applicable international standard and calculation formula is provided in Schedule 1 of the revised QoS Regulation included as Annex 1 to this consultation document.

### 4.2. Reasoning for the proposed changes

26. The objective of reviewing and revising the list of existing QoS KPIs is two-fold:

   a. First, the Authority is seeking to simplify the framework and identify those QoS KPIs that are truly relevant from an end-user perspective for each phase of the service.

   b. Second, the revised framework should reflect market and technology trends by focusing on the services the Authority considers will continue to be the most relevant for consumers during the coming years in Bahrain.

27. As such, the proposal reduces the overall number of QoS KPIs from 25 to 18, refocusing KPIs on key service grouping to ensure high levels of QoS for end users.

28. The Authority believes that the proposed QoS KPIs adequately reflect current market and technology developments and expected future trends in Bahrain. Moreover, they comply with the conceptual approach outlined in section 3.

29. The **General KPIs** proposed are broadly consistent with existing KPIs, but reduce the number of customer complaint related KPIs.

   a. The Authority believes that billing-related complaints (G-6 and G-7) are the most relevant type of complaint from an end-user perspective. Other complaints are no longer believed necessary to protect consumers considering the level of competition of retail fixed and mobile markets.

   b. The inclusion of “Availability of the “core” network” (G-8) seeks to address network availability which is the critical first phase of service usage.

30. Additional **Voice KPIs** are introduced to ensure high quality service to end users.

   a. Call set-up time (V-2) and Speech delay (V-4) are major issues associated with voice service integrity and are critical for consumers seeking to make voice calls.

   b. Similarly, Voice quality (V-3) is of paramount importance to consumers as it is also central to voice service integrity. While not included within the list of QoS KPIs under the 2008 Regulation, the Authority has nevertheless been measuring Voice quality via its audits for several years.
31. **Mobile** networks exhibit certain technical characteristics that justify the adoption of specific KPIs to ensure an end-to-end user centric approach:

   a. Network Coverage (M-2), which in Bahrain is addressed under the license conditions, is a key component for network availability. While not included within the list of QoS KPIs under the 2008 Regulation, the Authority has been measuring mobile coverage via its audits for several years.

32. The **Broadband KPIs** being proposed seek to remove existing dial-up Internet focused KPIs and adopt a set of KPIs that promote high-quality broadband service to end users.

   a. Throughput (B-1) is a critical KPI for broadband service usage. While not included within the list of QoS KPIs under the 2008 Regulation, the Authority has been measuring throughput via its audits for several years.

   b. Webpage loading time (B-3) is a relevant indicator from an end-user perspective. It focuses on one of the key applications for consumers. While not included within the list of QoS KPIs under the 2008 Regulation, the Authority has been measuring this KPI via its audits for several years.

33. Finally, to promote KPIs that take account of the end-user perspective, the Authority is proposing to withdraw existing network performance-related KPIs.

34. Annex 3 presents a comparison between existing QoS KPIs under the 2008 Regulation and the revised list of KPIs presented above.

**Questions**

3. Do you agree with the proposed groups of QoS KPIs? If not, please provide a reasoned response.

4. Do you agree with the specific QoS KPIs being proposed? If not, please provide a reasoned response.

5. Do you have any other comments on Schedule 1 of the revised QoS Regulation?
5. Approach toward target setting

5.1. Proposed approach

35. The Authority proposes to maintain the current approach toward target-setting. This entails:

a. not adopting specific binding targets at this time, but maintaining the power to intervene in setting QoS targets in the future if conditions so warrant; and

b. ensuring that the Authority is able to set binding targets pursuant to a determination, applicable to all or specific providers, in case specific market conditions or operators’ performance are found by the Authority to justify such intervention.

5.2. Reasoning supporting the proposed approach

36. International practice highlights three approaches typically used for setting targets for QoS KPIs:

a. Regulated: This approach involves the regulatory authority setting binding targets to be achieved by the operators subject to the specific QoS KPI. The target sets a minimum level or threshold of compliance. Breaches of these thresholds lead to enforcement actions, including orders, fines or other sanctions. This approach is used in numerous countries, including the Bahamas, Oman, Qatar (proposed), Saudi Arabia, St. Kitts and Nevis and Trinidad and Tobago (proposed).

b. Non-regulated: This approach relies on the principle of transparency to promote adequate levels of QoS. Instead of setting binding targets, QoS regulations require performance measurements to be published in a way that is easily understood by consumers. These publications are intended to serve as inputs for consumers to make informed decisions when purchasing services, thus relying on market forces to deliver high quality service. This is the case, for example, in Spain, France, Italy, Malta, Portugal and the United Arab Emirates.

c. Hybrid: Under this approach targets are not set for all QoS KPIs. This represents a more tailored approach, as it limits target-setting to a subset of KPIs that are considered more critical, underperforming or where market forces are not deemed sufficient to achieve an optimal outcome for consumers. This approach exists in the Seychelles (proposed), Singapore and the United Kingdom (for wholesale services only).

37. Determining which of the options to follow depends on various factors, including a review of the:

a. current performance of QoS for the various KPIs; and

b. level of competition in the various telecommunications markets.

38. Regulated targets are often the preferred approach for countries experiencing poor QoS performance or for markets where insufficient levels of competition would lead, absent regulated targets, to consumers receiving sub-optimal QoS levels. Conversely, in countries where service and QoS performance levels are deemed appropriate or where competition is expected to deliver
adequate QoS levels, relying on transparency rather than regulated targets is often the preferred approach.

39. Under the 2008 Regulation, Bahrain has followed a non-regulated approach towards QoS target-setting, relying on reporting, monitoring and auditing to promote adequate levels of QoS.

40. In addition, where the Authority perceives operators are not achieving the required levels of QoS, the 2008 Regulation allows the Authority to establish targets to be achieved within a specific timeframe in accordance with benchmarking or international standards. These targets may be established for all operators or for an individual operator. Failure to achieve targets subjects an operator to enforcement proceedings.9

41. Overall, the approach under the 2008 Regulation resulted in adequate QoS being delivered to Bahraini consumers for both fixed and mobile services. Moreover, monitoring and auditing by the Authority demonstrated that generally QoS levels consistently improved over the last several years. As such, at present the Authority found no systematic, market-wide problems that in the Authority’s view merit imposing regulated targets in Bahrain.

42. With regard to mobile services, recently published mobile audits conducted by the Authority support this conclusion.

a. Billing: The mobile billing audit (post-paid) conducted between 19th September and 18th October 2016 found that all three mobile providers accurately billed national calls, national short message services (SMS), data services, international calls and roaming services.10

b. Coverage: The mobile coverage audit conducted between the 1st and 19th of September of 2016 found voice service population coverage of 99.85-99.97% and 100% data coverage (LTE), consistent with coverage requirements imposed on all three providers.11

c. QoS: The mobile QoS audit conducted from 23rd August to 28th September 2016 found excellent to good QoS levels for voice and data services and Bahrain performing very well relative to benchmark countries.12

43. In relation to fixed services, the broadband QoS Report for Q3 2016 also shows adequate levels of performance for fixed wireline and wireless broadband services.13

44. In addition, as summarized in Table 6 the Authority verified an increase in competition in various retail markets reviewed over the last three years:

9 See 2008 Regulation, Art. 8.1.
Table 6: Summary of findings dominance determinations

<table>
<thead>
<tr>
<th>Year</th>
<th>Retail market</th>
<th>Authority determination</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>Mass-market fixed voice calls (domestic)</td>
<td>Market is competitive.</td>
</tr>
<tr>
<td>2016</td>
<td>Premium access market (fixed voice)</td>
<td>Not competitive, but products are typically consumed by large enterprises with bargaining power to control for QoS levels.</td>
</tr>
<tr>
<td>2016</td>
<td>Market for international outgoing calls</td>
<td>Market is competitive.</td>
</tr>
<tr>
<td>2014</td>
<td>Fixed broadband market, mass-market consumers</td>
<td>Market is competitive.</td>
</tr>
<tr>
<td>2014</td>
<td>Fixed broadband market, business consumers</td>
<td>Not competitive, but providers offer higher QoS to the end users in the form of more stringent KPIs or service level agreement (SLAs) than what is offered to mass-market users.</td>
</tr>
</tbody>
</table>

45. The Authority believes the considerations above support the conclusion that setting specific targets for QoS KPIs is not justified at this time.

Questions

6. Do you agree with the proposed approach and analysis toward target-setting outlined above? If not, please provide a reasoned response.

7. Do you agree that the Authority should retain the power to set targets in the future via a determination if so warranted? If not, please provide a reasoned response.
6. Approach toward reference values

6.1. Proposed approach

46. The Authority proposes to include a set of reference values for the most relevant QoS KPIs as described in Schedule 5 of the revised QoS Regulation.

47. Reference values do not represent a binding minimum threshold on licensed operators (i.e., they are not targets). Instead, these are numerical values for specific QoS KPIs that shall be used by the Authority to monitor QoS performance in accordance with the revised QoS Regulation.

48. The Authority may use reference values as a means to gauge whether market dynamics or operators’ performance are offering adequate levels of QoS to end users and thus make objective assessments as to whether there is justification for the Authority to impose binding targets as discussed in section 5 above.

6.2. Reasoning supporting the proposed approach

49. The goal of setting reference values in the revised QoS Regulation is to increase transparency of QoS performance in Bahrain both for end users and operators.

a. End users are expected to benefit from a reference framework based on national conditions and international practice to assess performance of their service providers; and

b. Licensed operators are expected to benefit from a reference framework that will provide additional certainty as to the performance levels that could be obtained in Bahrain, creating incentives (i) for improvements, where needed, or (ii) for further competition based on QoS performance to exceed reference values.

50. Reference values will also function as a safe harbor for licensed operators. If met, the Authority will not impose targets. If licensed operators do not meet the reference values, these may be used assist the Authority in setting targets, where warranted.

51. The following reference values are proposed:

Table 7: Proposed reference values

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Monitored service</th>
<th>Reference Value</th>
</tr>
</thead>
</table>
| G-1       | Supply time for initial connection | Fixed Voice Services (PSTN, VoIP)  
Existing lines: < 5 days target for the 95% ; <10 days for the 99%  
New lines: < 30 days for 95% where network is available within 100 mts of the premise; < 60 days for 99%  
Mobile Services (Voice/VoLTE/Broadband) | 2 hours for 95% |
| G-3 | Fault repair time | Fiber: < 30 days for 95% where network is available within 100 mts of the premise; < 60 days for 99%  
Copper: < 30 days for 95% where network is available within 100 mts of the premise; < 60 days for 99% |
| G-7 | Billing correctness complaints resolution time | Internet services (DSL, FTTH, Fixed Wireless)  
Existing lines: < 5 days target for the 95% ; <10 days for the 99%  
New lines: < 30 days for 95% where network is available within 100 mts of the premise; < 60 days for 99% |
| G-8 | Network availability of the "core" network | Fixed Voice Services (PSTN, VoIP)  
< 24 hours for 80% of complaints  
< 48 hours for 95%  
Mobile Services (Voice/VoLTE/Broadband)  
< 24 hours for 80% of complaints  
< 48 hours for 95%  
Internet services (DSL, FTTH, Fixed Wireless)  
< 24 hours for 80% of complaints  
< 48 hours for 95% |
| V-1 | Call Set-Up Success Rate | Fixed Voice Services (PSTN, VoIP)  
< 24 hours for 80% of complaints  
< 48 hours for 95%  
Mobile Services (Voice/VoLTE/Broadband)  
< 24 hours for 80% of complaints  
< 48 hours for 95%  
Internet services (DSL, FTTH, Fixed Wireless)  
< 24 hours for 80% of complaints  
< 48 hours for 95% |
| V-2 | Call Set-up time | Fixed Voice Services (PSTN, VoIP)  
< 24 hours for 80% of complaints  
< 48 hours for 95%  
Mobile Services (Voice/VoLTE/Broadband)  
< 24 hours for 80% of complaints  
< 48 hours for 95%  
Internet services (DSL, FTTH, Fixed Wireless)  
< 24 hours for 80% of complaints  
< 48 hours for 95% |
| V-3 | Voice Quality | Fixed Voice Services (PSTN, VoIP)  
< 24 hours for 80% of complaints  
< 48 hours for 95%  
Mobile Services (Voice/VoLTE/Broadband)  
< 24 hours for 80% of complaints  
< 48 hours for 95%  
Internet services (DSL, FTTH, Fixed Wireless)  
< 24 hours for 80% of complaints  
< 48 hours for 95% |
| V-4 | Speech Delay | Fixed Voice Services (PSTN, VoIP)  
< 24 hours for 80% of complaints  
< 48 hours for 95%  
Mobile Services (Voice/VoLTE/Broadband)  
< 24 hours for 80% of complaints  
< 48 hours for 95%  
Internet services (DSL, FTTH, Fixed Wireless)  
< 24 hours for 80% of complaints  
< 48 hours for 95% |
| V-5 | Speech Delay | Fixed Voice Services (PSTN, VoIP)  
< 24 hours for 80% of complaints  
< 48 hours for 95%  
Mobile Services (Voice/VoLTE/Broadband)  
< 24 hours for 80% of complaints  
< 48 hours for 95%  
Internet services (DSL, FTTH, Fixed Wireless)  
< 24 hours for 80% of complaints  
< 48 hours for 95% |
| V-6 | Speech Delay | Fixed Voice Services (PSTN, VoIP)  
< 24 hours for 80% of complaints  
< 48 hours for 95%  
Mobile Services (Voice/VoLTE/Broadband)  
< 24 hours for 80% of complaints  
< 48 hours for 95%  
Internet services (DSL, FTTH, Fixed Wireless)  
< 24 hours for 80% of complaints  
< 48 hours for 95% |
| M-1 | Dropped call rate | Fixed Voice Services (PSTN, VoIP)  
< 24 hours for 80% of complaints  
< 48 hours for 95%  
Mobile Services (Voice/VoLTE/Broadband)  
< 24 hours for 80% of complaints  
< 48 hours for 95%  
Internet services (DSL, FTTH, Fixed Wireless)  
< 24 hours for 80% of complaints  
< 48 hours for 95% |
<table>
<thead>
<tr>
<th></th>
<th>Completion Rate for SMS</th>
<th>Mobile Services (SMS)</th>
<th>&gt; 99%</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-1</td>
<td>Throughput</td>
<td>Internet services (DSL, FTTH, Mobile Broadband, Fixed Wireless)</td>
<td>Within the advertised typical throughput</td>
</tr>
<tr>
<td>B-2</td>
<td>Latency</td>
<td>Internet services (DSL, FTTH, Mobile Broadband, Fixed Wireless)</td>
<td>Fixed National &lt; 50 ms; Fixed international &lt;200 ms (Europe), &lt;300 ms (US); Mobile &lt; 100 ms</td>
</tr>
<tr>
<td>B-3</td>
<td>Web page loading time</td>
<td>Internet services (DSL, FTTH, Mobile Broadband, Fixed Wireless)</td>
<td>Fixed &lt; 3 seconds; Mobile &lt; 3 seconds</td>
</tr>
</tbody>
</table>

52. The reasoning supporting the proposed reference values is provided in Annex 4 to this consultation document.

**Questions**

8. Do you agree with the proposal to establish non-binding reference values in the revised QoS Regulation? If not, please provide a reasoned response.

9. Do you agree with the proposed reference values for the QoS KPIs identified in Schedule 5 of the revised QoS Regulation? If not, please provide a reasoned response.
7. Approach toward wholesale service QoS

7.1. Proposed approach

53. The Authority does not believe the revised QoS Regulation should include QoS KPIs for wholesale services applicable to dominant operators. Instead, these will continue to be included in the relevant Reference Offers of dominant providers approved by the Authority from time to time.

7.2. Reasoning supporting the proposed approach

54. The Authority recognizes that a lack of effective competition in certain wholesale markets justifies imposing QoS KPIs and performance targets specific to the dominant operator. This is because other operators are dependent upon the dominant operator’s services (e.g., response times, QoS levels, etc.) to provide their own services to their customers (e.g., achieve competitive response times, QoS levels, etc.). As such, coordination between wholesale and retail QoS KPIs is required to ensure the end-to-end approach towards QoS outlined in section 3 above.

55. International practice indicates that such coordination can be achieved in two ways: (i) via a QoS Regulation or (ii) via Reference Offers.

56. In Bahrain, wholesale QoS KPIs and targets are set in Reference Offers approved by the Authority and we believe this approach should be maintained for the following reasons:

a. First, including QoS KPIs and targets in the Reference Offer provides the Authority a holistic approach towards the remedies imposed to address competition concerns in the wholesale market, ensuring consistency and facilitating their application.

b. Second, Reference Offers may be reviewed periodically to be better tailored to ongoing wholesale market developments, thus allowing the Authority to keep more up-to-date QoS KPIs and targets in place for such services.

c. Third, in countries where no specific retail targets for QoS KPIs have been imposed (such as Bahrain) the risks of creating inconsistent retail and wholesale obligations is significantly reduced, if not absent (i.e., setting wholesale targets that do not allow compliance with retail targets).

57. To be clear, the Authority fully understands that wholesale KPIs and targets are in many instances directly linked to retail service QoS KPIs. Ensuring coordination between both has been the Authority’s practice to date and will remain its practice going forward. Therefore, when setting wholesale QoS KPIs and targets we will ensure that providers that depend on such wholesale services are in turn capable of meeting their retail QoS KPIs and/or targets (if applicable). Similarly, if retail QoS KPIs are set in accordance with the revised QoS Regulation, the Authority will ensure that they take account of any existing KPIs and targets for wholesale inputs.

58. The Authority will place particular attention to ensuring such coordination as the implementation of Batelco’s legal separation is undertaken in accordance with the Fourth National Telecommunications Plan (NTP4).
Questions

10. Do you agree with the proposed approach towards QoS KPIs and targets for wholesale services? If not, please provide a reasoned response.
8. Approach toward reporting, monitoring and auditing QoS KPIs

8.1. Proposed changes regarding reporting and monitoring QoS KPIs

59. To avoid unnecessary overlap, reduce QoS compliance costs and ensure consistency in measurement results, the Authority proposes the following reporting and monitoring framework:

a. **Self-reporting**: Operators will be required to continue filing quarterly reports on the General KPIs identified in Table 2 only.

b. **External measurements**: The Authority, either directly or through a qualified third party, will continue measuring voice, mobile and broadband KPIs identified in Tables 4-6. The Authority may also measure additional KPIs if warranted.

60. The revised QoS Regulation will require the Authority to make public the information reported by operators as well as its own measurements once they have been audited/reviewed. Operators will also make such information public on their websites as described in the revised QoS Regulation.

8.2. Reasoning supporting the proposed changes

61. In countries that rely on transparency to achieve adequate levels of QoS it is critical to enact a robust reporting, monitoring and auditing framework within the QoS Regulation. Such a framework is generally aimed at achieving the following key objectives:

a. ensuring that sufficient information is made publicly available in a simple and easy-to-understand manner to assist consumers in making informed purchasing decisions;

b. reducing compliance costs for licensed operators;

c. creating incentives for increased QoS levels and competition between service providers; and

d. providing the Authority sufficient information to assess the state of QoS in the various services and market segments and to adopt corrective/enforcement measures as needed.

62. Since the adoption of the 2008 Regulation, the Authority has relied on two separate sources of information to monitor QoS levels: (i) self-reporting by operators; and (ii) QoS measurements conducted by third parties on behalf of the Authority.

63. The 2008 Regulation requires operators to perform measurements and report results to the Authority on a quarterly basis. Under existing regulations, operators must comply with the following measures.\textsuperscript{14}

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\textsuperscript{14}See 2008 Regulation, art. 6.
a. Follow the prescribed measurement methods as outlined in Schedule 1 of the 2008 Regulation.

b. Submit the measurements to the Authority no later than 30 days after the end of the reporting period using the form contained in Schedule 1 of the 2008 Regulation.

c. Submit any information used in making the measurements and any other information requested by the Authority no later than 60 days after the end of the reporting period. Such information shall include but is not limited to the details of the observations and calculations made for the measurements.

d. Keep the measurements and any information used in making the measurements for at least 12 months after the end of the reporting period unless otherwise directed by the Authority.

64. As a complement to self-reporting by operators, the Authority currently publishes periodic audits of the state of QoS performance of both fixed and mobile services in Bahrain.\textsuperscript{15} These audits are based on external measurements that simulate end user behavior and use two main methods: (i) mobile drive-tests to assess mobile voice and data performance; and (ii) a fixed measurement network for fixed broadband, mobile voice and mobile broadband performance.

65. These complementary approaches have worked well since the adoption of the 2008 Regulation. Going forward, the Authority proposes to maintain the current framework toward QoS reporting and monitoring with certain adjustments.

66. The Authority is proposing to limit operators’ quarterly reporting to the General KPIs for the following reasons.

a. First, General KPIs are internal KPIs of each operator that are not easily observed using external testing methods. Self-reporting will thus be the most effective means to measure performance of these KPIs and obtain a larger number of measurements that will make results more statistically significant.

b. Second, external measurements of the remaining KPIs will allow measuring performance in a uniform manner using probes simulating end-user behaviour. In practice, internal measurements by operators for the remaining KPIs are typically based on network statistics. We note, however, that network statistics between operators do not necessarily measure the same QoS KPI even if the name is the same. Often complex calculations of a number of counters must be applied to determine the QoS KPI. Changes in the network and/or the software might require changes in the formulas used or even alter what a specific counter is pegging. While this information is useful to observe trends, it is not very useful for real comparisons between operators and verification of achieving specific targets (if applicable).

\textsuperscript{15} Reference to the latest audits published by the Authority are included in paragraphs 42 and 43 above.
67. Finally, considering that no binding targets are being proposed at this time, the Authority believes that all QoS information should be made publicly available. This will ensure a high level of transparency that is necessary to achieve the objectives discussed in paragraph 61.

Questions

11. Do you agree with the proposed reporting and monitoring framework being proposed? If not, please provide a reasoned response.
9. Operator maintenance and critical issue reporting

9.1. Proposed changes regarding operator maintenance and critical issue reporting

68. The Authority proposes to introduce a provision in the revised QoS Regulation addressing planned maintenance and unplanned outage reporting requirements. The purpose of this provision are to:

a. define the conditions of planned maintenance and unplanned outages;
b. implement the thresholds for reporting planned maintenance and unplanned outages; and
c. establish the requisite timing for the submission of notice to the relevant parties.

69. The revised QoS Regulation will define reporting thresholds for unplanned outages according to their severity as critical, major, or minor outages:

a. critical outages are proposed to be defined as those affecting emergency services, or the entire network, including the core network, such that greater than or equal to 30 percent of the traffic or subscribers are affected;
b. a major outage is proposed to be defined as one that affects part of the same network elements as a critical outage (but does not affect the entire network or the core network as does a critical outage) or less than 30 percent of traffic or subscribers; and
c. minor outages are proposed to be defined as those affecting individual sites and/or components at the edge level of the network that do not interrupt service or performance and do not exceed 12 hours in duration.

70. Regarding unplanned outage reporting requirements, the revised QoS Regulation proposes different notification requirements depending on the level of severity:

a. for a critical outage, written notifications must be made within two hours of the outage to the Authority and to end users;
b. major outages must be notified in writing within 24 hours of the outage to the Authority and to end users; and
c. minor outages must be reported in the operator’s quarterly QoS report for the applicable reporting period.

71. Following the resolution of a critical or major outage, written notification must be sent to the Authority stating that the outage has been resolved and services have been restored.

72. The revised QoS Regulation proposes to define network maintenance as a planned network outage and requires operators to provide at least 48-hour prior notice before engaging in such maintenance.
73. Finally, the revised QoS Regulation grants the Authority sufficient powers to inspect operator’s internal documents and equipment to investigate maintenance or outages. The Authority is also granted powers to impose fines for a failure to comply with reporting requirements and/or remedial measures in cases where non-compliance is found.

9.2. Reasoning supporting the proposed change

74. Given the importance of the continuity of service for consumers and businesses, it is common for service providers to be required to report major maintenance and critical issues (e.g., significant service interruptions) to regulatory authorities and to consumers themselves.

75. In Bahrain, neither the Telecommunications Law nor its implementing regulations address maintenance or critical issue reporting for retail services. Instead, existing requirements on these matters are contained in specific service licenses, as specified below.\(^{16}\)

a. A licensee may not intentionally interrupt or suspend the operation of its network in the normal course of business nor suspend the provision of any type of licensed service without having first obtained approval from the TRA in writing and provided reasonable advance notices to users that would be affected by such an interruption or suspension.

b. A licensee may suspend or interrupt operations of its network without prior notice, for the shortest period practicable, where:

   i. It has been directed to suspend or interrupt service by a Court, regulator or other relevant authority; or

   ii. It is necessary to do so to prevent imminent risk of danger, damage or injury to persons or property

76. The Authority believes the current framework requires revision for the following reasons.

a. First, establishing regulatory obligations (e.g., maintenance and critical issue reporting) under specific service licenses can create regulatory asymmetries between similarly situated competitors. This can be remedied by establishing the reporting requirement in a single regulation to ensure congruent requirements between competitors.

b. Second, service outages should be classified not on the basis of its causes (e.g., whether they are directed by a Court, the regulator or other relevant authority) but on whether such outages are planned or unplanned. This is the general practice internationally where, typically, unplanned outage reporting frameworks establish reporting obligations based on the severity of the outage (e.g., critical, major, or minor). The more important the infrastructure affected, or the greater the number of subscribers or amount of traffic affected, the sooner an outage must be reported. The level of severity is determined according to the network infrastructure,

\(^{16}\) See Article 10 of the Individual Mobile Telecommunications License (IMTL) and Article 10 of the National Fixed Wireless Licenses (NFWL) licenses.

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the number of subscribers and/or the amount of traffic affected. Reporting procedures for unplanned outages include notifying the regulator and customers regarding the status of the outage and measures being taken to restore the network or service and communicating when the network or service has been restored. Bahrain’s current framework makes no such distinction and thus does not establish variable reporting obligations depending on the severity of the outage.

c. Third, currently licensees require prior approval from the regulator before engaging in planned network maintenance. The Authority believes this to be a significant burden typically not used internationally. Instead, maintenance-related interruptions (or planned outages) should be notified to the regulator and customers beforehand (e.g., date and time, duration, services and service areas affected).

Questions

12. Do you agree with the need to establish a maintenance and critical issue reporting framework? If not, please provide a reasoned response.

13. Do you agree with the classification of unplanned outages and reporting requirements being proposed? If not, please provide a reasoned response.

14. Do you agree with the propose approach towards network maintenance? If not, please provide a reasoned response.
10. Enforcement mechanisms

10.1. Proposed changes regarding enforcement mechanisms

77. To ensure transparency and create the appropriate incentives for compliance, the Authority is proposing an enforcement framework that favors voluntary compliance as a first step while also empowering the Authority to exercise proportionate enforcement actions as a last resort. The authority believes this approach is in keeping with best practices and will be the most effective means to achieve compliance with the revised QoS Regulation.

78. Based on the types of obligations established in the revised QoS Regulation, it is proposed that enforcement mechanisms be directed towards three key issues:

a. **Compliance with reporting requirements**: reporting requirements are at the core of the proposed QoS framework and compliance with these obligations is critical to ensure end users are adequately informed of the levels of QoS being offered by the various operators. Failure to adequately report measurements by licensed operators can significantly undermine the successful implementation of a framework that is based on transparency and competition as means to achieve high levels of QoS for consumers. Therefore, specific enforcement provisions to ensure timely, complete and accurate reporting by operators, including warning, transparency requirements and fines.

b. **Compliance with targets set for specific KPIs**: in cases where targets are set, the Authority must ensure that operators meet and maintain the relevant thresholds in order to achieve the minimum QoS levels determined by the Authority to be acceptable. This is typically achieved via a stricter enforcement approach, using fines and other actions. Failure to meet targets is likely to be characterized by the Authority as a “material breach” of the operators’ obligations.

c. **Compliance with outage and maintenance notification requirements**: the Authority must ensure that licensed operators file timely and accurate notifications on planned and unplanned outages as well as effectively implement corrective measures to resolve the causes that resulted in an outage and prevent their future occurrence. To this end, voluntary compliance is incentivized via outage reporting and the Authority is granted the power to impose fines in case of breach.

10.2. Reasoning supporting the proposed change

79. Providing the Authority with appropriate enforcement tools is a key factor to achieve effective the implementation of the revised QoS Regulation.

• **Enforcement of QoS requirements**

80. Enforcement mechanisms should typically follow an escalation path to promote voluntary compliance while ensuring that the Authority has sufficient powers to compel compliance exercising proportionate enforcement actions. Consistent with our proposal not to set binding targets at this time (section 5), the revised QoS Regulation proposes an escalation process that would follow two stages:
a. The first stage applies to instances where no targets have been set for a specific KPI and is focused on reporting obligations.

b. The second stage applies to KPIs for which the Authority has set targets in accordance with the revised QoS Regulation and focuses on breaches of targets.

**Stage 1: Reporting obligations for General KPIs for which targets have not been set**

81. As noted above, the key objective of the enforcement framework relating to reportable KPIs (i.e., General KPIs) is to promote voluntary compliance. To this end, the revised QoS Regulation proposes a framework of incentives and sanctions.

82. The goal is to signal to operators that it is in their own self-interest to meet their reporting obligations under the revised QoS Regulation as a means to maintain the incentives-based enforcement approach (e.g., non-regulated targets, transparency as the preferred enforcement tool), while at the same time giving the Authority the tools to compel compliance in case of breaches.

83. Based on the above, the Authority proposes that the enforcement of reportable KPIs for which targets have not been set follow an escalation process divided into three phases.

**Figure 3: Phases for Stage 1 of the proposed enforcement framework for QoS KPIs**

<table>
<thead>
<tr>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Voluntary Compliance</strong></td>
<td><strong>Enforcement actions</strong></td>
<td><strong>Target setting</strong></td>
</tr>
<tr>
<td>TRA grants additional time for submission of QoS Report</td>
<td>TRA may issue warning, impose fines, order notices be published</td>
<td>TRA may impose individual targets on operators that fail to report</td>
</tr>
</tbody>
</table>

84. Each phase is described in more detail as follows:

a. **Voluntary compliance phase:** in case an operator fails to submit timely, complete or accurate measurements for reportable KPIs (i.e., General KPIs), the Authority shall provide the non-compliant operator an additional opportunity to voluntarily meet its reporting obligation by filing a complete and/or accurate QoS measurement report.

b. **Enforcement actions phase:** in case an operator fails to voluntarily submit a complete and/or accurate QoS measurement report, the Authority is empowered to promote compliance via one or more of the following mechanisms:

   o **Issuing warnings** to operators that failure to comply with their reporting obligations may result in individual targets being set (i.e., applicable only to the non-compliant operator) for the KPIs in question;
   
   o **Imposing fines** for non-compliance. These include one-time fines for the breach and daily fines for continuing breaches (i.e., delays in submitting complete and accurate QoS
information) and the revised QoS Regulation provides maximum thresholds for these fines as discussed further in Table 8;
  
  o Relying on transparency to promote compliance. The Authority is empowered to direct a non-compliant operator to publish a notice stating that it has failed to meet its QoS reporting obligations (in newspapers and/or on its website). This is intended to use reputational effects as a deterrent for non-compliance.

4. **Target setting phase**: failure to report QoS information for General KPIs seriously undermines the non-regulated approach toward targets proposed in the revised QoS Regulation. Lack of timely, complete and accurate reporting leads to a lack of transparency in QoS information available to consumers. This in turn reduces the potential of competitive forces disciplining the level of QoS offered to end users. As such, the Authority will be able to impose targets for individual operators that fail to report QoS information in any two (2) reporting periods within four (4) consecutive reporting periods. This two-strike rule will serve as a deterrent for non-compliance, as individual, non-compliant operators would be subject to asymmetric targets if they fail to report QoS data consistently. This would not only have a reputational effect on the operator, but would further escalate the enforcement options available to Authority, ushering in the second stage of enforcement proposed.

**Stage 2: Compliance with QoS KPIs for which targets have been set**

85. The second enforcement stage refers to compliance with targets set by Authority for specific KPIs (applicable to all or some operators).

86. In case targets are set, the Authority must be empowered to ensure that operators achieve and maintain such targets. Like in stage 1 discussed above, the Authority will seek to incentivize voluntary compliance with established targets, while also having the ability to exercise a set of enforcement actions, including fines, to deter non-compliance.

87. Based on the above, the Authority proposes that the enforcement of targets follow an escalation process divided into two phases.

**Figure 4: Phases of Stage 2 of the proposed enforcement framework for QoS KPIs**

88. Each phase is described in more detail as follows:

(i) **Voluntary compliance phase**: the Authority shall require operators that are subject to targets to present a compliance plan to meet and maintain such targets. This obligation should be triggered by failure to meet the target in one reporting period. Compliance plans should be submitted for review and approval of the Authority.
(ii) **Enforcement actions phase**: if following the implementation of an approved compliance plan an operator fails to meet and maintain the target for a specific KPI during two (2) reporting periods within four (4) consecutive reporting periods, this conduct may be treated as a material breach and be subject to enforcement in accordance with article 35 of the Telecommunications Law. Similarly, failure to present a compliance plan that is approved by the Authority may also be deemed a material breach.

Assessment of the level of fines

89. Specifically relating to **reporting obligations**, the revised QoS Regulation sets specific amounts for fines for failing to report on a timely, complete and accurate manner. In setting the levels of these fines, the Authority acknowledges the need to impose fines that promote compliance, but that are not too high as to lead to excessive and disproportionate penalties.

90. Table 8 presents proposals for specific amounts of fines for failing to meet QoS reporting obligations under the revised QoS Regulation.

**Table 8: Proposed amounts for breach of reporting obligations**

<table>
<thead>
<tr>
<th>Breach</th>
<th>Amount of fine</th>
<th>Authority’s view</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failure to submit QoS report on a <strong>timely</strong> basis</td>
<td>One-time fine of BHD 600 per reporting period.</td>
<td>The proposed fine is deemed appropriate to promote compliance, while not being excessive. This amount is broadly consistent with that proposed by Authority in the 2014 consultation. The Authority believes that these fines need not be higher since they will be implemented in combination with other enforcement mechanisms (i.e., warnings and transparency). Together, these mechanisms will appropriately deter non-compliance.</td>
</tr>
<tr>
<td></td>
<td>A daily fine of BHD 50 for each working day of delay in submitting the quality of service report up to a maximum of twenty (20) working days.</td>
<td>Imposing daily fines is common practice to limit delays in case of continuing breaches. Combined with the one-time fine, Authority may impose a total fine of up to BHD 1,600.</td>
</tr>
<tr>
<td>Failure to submit a <strong>complete</strong> QoS report</td>
<td>A one-time fine of BHD 75 per reportable parameter for which the licensed operator has submitted incomplete information within a reporting period.</td>
<td>Taking into account that there are 8 reportable parameters (i.e., the General KPIs), this amount would be equivalent on a prorated basis to the BHD 600 fine for failing to present a timely report (8x75=600). The Authority’s intent is to incentivize licensed operators to file timely and...</td>
</tr>
</tbody>
</table>
A daily fine of BHD 50 for each working day of delay in submitting a complete quality of service report for a maximum of twenty (20) working days.

Combined with the one-time fine, the Authority may impose a total fine of up to BHD 1,600.

<table>
<thead>
<tr>
<th>Breach</th>
<th>Amount of fine</th>
<th>Authority’s view</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failure to submit an accurate QoS report</td>
<td>A one-time fine of BHD 5,000 per reportable parameter for which the licensed operator has submitted inaccurate information within a reporting period.</td>
<td>Reporting inaccurate information threatens to undermine the entire QoS framework proposed (i.e., relying on transparency and competitive forces as the key means to ensure adequate levels of QoS). This is because inaccurate reporting defeats the objective of ensuring appropriate levels of transparency in the market. Accordingly, the Authority believes a high fine is justified to deter this behavior. This fine is consistent with the amount proposed in the 2014 consultation.</td>
</tr>
</tbody>
</table>

91. With respect to **compliance with targets** for specific QoS KPIs, the Authority is proposing an upper bound for assessing fines for non-compliance in accordance with article 35 of the Telecommunications Law.

92. To further secure consistent implementation of enforcement actions under article 35 of the Telecommunications Law, the Authority will follow guidelines for setting fines to ensure the Authority assesses all relevant facts that are relevant to determining the quantum of the fines within the pre-established range.¹⁷

**Table 9: Proposed range for material breaches of failing to achieve targets for QoS KPIs**

<table>
<thead>
<tr>
<th>Breach</th>
<th>Amount of fine</th>
<th>Authority’s view</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failure to meet or maintain a target for a specific parameter for any two (2) reporting periods within four (4) consecutive reporting periods</td>
<td>A fine of up to BHD 1,000 per unit of deviation from the target as determined in the determination setting the target issued by the Authority.</td>
<td>This approach is proportionate with the principle of escalation at the core of the enforcement framework being proposed. Since this fine is the last enforcement action available under the proposed framework, it is relevant to empower the Authority to impose a fine that has the appropriate deterrent effect.</td>
</tr>
</tbody>
</table>

¹⁷ See Guidelines for the setting of the amount of a fine for violations of article 35 and/or 65 of the Telecommunications Law of the Kingdom of Bahrain issued by the Authority on 16 March 2014.
By linking the fine to units of deviation from the target, the proposed range ensures that any fine would be proportional to the breach.

This range is consistent with that proposed in the 2014 consultation.

- **Enforcement of planned and unplanned outages**

93. With respect to **planned and unplanned outages**, the revised QoS Regulation proposes enforcement actions for failure to file outage reports as well as for failure to propose adequate corrective measure or to effectively implement such corrective measures once accepted by the Authority.

94. Failure to submit outage and maintenance reports will result in monetary fines. The revised QoS Regulation sets the fine at BHD 1,600 per occurrence which is consistent with the breach of other reporting requirements as discussed above. The Authority believes that this quantum is proportionate with the breach and expects it will be sufficient to ensure compliance.

95. In the case of unplanned outages, designing and implementing effective corrective measures to address and resolve the causes of an outage and prevent their future reoccurrence is a critical objective of the revised QoS Regulation.

96. Based on the above, the Authority proposes that the enforcement of corrective measures to address outages follow an escalation process divided into three phases.

**Figure 5: Phases of the proposed enforcement framework for outage reporting and corrective measures**

97. Each phase is described in more detail as follows:

(i) **Voluntary compliance phase**: licensed operator must specify the corrective measure to address outages and prevent their causes to avoid future occurrence in their outage reports. This allows operators to assess the causes of an outage and design appropriate measures to address them. Compliance plans should be submitted for review and approval of the Authority.

(ii) **TRA Assessment phase**: outage reports must be file for review and approval of the Authority. In its review, the Authority may accept the proposed corrective measure as presented, require
changes to such proposed measures or require additional measures. Similarly, the Authority shall have the power to initiate investigations into outages where necessary.

(iii) **Enforcement actions phase**: failure to propose adequate corrective measures that are approved by the Authority may also be deemed a material breach. Similarly, failure to effectively implement approved corrective measures may also be considered a material breach. In both instances the Authority may exercise enforcement actions in accordance with article 35 of the Telecommunications Law.

Questions

15. Do you agree with the three key enforcement issues identified by the Authority? If not, please provide a reasoned response.

16. Do you agree with the escalation mechanisms proposed for enforcement actions in each of the key issues identified? If not, please provide a reasoned response.

17. Do you agree with the Authority’s proposal (i) to set specific levels of fines for specific breaches and (ii) the specific monetary levels for such fines being proposed? If not, please provide a reasoned response.
Annex 1: Revised QoS Regulation
Annex 2: Consultation Questionnaire

1. Do you agree with the proposed end user-centric approach for the review of existing QoS KPIs? If not, please provide a reasoned response.

2. Do you agree with identifying QoS KPIs based on the various consecutive phases of the service? If not, please provide a reasoned response.

3. Do you agree with the proposed groups of QoS KPIs? If not, please provide a reasoned response.

4. Do you agree with the specific QoS KPIs being proposed? If not, please provide a reasoned response.

5. Do you have any other comments on Schedule 1 of the revised QoS Regulation?

6. Do you agree with the proposed approach and analysis toward target-setting outlined above? If not, please provide a reasoned response.

7. Do you agree that the Authority should retain the power to set targets in the future via a determination if so warranted? If not, please provide a reasoned response.

8. Do you agree with the proposal to establish non-binding reference values in the revised QoS Regulation? If not, please provide a reasoned response.

9. Do you agree with the proposed reference values for the QoS KPIs identified in Schedule 5 of the revised QoS Regulation? If not, please provide a reasoned response.

10. Do you agree with the proposed approach towards QoS KPIs and targets for wholesale services? If not, please provide a reasoned response.

11. Do you agree with the proposed reporting and monitoring framework being proposed? If not, please provide a reasoned response.

12. Do you agree with the need to establish a maintenance and critical issue reporting framework? If not, please provide a reasoned response.

13. Do you agree with the classification of unplanned outages and reporting requirements being proposed? If not, please provide a reasoned response.

14. Do you agree with the propose approach towards network maintenance? If not, please provide a reasoned response.

15. Do you agree with the three key enforcement issues identified by the Authority? If not, please provide a reasoned response.

16. Do you agree with the escalation mechanisms proposed for enforcement actions in each of the key issues identified? If not, please provide a reasoned response.
17. Do you agree with the Authority’s proposal (i) to set specific levels of fines for specific breaches and (ii) the specific monetary levels for such fines being proposed? If not, please provide a reasoned response.
## Annex 3: Comparison between existing QoS KPIs and revised KPIs

<table>
<thead>
<tr>
<th>Existing KPIs – 2008 Regulation</th>
<th>Revised QoS KPIs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General KPIs</strong></td>
<td></td>
</tr>
<tr>
<td>Service supply time</td>
<td>G-1 Supply time for initial connection</td>
</tr>
<tr>
<td>Number of faults reported</td>
<td>G-2 Fault Rate</td>
</tr>
<tr>
<td>Fault report rate</td>
<td>G-3 Fault repair time</td>
</tr>
<tr>
<td>Fault repair time</td>
<td>G-4 Response times for call center services</td>
</tr>
<tr>
<td>Call statistics for int’l manual operator services</td>
<td>G-5 Response times for directory services</td>
</tr>
<tr>
<td>Unsuccessful call center access</td>
<td></td>
</tr>
<tr>
<td>Call statistics for national manual directory queries</td>
<td></td>
</tr>
<tr>
<td>Account complaint rate</td>
<td>G-6 Billing correctness complaints rate</td>
</tr>
<tr>
<td>Account complaint resolution time</td>
<td>G-7 Billing correctness complaints resolution time</td>
</tr>
<tr>
<td>No equivalence</td>
<td>G-8 Network availability of the “core” network</td>
</tr>
<tr>
<td>Disconnection complaint rate</td>
<td>Removed</td>
</tr>
<tr>
<td>Disconnection complaints received</td>
<td>Removed</td>
</tr>
<tr>
<td>Disconnection complaint resolution time</td>
<td>Removed</td>
</tr>
<tr>
<td>Miscellaneous complaint</td>
<td>Removed</td>
</tr>
<tr>
<td><strong>Voice KPIs</strong></td>
<td></td>
</tr>
<tr>
<td>Unsuccessful call set-up</td>
<td>V-1 Call set-up success rate</td>
</tr>
<tr>
<td>No equivalence</td>
<td>V-2 Call set-up time</td>
</tr>
<tr>
<td>No equivalence</td>
<td>V-3 Voice quality</td>
</tr>
<tr>
<td>No equivalence</td>
<td>V-4 Speech delay</td>
</tr>
<tr>
<td><strong>Mobile KPIs</strong></td>
<td></td>
</tr>
<tr>
<td>Dropped call ratio</td>
<td>M-1 Dropped call rate</td>
</tr>
<tr>
<td>No equivalence</td>
<td>M-2 Coverage</td>
</tr>
<tr>
<td>Unsuccessful SMS transmission ratio</td>
<td>M-3 Completion rate for SMS (inverse)</td>
</tr>
<tr>
<td>Unsuccessful MMS transmission ratio</td>
<td>Removed</td>
</tr>
<tr>
<td><strong>Broadband KPIs</strong></td>
<td></td>
</tr>
<tr>
<td>No equivalence</td>
<td>B-1 Throughput</td>
</tr>
<tr>
<td>Internet data transmission time</td>
<td>B-2 Latency</td>
</tr>
<tr>
<td>No equivalence</td>
<td>B-3 Web page loading time</td>
</tr>
<tr>
<td>Unsuccessful Internet session login ratio</td>
<td>Removed</td>
</tr>
<tr>
<td>Dropped Internet session ratio</td>
<td>Removed</td>
</tr>
<tr>
<td>Unsuccessful Internet data transmission ratio</td>
<td>Removed</td>
</tr>
<tr>
<td><strong>Network performance KPIs</strong></td>
<td></td>
</tr>
<tr>
<td>Observation on international outgoing telephone calls</td>
<td>Removed</td>
</tr>
<tr>
<td>Internal automatic observations</td>
<td>Removed</td>
</tr>
<tr>
<td>IP based network measurements</td>
<td>Removed</td>
</tr>
<tr>
<td>Performance and availability of MPLS networks</td>
<td>Removed</td>
</tr>
</tbody>
</table>

- Proposed KPI seeks to address a functionally equivalent issue
- Proposed KPI seeks to address a new issue
- No functionally equivalent KPI being proposed
Annex 4: Proposed reference values

G-1 Supply time for initial connection

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Monitored service</th>
<th>Reference Value</th>
</tr>
</thead>
</table>
|                           | **Fixed Voice Services (PSTN, VoIP)** | Existing lines: < 5 days target for the 95%; <10 days for the 99%  
New lines: < 30 days for 95% where network is available within 100 mts of the premise; < 60 days for 99% |
| G-1 Supply time for initial connection | **Mobile Services (Voice/VoLTE/Broadband)** | 2 hours for 95%                                                                |
|                           | **Fixed Line (fiber)**            | Fiber: < 30 days for 95% where network is available within 100 mts of the premise; < 60 days for 99% |
|                           | **Fixed Line (copper)**           | Copper: < 30 days for 95% where network is available within 100 mts of the premise; < 60 days for 99% |
|                           | **Internet services (DSL, FTTH, Fixed Wireless)** | Existing lines: < 5 days target for the 95%; <10 days for the 99%  
New lines: < 30 days for 95% where network is available within 100 mts of the premise; < 60 days for 99% |

The reference value for the supply time for initial connection should differentiate between:

- Supplying an initial connection over an existing line
- Supplying an initial connection over a new line which requires physical installation

An initial connection over an existing line can be delivered relatively quickly while the installation of a new line would take more planning and work to be completed.
Average supply time as reported by operators (days)

The existing values reported by licensed operators in Bahrain show that a supply time of a few days is a reasonable reference value that can be achieved over existing lines. Historically, with most lines assumed to be existing lines, it has taken incumbents about 5.5 days to supply an initial connection. It is also observed that the supply of new lines (mostly fiber optic) effectively takes longer.

The supply time target of 5 days for existing lines seems reasonable based on the benchmark countries as well.

<table>
<thead>
<tr>
<th>Country</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oman</td>
<td>• Within 5 working days: &gt; 75%</td>
</tr>
<tr>
<td></td>
<td>• Within 10 working days: &gt; 90%</td>
</tr>
<tr>
<td>Qatar*</td>
<td>• With 5 calendar days: &gt; 99%</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>• Within 10 working days: &gt; 90%</td>
</tr>
<tr>
<td>Seychelles</td>
<td>• Residential services: &lt; 5 days</td>
</tr>
<tr>
<td></td>
<td>• Business services: &lt; 3 days</td>
</tr>
<tr>
<td>Singapore</td>
<td>• Residential within 5 working days: &gt; 95%</td>
</tr>
<tr>
<td>St Kitts &amp; Nevis</td>
<td>ECTEL proposal</td>
</tr>
<tr>
<td></td>
<td>• Within 5 working days: &gt; 90%</td>
</tr>
<tr>
<td>Trinidad &amp; Tobago</td>
<td>• Within 5 gradually reducing to 3 working days: &gt; 75%</td>
</tr>
<tr>
<td></td>
<td>• Within 7 gradually reducing to 5 working days: &gt; 95%</td>
</tr>
<tr>
<td></td>
<td>• Within 10 working days: 100%</td>
</tr>
</tbody>
</table>

*Proposal
In benchmark countries some countries make an allowance for new lines. For example, Qatar’s proposed 5 days for 99% for existing copper lines and 15 days whenever fiber is available within 100 meters. New line deployment is a very different process and has many more dependencies on third parties.

The proposed reference values are:

- For fixed voice and internet services it is proposed to use the <5 days target for the 95% threshold and <10 days for the 99% threshold.
- For new lines this has to be substantially longer and <60 days for 95% threshold and <90 days for 99% threshold is proposed.
- For mobile services the connection time can be very short, almost instantaneous. The proposed target is 2 hours for 95%.

### G-3 Fault repair time

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Monitored service</th>
<th>Reference Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>G-3</td>
<td>Fault repair time</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fixed Voice Services (PSTN, VoIP)</td>
<td>&lt; 24 hours for 80% &lt; 48 hours for 95%</td>
</tr>
<tr>
<td></td>
<td>Mobile Services (Voice/VoLTE/Broadband)</td>
<td>&lt; 24 hours for 80% &lt; 48 hours for 95%</td>
</tr>
<tr>
<td></td>
<td>Internet services (DSL, FTTH, Fixed Wireless)</td>
<td>&lt; 24 hours for 80% &lt; 48 hours for 95%</td>
</tr>
</tbody>
</table>

Current performance of fault repair times are < 24 hours for Internet services but only < 68 hours for residential telephony.
The international benchmark shows that most countries target a large number of the faults to be repaired within 24 hours with some allowance for a small percentage of the faults to require a longer time to be repaired.

<table>
<thead>
<tr>
<th>Country</th>
<th>Reference</th>
</tr>
</thead>
</table>
| Oman             | • Within 24 hours: > 90%  
                    • Within 72 hours: > 99.5%                                              |
| Qatar*           | • Within 24 hours: > 90%  
                    • Within 72 hours: > 99.9%                                              |
| Saudi Arabia     | • Within 24 hours: > 90%                                                 |
| Seychelles       | • Mean fault repair time for residential Services: < 72 hours             |
| Singapore        | • Within 24 hours: > 90%  
                    • Within 72 hours: > 99.9%                                              |
| St Kitts & Nevis | ECTEL proposal  
                    • Within 24 hours: > 80%  
                    • Within 48 hours: > 90%                                              |
| Trinidad & Tobago| • Within 36 gradually reducing to 24 hours: > 75%  
                    • Within 48 hours: > 90%                                              |
*Proposal*

From a consumer perspective, the Authority believes a reasonable reference value would be to have at least 80% of the faults repaired within 24 hours and for 95% of the faults to be repaired within 48 hours.

**G-7 Billing correctness complaints resolution time**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Monitored service</th>
<th>Reference Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>G-7</td>
<td>Billing correctness complaints resolution time</td>
<td>Fixed Voice Services (PSTN, VoIP)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mobile Services (Voice/VoLTE/Broadband)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Internet services (DSL, FTTH, Fixed Wireless)</td>
</tr>
</tbody>
</table>

The current performance for fixed voice services appears relatively high, when compared to mobile and other services.

**Account complaint resolution time for fixed services (days)**

![Graph showing account complaint resolution time for fixed services](image)

Source: based on operator reports

Some countries within the benchmark set values for this KPI:

<table>
<thead>
<tr>
<th>Country</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oman</td>
<td>• Within 10 days: &gt; 90%</td>
</tr>
</tbody>
</table>

43
The Authority believes that billing correctness complaint resolution time should not depend on service-specific factors. Instead, it is more dependent upon the process within the operator to verify the actual usage and the invoiced amounts which is all linked to internal IT systems and not the access network technology as such.

A billing correctness complaint should be an event which can be handled rapidly. If that can be realized for mobile and internet services, then it should also be possible for fixed voice services. Accordingly, the Authority proposed reference value 80% of complaint to be resolved within < 24 hours.

**G-8 Network availability of the “core” network**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Monitored service</th>
<th>Reference Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>G-8</td>
<td>Fixed Voice Services (PSTN, VoIP)</td>
<td>99.90%</td>
</tr>
<tr>
<td></td>
<td>Mobile Services (Voice/VoLTE/Broadband)</td>
<td>99.90%</td>
</tr>
<tr>
<td></td>
<td>Internet services (DSL, FTTH, Fixed Wireless)</td>
<td>99.90%</td>
</tr>
</tbody>
</table>

The core network of telecommunications operators should be highly reliable. Often the industry mentions the five (5) 9’s, 99.999% but in practice that still proves quite challenging to achieve. A reasonable assumption is that most, if not all, of the core network is redundant to achieve a very high availability.

No specific performance data in Bahrain for this new proposed KPI is available at this time. However, there are some international references that can help assess values used in other countries:

<table>
<thead>
<tr>
<th>Country</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egypt</td>
<td>&gt;99.9%</td>
</tr>
<tr>
<td>India</td>
<td>&gt;98%</td>
</tr>
<tr>
<td>Lebanon</td>
<td>Fixed: &gt;99.9%</td>
</tr>
<tr>
<td></td>
<td>Broadband: &gt;99%</td>
</tr>
<tr>
<td>Oman</td>
<td>Fixed: &gt; 99.99%</td>
</tr>
<tr>
<td></td>
<td>Mobile: &gt; 99.9%</td>
</tr>
<tr>
<td></td>
<td>Mobile broadband: 95%</td>
</tr>
<tr>
<td>Singapore</td>
<td>&gt; 99.9%</td>
</tr>
</tbody>
</table>
Outages of the core network have major impact on the public life, business and security of Bahrain and its citizens. Accordingly, an initial reference value of at least 99.9% is proposed. This would imply that yearly the outage of the core should be less than 8-9 hours.

**V-1 Call set-up success rate**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Monitored service</th>
<th>Reference Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>V-1</td>
<td>Call Set-Up Success Rate</td>
<td>Voice Services (PSTN, VoIP, Mobile Voice, VoLTE)</td>
</tr>
</tbody>
</table>

The call set-up success rate on the mobile networks in Bahrain is > 98.2%. No performance information is currently available for fixed voice.

**Unsuccessful call set-up ratio**

Note: the figure reports unsuccessful call set up which is the inverse of the proposed KPI of call set up success rate. Source: based on operator reports

The benchmark countries often show a differentiation between mobile and fixed.

<table>
<thead>
<tr>
<th>Country</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bahamas</td>
<td>• Fixed: &gt; 99.5%</td>
</tr>
<tr>
<td></td>
<td>• Mobile: &gt; 99%</td>
</tr>
<tr>
<td>Oman</td>
<td>• Fixed: &gt; 99%</td>
</tr>
<tr>
<td></td>
<td>• Mobile: &gt; 95%</td>
</tr>
<tr>
<td>Qatar*</td>
<td>• Fixed: &gt; 99%</td>
</tr>
<tr>
<td></td>
<td>• Mobile: &gt; 99%</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>• Fixed: &gt; 98%</td>
</tr>
<tr>
<td></td>
<td>• Mobile: &gt; 98%</td>
</tr>
</tbody>
</table>
Seychelles | • Mobile: > 98%
---|---
Singapore | • Mobile: > 99%
St Kitts & Nevis | ECTEL proposal:
| • Fixed: > 98%
| • Mobile: > 95%
Trinidad & Tobago | • Fixed and mobile: from > 97% (year 1) to > 99% (year 3)

*Proposal*

It is proposed to differentiate the reference for fixed and mobile with > 99% for fixed and > 98% for mobile. For fixed services a higher call set-up success rate can be achieved easier than for mobile services. For mobile services a call set-up success rate > 98% is a realistic value achievable and is being achieved by market participant in the Bahrain today.

V-2 Call set-up time

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Monitored service</th>
<th>Reference Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>V-2</td>
<td>Call set-up time</td>
<td>Voice Services (PSTN, VoIP, Mobile Voice, VoLTE)</td>
</tr>
</tbody>
</table>

The call set-up time is about 6 seconds on the mobile networks in Bahrain.

**Mobile voice call set-up time, 2Q 2016**

<table>
<thead>
<tr>
<th>Country</th>
<th>Call set-up time (On-net)(sec)</th>
<th>Call set-up time (Off-net)(sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viva</td>
<td>5.6</td>
<td>6.2</td>
</tr>
<tr>
<td>Batelco</td>
<td>5.2</td>
<td>5.5</td>
</tr>
<tr>
<td>Zain</td>
<td>6.3</td>
<td>6.0</td>
</tr>
<tr>
<td>Average</td>
<td>5.7</td>
<td>5.9</td>
</tr>
</tbody>
</table>

Source: ASCOM, Fixed Broadband QoS Report, Q2 2016

The benchmark countries tend to show somewhat lower reference values:

<table>
<thead>
<tr>
<th>Country</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bahamas</td>
<td>• Fixed: &lt; 3 seconds (mean)</td>
</tr>
<tr>
<td>Oman</td>
<td>• Fixed: &lt; 4 seconds</td>
</tr>
<tr>
<td>Qatar*</td>
<td>• Fixed: &lt; 2 seconds (95% fastest)</td>
</tr>
</tbody>
</table>
| St Kitts & Nevis | ECTEL proposal:
| • Fixed: < 3 seconds (mean) |
| Trinidad & Tobago | • Mobile: < 3 seconds (mean) |

*Proposal*
UMTS/3G usually has a faster call set-up time than GSM. However, the introduction of LTE and the initial use of Circuit Switched Fall-Back (CSFB) on LTE to send a voice call back to GSM or UMTS typically results in a longer call set-up time since the mobile phone first has to fall-back to GSM or UMTS before the actual call set-up can start. The next technological step, Voice over LTE (VoLTE), again reduces the call set-up time.

However, the migration to LTE is a desirable trend and the resulting increased call set-up time due to CSFB should be accepted as a necessary in-between step for the foreseeable future.

Therefore, a reference value for mean Call set-up time of < 5 seconds for fixed and < 8 seconds for mobile services is proposed. In addition, for the 95% fastest call set-up times the proposed reference values are < 7 seconds for fixed and < 10 seconds for mobile.

**V-3 Voice Quality**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Monitored service</th>
<th>Reference Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>V-3 Voice Quality</td>
<td>Voice Services (PSTN, VoIP, Mobile Voice, VoLTE)</td>
<td>Fixed MOS &gt; 3.75 for 90% of measurements; Mobile MOS &gt; 3.5 for 90% of measurements</td>
</tr>
</tbody>
</table>

The maximum Mean Opinion Score (MOS) is dependent upon the codec being used and the quality of the transmission channel. A PSTN G.711 codec can achieve a maximum MOS of above 4. A mobile codec such as Adaptive Multirate (Narrowband AMR) can reach a MOS of 4 but under typical mobile conditions with some interference and a lower bitrate (more error correction) it degrades to a MOS of 3.5. A MOS below 3 is deemed to be really degraded.

The actual MOS determined for the mobile networks in Bahrain are as follows:

**Mobile voice call quality (1-5), 2Q 2016**

<table>
<thead>
<tr>
<th>Quality score (On-net)</th>
<th>Quality score (Off-net)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viva</td>
<td>4.2</td>
</tr>
<tr>
<td>Batelco</td>
<td>4.2</td>
</tr>
<tr>
<td>Zain</td>
<td>4.3</td>
</tr>
<tr>
<td>Average</td>
<td>4.2</td>
</tr>
</tbody>
</table>

Source: ASCOM, Fixed Broadband QoS Report, Q2 2016

The benchmark countries show a range of MOS 3 to 4:

<table>
<thead>
<tr>
<th>Country</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bahamas</td>
<td>• MOS &gt; 4 (test with 100 customers)</td>
</tr>
<tr>
<td>Oman</td>
<td>• MOS &gt; 3 (PESQ method)</td>
</tr>
<tr>
<td>Qatar*</td>
<td>• MOS &gt; 3.75 for 90% using P.563 algorithm</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>• MOS &gt; 3.5</td>
</tr>
<tr>
<td>Trinidad &amp; Tobago</td>
<td>• MOS &gt; 3.8</td>
</tr>
</tbody>
</table>
The most recent ITU standard for objective voice quality measurements is the POLQA method. Typically there is a voice quality difference between fixed and mobile, at least as long as the narrow-band codecs (speech up to 4 kHz) are being used. Wideband codecs can provide a better speech quality and a separate POLQA Wideband method exists to measure the wideband quality. For now the minimum reference is still based on narrow-band voice such as used in the PSTN.

Therefore, it is proposed to set the reference value at a POLQA NB MOS > 3.75 for fixed and > 3.5 for mobile services for 90% of the measurements.

V-4 Audio delay

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Monitored service</th>
<th>Reference Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>V-4</td>
<td>Speech Delay</td>
<td>Voice Services (PSTN, VoIP, Mobile Voice, VoLTE)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>National &lt; 150 ms</td>
</tr>
<tr>
<td></td>
<td></td>
<td>International &lt; 200 ms (Europe); &lt; 300 ms (US)</td>
</tr>
</tbody>
</table>

There are no actual measurement results available for the audio delays on the operational networks in Bahrain at this time. There are some examples internationally of countries that set target values.

<table>
<thead>
<tr>
<th>Country</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saudi Arabia</td>
<td>• Audio delay &lt; 25 ms</td>
</tr>
<tr>
<td>St Kitts &amp; Nevis</td>
<td>ECTEL proposal:</td>
</tr>
<tr>
<td></td>
<td>• Audio delay &lt; 150 ms</td>
</tr>
</tbody>
</table>

The original GSM Full-Rate codec had a delay of 55 ms and more recent codecs are able to reduce that to 25 ms. ITU-T Rec. E.802 (02/2007) and ITU-T Rec. G.114 (05/2003) have specified that the recommended one way audio delay should be below 150 ms. At larger delays voice quality degradation starts to be noticeable.
At the national level it should be possible to keep the audio delay well below 150 ms. On International routes this might be more difficult given the actual propagation speed of light in fiber optic cables which leads to higher values. Satellite links via geostationary satellites suffer from long delays given the speed of light and the distance earth-satellite-earth.

Accordingly, the Authority is proposing 150 ms delay to be the reference value for local calls. For international calls, there are inevitable additional delays due to the distance. Therefore, the proposed reference delays are:

- Europe < 200 ms
- US < 300 ms
M-1 Dropped call rate

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Monitored service</th>
<th>Reference Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-1</td>
<td>Dropped call rate</td>
<td>Mobile Services (Mobile Voice, VoLTE)</td>
</tr>
</tbody>
</table>

The current dropped call rate on the mobile networks in Bahrain is < 1%.

**Mobile dropped call ratio**

![Graph showing mobile dropped call rates from Q1 2014 to Q2 2016 for different operators.]

Source: based on operator reports

In international benchmarks a similar dropped call rate level can be found.

<table>
<thead>
<tr>
<th>Country</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bahamas</td>
<td>• Mobile Dropped Call Rate: &lt; 1%</td>
</tr>
<tr>
<td>Oman</td>
<td>• Mobile Dropped Call Rate: &lt; 0.8%</td>
</tr>
<tr>
<td>Qatar*</td>
<td>• Fixed Dropped Call Rate: &lt; 1%</td>
</tr>
<tr>
<td></td>
<td>• Mobile Dropped Call Rate: &lt; 1.5%</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>• Fixed Dropped Call Rate: &lt; 2%</td>
</tr>
<tr>
<td></td>
<td>• Mobile Dropped Call Rate: &lt; 2%</td>
</tr>
<tr>
<td>Seychelles</td>
<td>• Mobile Dropped Call Rate: &lt; 2%</td>
</tr>
<tr>
<td>Singapore</td>
<td>• Mobile Dropped Call Rate: &lt; 1%</td>
</tr>
<tr>
<td>Trinidad &amp; Tobago</td>
<td>• Mobile Dropped Call Rate: &lt; 2%</td>
</tr>
<tr>
<td>UAE</td>
<td>• Fixed Dropped Call Rate: &lt; 1% (medium term)</td>
</tr>
<tr>
<td></td>
<td>• Mobile Dropped Call Rate: &lt; 2% (medium term)</td>
</tr>
</tbody>
</table>

*Proposal
Since Bahrain meets the 1% reference it is proposed to set the reference value to a mobile dropped call rate of < 1%.

**M-3 SMS completion rate**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Monitored service</th>
<th>Reference Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-3 Completion Rate for SMS</td>
<td>Mobile Services (SMS)</td>
<td>&gt; 99%</td>
</tr>
</tbody>
</table>

The current SMS completion rate is better than 99%.

**Unsuccessful SMS transmission ratio**

![Graph showing SMS transmission ratio](image)

Note: the figure reports unsuccessful SMS transmission rate which is the inverse of the proposed KPI of SMS completion rate. Source: based on operator reports

Some of the benchmark countries include targets for this KPI with levels above 95%.

<table>
<thead>
<tr>
<th>Country</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Qatar*</td>
<td>• SMS completion rate: &gt; 99.8%</td>
</tr>
<tr>
<td>St Kitts &amp; Nevis</td>
<td>ECTEL proposal</td>
</tr>
<tr>
<td></td>
<td>• SMS completion rate: &gt; 95%</td>
</tr>
</tbody>
</table>

*Proposal

Taking account of the above, it is proposed to maintain the existing SMS completion rate service level and to set the reference value at > 99%. The Authority believes this reference value is reasonable and achievable.
**B-1 Throughput**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Monitored service</th>
<th>Reference Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-1</td>
<td>Throughput</td>
<td>Within the advertised typical throughput</td>
</tr>
</tbody>
</table>

The measured throughput should be within the advertised range. Accordingly, each licensed operator should advertise the typical throughput speed and be able to achieve that typically. This is to avoid advertising a much higher “up to” speed without clear indication of what the typical throughput an end user can expect to achieve. This can be applied to every broadband service.

The existing practice shows this is mostly the case:

![HTTP Download Rate - Fixed Wire-Line ADSL Residential (On-Net)](image)

Source: ASCOM, Fixed Broadband QoS Report, Q2 2016

Therefore it is proposed to continue to use the advertised throughput speed as the reference value typically achieved.

**B-2 Latency**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Monitored service</th>
<th>Reference Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-2</td>
<td>Latency</td>
<td>Fixed National &lt; 50 ms; Fixed international &lt;200 ms (Europe), &lt;300 ms (US); Mobile &lt; 100 ms</td>
</tr>
</tbody>
</table>

The current latency values are measured towards a server located in London and not locally in Bahrain. The Authority believes it is critically important that local latency be low to support latency sensitive services. For example, business products in the US or Europa often include guarantees of latencies below 35 ms across the continent. Consumer products such as ADSL do add latency on top of the actual transport latency (typically about 15 ms), while FTTH can deliver a lower latency.

Mobile also has built-in latency due to channel coding and channel access technologies. In UMTS this can be well below 100 ms and in LTE even lower.

Some of the benchmark countries have set targets that take these factors into account.
Bahamas

- Latency: < 223 ms

Oman

- Latency: < 100 ms (fixed and mobile)

Qatar*

- Latency: < 80 ms (local, to international gateway in Qatar)
- Latency: < 300 ms (to NAP abroad)

Seychelles

- Latency: < 200 ms (fixed and mobile)

St Kitts & Nevis

ECTEL proposal:
- Latency: < 75 ms (for interactive data)

*Proposal

Given the importance of low latency for the actual customer experience and the technologies in place in Bahrain, a lower reference latency value should be highly desirable and achievable.

Based on the usual latency within a country and the latency of typical fixed broadband services it is proposed to set < 50 ms as a reference value for national fixed latency. This will ensure peering/interconnection somewhere within the region to avoid excessive latencies within Bahrain. For mobile services, the proposed reference value is < 100 ms due to the latency of the 3G/UMTS technology. In LTE there has been a strong focus on reducing latency, so typically the LTE layer will perform better than the 3G/UMTS layer.

International latencies are unavoidable due to the distance and speed of light in the fiber optic. Therefore, it is proposed to use as reference values: 200 ms (Europe), 300 ms (US)

**B-3 Webpage loading time**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Monitored service</th>
<th>Reference Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-3</td>
<td>Web page loading time</td>
<td>Internet services (DSL, FTTH, Mobile Broadband, Fixed Wireless)</td>
</tr>
</tbody>
</table>

The actual webpage loading for locally hosted websites is below 3 seconds (the much longer webpage loading time for Yahoo is due to the fact that the content has to be retrieved from hosts located abroad):

The actual webpage loading time is < 3 seconds for mobile and < 2 seconds for fixed. The Authority notes that 3 seconds is also a typical value used in the industry internationally as threshold to be achieved to
make sure users do not leave the page. The impact of the webpage loading time on abandonment of the website is shown in the figure below:

![Graph showing the relationship between webpage loading time and abandonment percentage.](image)


As can be observed, a longer webpage loading has a strong impact on customers abandoning a website. From 2 seconds to 4 seconds results in 8% abandonment, if it increases to 6 seconds then 25% of the customers abandons the website. So for good performance webpage loading times should be in the 2-3 seconds range.

Given the need for low webpage loading times for end users, and the fact that the below 3 seconds webpage loading can actually be achieved in Bahrain for local content, it is proposed to use 3 seconds as the reference value for fixed and mobile webpage loading time.