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Quality of Service Consultation Report

Report on the Consultation for the Draft Quality of Service Regulation

A report issued by the Telecommunications Regulatory Authority
13 November 2008

Purpose: To report on the consultation for the draft Quality of Service Regulation



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Background

The Telecommunications Regulatory Authority (TRA) is the independent regulator of telecommunications services in Bahrain. Its duties include protecting the interests of users in relation to quality of service.

TRA first consulted about quality of service in 2003 (in document MOU/CN/007). Following that consultation, a number of Licensed Operators reported measurements to TRA regularly. However, there have been major changes in the market since then, so for this consultation TRA has broadened its approach to cover all Licensed Operators. In doing so it has held informal discussions about quality of service measurement and reporting with user representatives and Licensed Operators of different types. These discussions have helped in the development of this consultation, but TRA alone is responsible for the draft documents.

TRA asked for comments on its proposed approach to quality of service. The consultation consisted of two documents:

- A draft Regulation that describes general obligations on Licensed Operators for measuring and reporting quality of service.
- A draft Schedule that prescribes specific measurements, contents and formats for published measurements, services requiring measurement and reporting, and numerical values reached by published measurements when services are satisfactory.

TRA gratefully acknowledges contributions received from Bahrain Telecommunications Company (BATELCO) B.S.C (“Batelco”), Etisalcom Bahrain W.L.L. (“Etisalcom”), Light Speed Communications W.L.L (“Light Speed”), MTC-Vodafone Bahrain B.S.C. (“Zain”), Mena Telecom W.L.L (“Mena Telecom”), as well as responses from the Businesses User Advisory Group (“BAG”) and Consumer Advisory Group (“CAG”).

This report details the responses received on TRA Draft Quality of Service Regulation (Reference TOD/0508/134) issued 14 May 2008.

Licensed Operator Responses

Batelco’s contribution made reference to its objectives as a customer-driven organisation and stated that the initiative of TRA with respect to quality of service reporting and publication is wholly supported. Batelco added that quality of service can also be competition driven, and thus regulatory intervention for selected services should only be applied as a last resort should competitive influences fail.

Batelco stated that the burden of compiling, measuring and reporting should be evenly applied to all licensed operators in similar circumstances on a non-discriminatory basis.

As well as the requirement to continue meetings for a clearer understanding of the regulatory measures, Batelco suggested that their internal projects would require resource prioritisation to implement QoS initiatives should the regulation be finalised.

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The concept of a qualifying population as a base line for measurement and reporting for an individual service was raised, as the wide range of products at differing life cycle stages offered by Batelco could involve major effort with minimal reporting value for non-volume products.

Batelco requested clarification as to whether the Regulation would replace its current Licence obligations with respect to QoS, and suggested that 6-monthly reporting would be less burdensome than the quarterly requirement.

Other items covered in Batelco's response were: section 77 of the Telecommunications Law and the investigation powers of TRA, QoS target-setting and enforcement, in addition to a submission in relation to QoS measures for regulated wholesale products suggesting a potential conflict with commercial wholesale agreements.

Zain contributed with a statement that supported the efforts of TRA, believing that a properly structured, well-defined and equitable QoS regime will be of overall benefit to the Bahrain telecommunications market.

Zain stated that QoS parameters should be easily understood by the public to be useful, and that some proposals in the draft regulation would have little or no meaning to the general mobile subscriber. It also suggested that the quarterly regime for reporting would not allow operators time to adapt between reports if improvements in QoS were required, and further recommended 6 months as the minimum, with a preference for annual reporting.

It is suggested that the requirement of informing TRA prior to the launch of a commercial service should only be applicable to operators designated as having Significant Market Power (SMP).

Of major concern to Zain is the excessive number of items to be tracked and the resources required, as well as the pertinence of some of the elements. Some of the calculation methods are questioned, and it is requested that several specific parameters be modified or clarified.

A recommendation is made that TRA should issue a document separate from the regulation with measurement parameters that may be revised more easily and regularly in consultation with Licensees. In addition, services provided to other operators should not be included. Rather, these measures should be included in the Interconnection Regulation, as the major requirement of a QoS Regulation is to address end user perception of individual operator services.

Further, Zain suggests that a programme of encouragement would be more beneficial than enforcement; thus reliance on widespread publication of measurement results would achieve the required objectives.

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It is suggested that a period of 12 to 18 months following publication of a QoS Regulation or following the launch of new commercial services should be granted as a grace period to implement measurement systems and activities, and as a settling-in period to iron out initial QoS problems prior to reporting.

Finally, Zain would like TRA to publish on its website comparable services and packages provided by each service provider. However, prior to this, Zain wishes to encourage TRA to consult on identification and agreement of definitions and methodologies for the measured parameters.

Light Speed believes that introducing and developing a Quality of Service regulatory framework will contribute to structuring the Bahraini market for effective competition. It believes the regulations should be both proportionate to the current quality of service issues and not unduly burdensome on operators, and should support consumer awareness and develop the competitive process whilst being 'evidence based' and above all proportionate to the intended objective.

Light Speed emphasises the requirement for TRA to apply QoS primarily on wholesale services as an initial stage to facilitate healthy and effective competition, which will in turn create appropriate quality of service in the competitive market. It is stated that while there is a dominant operator with significant market power and control over bottleneck facilities, the overall QoS from new entrants will be restricted by that operator.

Of concern to Light Speed is the cost of implementing QoS measures to newly licensed operators in comparison to operators with dominance or SMP, where that cost may effectively prove a barrier to introducing services if QoS regulation is not applied proportionately. The argument is that new operators need to provide a higher level of quality in order to overcome switching resistance of consumers, whilst operators with SMP only provide a QoS level which facilitates retention of the customer. This asymmetric market should justify the asymmetric regulatory intervention in the treatment of operators.

Thus it may be appropriate to have a grace period after the introduction of a new service by an operator without SMP, reflecting the basis on which new entrants compete.

Light Speed further submits that there is a need to ensure transparent and non-discriminatory application of QoS parameters whereby an operator with SMP could not offer a subsidiary or JV partner preferential QoS for common services.

Light Speed strongly believes that TRA should clearly distinguish between new and small operators and dominant operators, adopting a regime of encouragement for the smaller players and enforcement for dominant operators.

There is general agreement as to the requirements of Article 6 (Measurement and Reporting), but it is suggested that the proposed quarterly reporting should be extended to 6-month intervals to relieve the burden on limited resources and operational costs, in addition to a minimum subscriber base being in place before reporting is required.

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Etisalcom made detailed comments on individual parameters and measurement techniques, emphasising the potential for error in certain parameters, or the simple capability of systems to record data or not.

Concern is expressed with regard to network observations on outgoing international telephone calls, and in particular ITU recommendation E.422 which would be difficult to commit to, and the IP-based network measurements which could be simplified. Further elaboration would be welcomed by Etisalcom with the aim of reducing the total measurements required, and reviewing definitions.

Etisalcom states that this regulation should not be imposed on all OLOs as a mandatory obligation, as the investment and development required in order to comply would be restrictive.

Mena Telecom highlighted the requirement for end users to understand the QoS measures so as to be able to compare the performance of different operators, and the need for publishing quality benchmarks against which those comparisons may be made in a language easily understood by the public.

As a general principle, Mena Telecom believes that the requirement to measure and report should not be overly burdensome on small operators who may not be able to justify the required investment in relevant IT applications for automated reporting; thus a proper balance must be struck.

Mena Telecom suggests that details of operators' subscriber numbers are clearly of commercial sensitivity and are therefore confidential and should not be published. In addition, the potential for operators with SMP to republish QoS statistics to their own advantage in advertising material could easily be exploited in numerous anticompetitive ways.

Value and quality are factors of competition, and whilst regulatory intervention may be required at some stage, competing to achieve a good name through quality of service should be the approach adopted among operators. Thus, in the event that intervention is required, target-setting should be realistic relative to resource availability.

Mena Telecom feels that some extenuating circumstances that may hinder an operator's ability to apply QoS measures may justify exemptions from elements of the regulation, and suggests a provision allowing extenuating circumstances to be considered.

Mena goes on to comment on individual measurement methods, and suggests that ITU standards may be too stringent when operators may already have invested and implemented other equally valid standards. It suggests that some ITU standards noted in the Draft Regulation will not apply to all operators as they are based on technologies that not all operators have deployed. The requirement to reinvest would thus be too burdensome an obligation, where the Regulator could simply be more detailed in its own requirements.

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User Group Responses

User groups representing consumers and business users were overwhelmingly concerned with the quality of service provided by all operators and advocate a stringent measurement and reporting regime. A general requirement is voiced for high targets to be set from day one, with no exemptions for smaller operators. However, review of the overall requirements should be made regularly in cooperation with all parties concerned.

Consumer surveys are deemed an important input to enhance the process and a requirement to establish a continuous rapport between consumers and operators is made.

TRA Assessment

TRA has taken into account the valuable responses of all parties and made every effort to satisfy the concerns of consumers and the requirements of operators in producing a final regulation.

It is TRA's obligation to ensure that licensed telecommunications operators provide levels of service at a quality expected by consumers in the Kingdom of Bahrain, and an obligation of licensed operators to satisfy the expectations of those consumers.

Education of the consumer in this new era of development in the Kingdom of Bahrain is of prime concern and only through the publication of measured data will consumers be able to compare and evaluate the quality of services for themselves.

Continued concern among consumer groups indicates that competitive forces have not secured the required confidence at this stage of the development of the telecommunications market to ensure sufficient quality of service.

The following sections provide TRA's explanation of the Regulation and the Schedule, together with reasoning and decision-making factors for each of the subjects raised in the consultation.

The Regulation

Scope

A Licensed Operator does not necessarily operate a network; for example, a calling card service provider or an internet service provider may be a Licensed Operator. Also, the service provided by a Licensed Operator that operates a network may seem to users to be just like the service provided by a Licensed Operator that does not operate a network. The quality problems noticed by users are not necessarily associated with networks, so a Licensed Operator that does not operate a network may nonetheless have quality of service obligations.

The Services for which a Licensed Operator would have quality of service obligations are listed in Part B of the draft Schedule. Currently a Licensed Operator offering one of these Services would have a Licence for Fixed National Services, Mobile Telecommunications

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Services, Internet Services, Internet Exchange Services, International Telecommunications Services or International Telecommunications Facility Services.

Objectives

TRA considers that quality of service monitoring should aim to maintain or even improve quality. Competitive forces can help in maintaining or even improving quality, but competition is still limited. Quality of service obligations must therefore be imposed. This is so, in particular, if there are few Licensed Operators offering the services or if there are severe pressures on the Licensed Operators offering the services that could otherwise make services worse.

TRA considers that quality of service monitoring should also make information available about the quality of particular services. This should help End Users to make informed choices of services, Licensed Operators to create end-to-end connections with satisfactory quality, and others, such as potential market entrants and strategic planners, to take advantage of opportunities; for example, a potential market entrant might notice a gap in service provision that could be filled.

Principles

Quality of service does not cover aspects of services that in international standards are generally regarded as intrinsic to the services or that are usually specified through licence conditions or other regulations (such as universal service obligations); for example, in the case of a 128kb/s digital leased line service, the bit rate is outside the scope of quality of service monitoring, but the number of complaints might be inside the scope of quality of service monitoring, and among the complaints might be some about failing to achieve the 128kb/s bit rate.

Quality of service in the draft Regulation is also limited to aspects of services that are directly perceived by users; for example, dropped calls can be directly perceived by users, but wireless network traffic channel congestion is not directly perceived by users though it is one cause of dropped calls. TRA does not wish to constrain the ways in which Licensed Operators implement services beyond ensuring that the services are satisfactory to users.

TRA does not wish to impose unnecessary burdens on Licensed Operators or on people seeking available information about the quality of particular services, so only potential significant service deficiencies are considered. Different deficiencies may become significant as services and user expectations evolve, so the quality of service standards may need to change.

TRA intends to guide Licensed Operators about the quality of service standards that future services might have. In the draft Schedule the Parameters therefore have, as far as possible, definitions that are independent of existing services and that implicitly extend to future services. Where this is not possible, in the draft Schedule analogies between services show which new Parameters are likely to be needed for future services.

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TRA expects competitive forces to help in maintaining or even improving quality, but in the absence of full competition it may need to mandate the application of quality of service standards.

Structure

A Parameter is a measurable characterisation of the quality of an aspect of a service derived from measurement; for example, the fault report rate indicates how often faults are reported and the fault repair time indicates how fast faults are repaired. (A Parameter is called an ‘indicator’ in some documents.) It may have more than one Measurement associated with it; for example, both the average fault repair time and the maximum fault repair time for the best 95% of cases (say) might be useful. However, TRA believes that some Measurements associated with a Parameter should not be published, because they could overwhelm users with data that would be difficult to understand.

A Parameter such as ‘fault repair time’ can be relevant to more than one service. However, TRA believes that some services may not need Measurements to be made for an apparently relevant Parameter, because they should have good quality in the aspect that the Parameter characterises; for example, dropped calls could in principle be counted for fixed networks but in practice are often counted only for mobile networks. The draft Schedule includes a way of ensuring that Measurements need to be made only for certain Services and indeed only for certain Licensed Operators of those Services. If Measurements must be made for a Parameter, the Parameter is said to be “Reportable” (for a Service of a Licensed Operator).

The draft Regulation is concerned with measurement and reporting tasks that are applicable whatever the Parameters may be. The draft Schedule defines the specific Parameters. It does so in ways intended to separate how to measure Parameters (in Part A of the draft Schedule) from whether to measure Parameters (in Part B of the draft Schedule).

Initially TRA does not plan to set a “Target” for each monitoring parameter as it considers that realistic objectives shall be constructed based on real figures for Bahrain and such information will only be available after Quality of Service has been measured and reported a significant amount of time. Such targets would be set if considered necessary by TRA having due regard to the development of the market. Eventually, if TRA were to implement QoS “Targets”, this would take the form described in the following part of the document.

The draft schedule describes each Parameter using the following structure:

- Part A of the draft Schedule prescribes the method of measuring the Parameter (the “Measurement Method”) and the content and format of any published Measurement (the “Published Measurement”) in ways that are independent of Services.
- Part B of the draft Schedule identifies every Service for which Measurements must be made (a “Monitored Service”) and any numerical value of a Published Measurement that must be reached if the Service is to be satisfactory (a “Target” or, more fully, a

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“Published Measurement Target”). (A Target is called an ‘objective’, ‘threshold’ or ‘benchmark’ in some documents.)

The description of a Monitored Service is as specific as it needs to be; for example, it may name a particular Licensed Operator. In principle, therefore, Part B of the draft Schedule determines the Services and Licensed Operators for which each Parameter is Reportable and any Targets for the Parameter applicable to those Services and Licensed Operators. Figure 1 (in which all the numbers are just examples) shows how a fragment of Part B of the draft Schedule might develop over time. According to it:

- Licensed Operators other than X are required to make Measurements, but not to reach Targets, for the fault repair times of their Fixed Telephony Access Network Services.
- X is required to make Measurements, and to reach a Target of 1.5 days, for the fault repair times of its Fixed Telephony Access Network Services.
- Licensed Operators are required to make Measurements, and to reach a Target of 0.5 days, for the fault repair times of their Telephony Transit Network Services (which are services for interconnecting telephony networks, as opposed to Telephony Access Network Services for serving End Users directly).

Parameter Name	Monitored Service	Published Measurement Target
Fault repair time	Fixed Telephony Access Network Services not provided by X	
Fault repair time	Fixed Telephony Access Network Services provided by X	at most 1.5 days
Fault repair time	Telephony Transit Network Services	at most 0.5 days

Figure 1 – Example descriptions of Monitored Services and Targets

Review and amendment

The surveys of users to be conducted by TRA should provide input to its annual report and to reviews of the Regulation and the Schedule. However, the draft Regulation does not set a regular interval of time (such as 2 years) between surveys of users or between reviews of the Regulation and the Schedule, to avoid distorting the priorities for regulatory action.

The Schedule may need more frequent and extensive amendments than the Regulation; for example, a Parameter may be made Reportable for a Service of a Licensed Operator when it was not Reportable before, or a Target may be made more demanding than it was

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before. In particular, amendments to the Schedule will not necessarily affect the Regulation.

Amendments to the Regulation and the Schedule may be developed independently, but always require consultations under the Telecommunications Law before they come into force.

Measurement and reporting

The Reporting Period is the interval of time over which information (such as the observed number of dropped calls) is collected to make one set of Measurements that is then reported to TRA. The Reporting Period is taken to be 3 months in the draft Regulation; this is so in many countries, but figures of 6 months and 1 month might also be used, depending on the rate of change of the market. To ensure consistency in when different Licensed Operators report Measurements, the draft Regulation aligns the Reporting Period with the Gregorian calendar.

Each Licensed Operator must provide certain figures, to let TRA assemble information on the availability of Services and the numbers of Subscribers; for example, TRA may include aggregate numbers of Subscribers in its annual report to improve understanding of how the market is developing.

Each Licensed Operator must make Measurements for each Parameter that is Reportable for a Service of the Licensed Operator. Additionally each Licensed Operator must keep information about how the Measurements are made, so that the measurement and reporting procedures can be investigated if necessary.

The Measurements made for Services that have very few Subscribers may not be statistically significant (so that differences between them are almost meaningless), particularly if at most 1500 independent observations are used in making the Measurements. The draft Schedule includes a way of exempting Licensed Operators of such Services from quality of service obligations. However, it does not actually make any such exemptions, because:

- Services to End Users are likely to either fail or grow rapidly to have more than 1500 Subscribers.
- Services to Licensed Operators (for interconnection) should have quality of service obligations, according to many Licensed Operators.

Licensed Operators that have large shares of the markets for their Services, particularly if they are 'dominant', can affect many users if they have service deficiencies. The draft Schedule includes a way of distinguishing the Parameters that are Reportable or the Targets that are applied for such Licensed Operators from those for other Licensed Operators. However, it does not actually make any such distinctions, because:

- TRA envisages the use of few Parameters and Targets, so the burden on all Licensed Operators should not be excessive.
- Quality of service obligations can protect the interests of users, whatever the size or market share of a Licensed Operator may be.

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- The markets for Services used in tests of dominance are not always appropriate to quality of service obligations; for example, in many countries individual mobile network Licensed Operators are held to be dominant in markets for incoming calls only, but quality of service standards apply to outgoing calls only.

Publication and investigation

TRA intends to publish quality of service information on its website to help users with comparisons between Licensed Operators. This information might be read by users directly or read by journalists and others who would use it in informing users. Most of the people with whom TRA has held informal discussions favoured publication by TRA (not, say, reliance on Licensed Operators to publish information).

However, the information published must be fair and comparable between Licensed Operators as far as practicable, taking into account the following points:

- A Licensed Operator may offer two similar Services (for business and residential users, say) with different levels of quality and pricing. Such Services should be reported separately from one another to avoid distortion. The draft Regulation ensures this.
- Differences in numerical values of Measurements do not necessarily represent differences in levels of quality that are perceptible to users; for example, a fault repair time of 0.999 days is not likely to be perceptibly different from one of 1.000 days, though a fault repair time of 1.1 days is likely to be perceptibly different from one of 1.9 days. Differences in numerical values should not be displayed to users if they do not represent perceptible differences in levels of quality. The draft Schedule seeks to achieve this by arranging that Published Measurements are rounded suitably.
- A target is either reached or not reached, so it provides a rather coarse measure of quality. It can be made less striking (by colour codes distinguishing degrees of closeness to the target, say) but doing this could just make it more difficult to understand. The draft Regulation provides for indicating when Targets are not reached (perhaps just by shading the corresponding Published Measurement), but no Targets are specified in the draft Schedule.
- A Licensed Operator X may need to use the facilities of another Licensed Operator Y when providing a Service, so that the quality of service from X will depend on the quality of service from Y; for example, X may have faults on lines leased from Y for which Y does not offer fast protection switching. The draft Regulation seeks to compensate for this by arranging that X can, with the approval of TRA, annotate Published Measurements to explain that particular service deficiencies can be attributed to Y. The Subscriber can then know both how satisfactory the Service is and why the Service may have problems.
- The draft Regulation also provides for remarks to be added by TRA, particularly when a Published Measurement does not reflect the true state of affairs; for example, numerical values may not be statistically significant when Services have very few Subscribers.

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The draft Regulation does not specify whether quality of service reports are arranged by Service, Parameter, Licensed Operator or Reporting Period; in fact if there were suitable ordering or searching facilities on the website all these arrangements could be available. However, the draft Regulation does specify the information presented for each Service, Parameter, Licensed Operator and Reporting Period. Figure 2 shows what this might look like. (Its layout is just an example, as the draft Regulation allows various tabulations that might, for instance, order the information according to the values in particular columns.) According to it:

- In January-March 2007 the Supercalls service from Licensed Operator X had a fault repair time of 3.5 days; this is shaded to indicate that X had failed to reach a target and is accompanied by a remark written by X and approved by TRA attributing the failure in part to the performance of another Licensed Operator.
- In January-March 2007 the Business Telephony service from Licensed Operator Z had a fault repair time of 0.3 days; this is accompanied by a remark written by TRA noting that there were very few Subscribers (so a user might infer that the fault repair time could get worse as the service developed).
- In January-March 2007 the Friendship service from Licensed Operator Y had a fault repair time of 1.1 days.
- In January-March 2007 the Pluscalls service from Licensed Operator X had a fault repair time of 1.9 days (so a user might infer that the prices of the Supercalls and Pluscalls services needed to be compared when choosing between them).

Reporting Period	Monitored Service	Parameter Name	Published Measurement	Explanatory remarks by the Licensed Operator	Further remarks by TRA
January-March 2007	X Supercalls	Fault repair time	3.5 days	The performance was affected by the poor response of the backhaul provider to fault reports.	
January-March 2007	Z Business Telephony	Fault repair time	0.3 days		The performance was calculated when the service had very few Subscribers.
January-March 2007	Y Friendship	Fault repair time	1.1 days		
January-March 2007	X Pluscalls	Fault repair time	1.9 days		

Figure 2 – Example entries in quality of service reports

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The draft Schedule does not specify any Targets, for the following reasons:

- There are very wide variations in international practice. TRA considers that Targets should only be constructed with the knowledge of what would be realistic for Bahrain, obtained after quality of service has been measured and reported for some time.
- Different Licensed Operators may have different quality policies, corresponding with different pricing policies; in fact even a single Licensed Operator may offer two similar services with different levels of quality and pricing. TRA does not wish to constrain the policies of Licensed Operators, even by subjecting apparently similar services to the same Targets.
- For Transit Network Services specifically, there are rather few Subscribers. Measurements of Parameters related to them will therefore depend on small sample sizes, and Targets that lay down upper bounds on proportions of users (“those making complaints”, for instance) are not practicable.

However, TRA recognises that Targets can be useful when, for instance, there are few Licensed Operators offering the services (as is typical for interconnection and wholesale services) or there are severe pressures on the Licensed Operators offering the services that could otherwise make services unusable. Accordingly the draft Schedule is structured to accommodate Targets if necessary.

The draft Schedule is written as if Targets are defined by TRA. An alternative is to oblige individual Licensed Operators to commit to Targets that they devise and publicise (perhaps in consultation with TRA) and to have TRA publish indications of whether these Targets are reached. With this alternative, if TRA is to avoid imposing minimum Targets then competitive forces must ensure that Licensed Operators do not choose very undemanding Targets.

Contravention and enforcement

Most of the people with whom TRA has held informal discussions favoured having at least a short period between the introduction of a service and the enforcement of quality of service obligations. Some remarked that Services should not be launched until measurement and reporting procedures were in place. The draft Regulation provides for a grace period of up to 3 months before information must be gathered for Measurements, depending on the Commercial Launch Date of the Service.

TRA intends fining for quality of service contraventions to be a reserve power. Improvements can be encouraged in other ways; for example, the draft Regulation ensures that TRA can oblige a contravening Licensed Operator to publicise quality of service comparisons with competitors.

Other forms of encouragement and enforcement could be considered. For instance:

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- TRA could endorse Services of some Licensed Operators as ‘quality approved’. Doing this would entail imposing some Targets, might exaggerate some small differences between levels of quality and would ignore tariffs, which usually form the principal concern of Subscribers.
- TRA could require a contravening Licensed Operator to provide service credits or rebates to Subscribers. Doing this could be complicated, particularly for prepaid services.
- TRA could replace the measurement and reporting procedures of a contravening Licensed Operator by those of a third party, paid for by the Licensed Operators. Doing this could be disruptive and expensive.

In some countries there are joint working groups, involving Licensed Operators and user representatives, to devise quality of service arrangements; for example, they might define details of the complaint classes, of the measurement methods or of the auditing to be used in investigations of measurement and reporting procedures. Several of the people with whom TRA has held informal discussions felt that doing this would waste time and effort and slow down the introduction of quality of service standards. The draft Regulation does not provide for such joint working groups.

A variant keeps individual Licensed Operators responsible for devising their own internal quality of service arrangements (particularly for the details of the measurement methods) but requires the arrangements to be approved by TRA before use. The approval process again would necessarily increase the burden on Licensed Operators and TRA and slow down the introduction of quality of service standards. The draft Regulation does not provide for such an approval process but ensures that TRA can investigate measurement and reporting procedures.

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The Schedule

Definitions of Parameters

Quality of service parameters related to several of the Parameters defined in the draft Schedule have existed for many years, and are referred to in documents published by the European Telecommunications Standards Institute (ETSI), the International Telecommunication Union (ITU) and other sources. Those most closely related are defined in ETSI documents available at <http://pda.etsi.org/pda/queryform.asp>. The documents are:

- *Speech Processing, Transmission and Quality Aspects (STQ); User related QoS parameter definitions and measurements;*
 - *Part 1: General User related QoS* (ETSI EG 202 057-1).
 - *Part 2: Voice telephony, Group 3 fax and modem data services* (ETSI EG 202 057-2).
 - *Part 3: QoS parameters specific to Public Land Mobile Networks (PLMN)* (ETSI EG 202 057-3).
 - *Part 4: Internet access* (ETSI EG 202 057-4).
- *Speech Processing, Transmission and Quality Aspects (STQ); QoS aspects for popular services in GSM and 3G networks;*
 - *Part 1: Identification of Quality of Service aspects* (ETSI TS 102 250-1).
 - *Part 2: Definition of Quality of Service parameters and their computation* (ETSI TS 102 250-2).
 - *Part 3: Typical procedures for Quality of Service measurement equipment* (ETSI TS 102 250-3).
 - *Part 4: Requirements for Quality of Service measurement equipment* (ETSI TS 102 250-4).
 - *Part 5: Definition of typical measurement profiles* (ETSI TS 102 250-5).
 - *Part 6: Post processing and statistical methods* (ETSI TS 102 250-6).

These documents contain useful extra information, especially about measurement methods, but the draft Schedule takes precedence over them where they have different meanings or mention different numerical values. Measurements obtained using the Measurement Methods in the draft Schedule should be comparable with each other but are not always comparable with measurements for parameters having similar names in different countries.

Choice of Parameters

The draft Schedule provides rather few Parameters and applies most of them to all services. Some well-known parameters are not mentioned in the draft Schedule, typically

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because they duplicate to some extent those that are mentioned or they are not measures of quality significant to users in Bahrain. The answer-seizure ratio, for instance, is sometimes used in international comparisons but has very limited value as a measure of quality (by contrast with the unsuccessful call setup ratio), because its numerical value depends mainly on whether people use voice mail, fax machines or dial-up internet modems, when people are close to their phones, and how fixed and mobile tariffs compare.

Some further specialised Parameters (such as conversational voice quality) are mentioned below.

Subjective and objective measurements

The Parameters in the draft Schedule are measured by counting events. They do not exclude subjectivity completely; in particular, where the events are complaints there is subjectivity in decisions to complain. However, the measurement methods aim to be objective.

Some quality of service parameters have measurement methods that are subjective. They depend on surveys of customers, which may ask for opinions about many matters (such as responsiveness to customer enquiries or comprehensibility of service descriptions). TRA may perform such surveys itself but is not currently proposing that Licensed Operators should be obliged to do so. There are great difficulties in designing a survey and obtaining results that could be published as a fair and comprehensive statement about the quality of all important aspects of services for all Licensed Operators.

Parameters for future services

Future services will have aspects in common with current services: they can cause complaints, they can have faults, they can be supplied and they can require contact with customers. All these aspects are likely to be among those perceived by customers, so they are likely to be assessed by TRA through the use of the service-independent Parameters that are already in the draft Schedule.

Services have other aspects in common, because they generally have either or both of the following features:

- **Needing invocations** (such as call setups, SMS message transmissions, internet session logins and internet data transmissions). Invocations can have two quality of service parameters, which are the probability of unsuccessful invocation and the time needed for successful invocation.
- **Needing connections** (such as those established during call setups and internet session logins). Connections can have one quality of service parameter, which is the probability of dropped connections.

This classification makes constructing quality of service parameters systematic and straightforward; for example, the call setup success ratio and the call setup time are the

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quality of service parameters for call setups. Just considering future services in terms of invocations and connections will usually suggest service-dependent Parameters that TRA might introduce.

Of course, a quality of service parameter does not have to be used just because it can be defined; for example, the SMS message transmission time is not a Parameter in the draft Schedule.

Services also have in common that communications involve “media” (voice, video, audio, text, and so on). The ability to perform communications without making the media deteriorate unacceptably is very important but very difficult to assess. The properties of networks affecting media are known, but exactly how these properties relate to measurable user experience is less well understood. It is discussed briefly below.

Conversational voice quality

Assessments of conversational voice quality take the following forms:

- **Subjective assessments.** These use surveys of Mean Opinion Score (MOS), described in ITU-T P.800 and P.830. Their results are strongly affected by the attitudes and environments of the survey participants and may not be replicated in other similar surveys.
- **Limited objective assessments.** These use estimators such as Perceptual Evaluation of Speech Quality (PESQ), described in ITU-T P.862. Their results estimate distortion but not conversational voice quality, which depends on other factors besides distortion (such as listening level, loudness loss, delay, sidetone and echo), some of which are particularly important for voice over IP.
- **Extensive objective assessments.** These use the E-Model, described in ITU-T G.107 and G.108. Their results take into account 15 factors on which conversational voice quality depends, but the factors have not yet been justified in all possible cases (such as some using voice encodings in tandem). The factors depend on the network paths, the equipment types and the call types, so the results often describe voice quality for telephony on reference connections devised by service providers, not for typical connections experienced by callers.

All these have disadvantages: subjective assessments are strongly affected by the attitudes and environments of participants and may not be reproducible, and objective assessments either do not consider important factors such as delay or are burdensome (because they require different Licensed Operators to have comparable reference connections). TRA regards these methods as inappropriate to Bahrain currently, so the draft Schedule omits a Parameter for conversational voice quality.

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Quality of media other than voice

Quality standards for media other than voice are less well developed than those for voice. Even the audio requirements can range from those for telephony to those for “surround sound” in interactive gaming. The perceived quality depends on the applications: for example, it may depend more on lip synchronization and conversational voice quality in a video conference application, and more on picture clarity and presentation in a video lecture. For video services (except broadcast analogue television) the factors needed for complete objective assessments are still being investigated, and for multimedia services using handset displays, even user expectations are not well understood yet. TRA is therefore not proposing any assessments of services specific to video; for example, video telephony services are subject to quality of service measurement and reporting as if they were telephony services.

Additionally TRA is not proposing any assessments of services specific to particular data applications that use the internet, such as email delivery, web browsing and file transfer.

Dependencies between services

The quality of service provided for a network path depends on all the networks that the path goes through; for example, the delay between an End User on network X and an End User on network Z that passes through a network Y is the sum of three delays (from the End User in X to a point of interconnection of X with Y, from the point of interconnection of Y with X to a point of interconnection of Y with Z, and from the point of interconnection of Z with Y to the End User in Z).

Parameters for interdependent services can be defined in the following ways:

- **Using network-by-network measurements.** The individual networks are considered in isolation, so an end-to-end delay along a path is calculated by summing the delays across the individual networks used by the path. The Parameters for a network of a Licensed Operator therefore do not represent what customers experience, at least for paths ending in other networks, but they do represent what the Licensed Operator controls immediately.
- **Using end-to-end measurements.** The individual networks are considered in combination, so an end-to-end delay along a path is measured directly (and the delay averaged over all paths through a network takes account of paths ending outside the network). The Parameters for a network of a Licensed Operator therefore represent what customers experience on average, but they do not represent what the Licensed Operator controls immediately.

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Figure 3 shows the distinction between these.

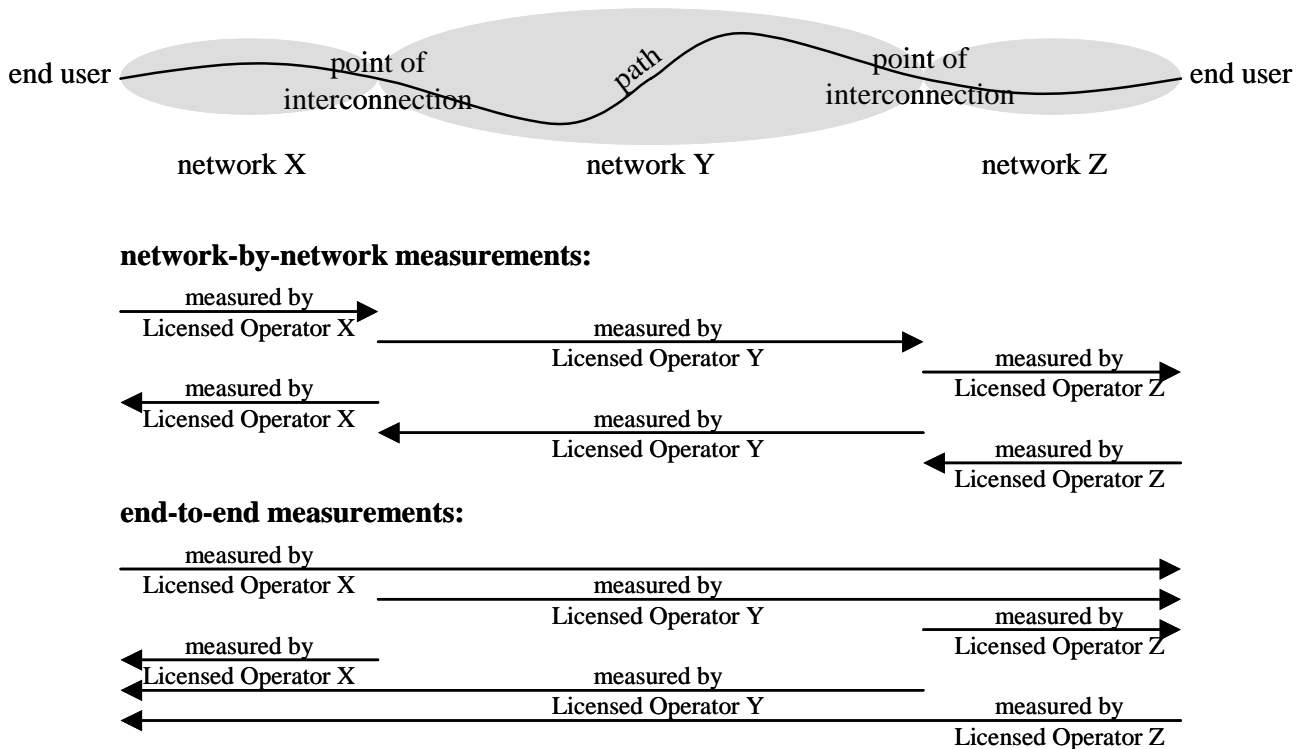


Figure 3 – Example measurements across three networks

The draft Schedule provides end-to-end definitions of Parameters (not network-by-network ones). Publishing Measurements of such Parameters is consistent with limiting attention to aspects of services that are directly perceived by customers. It should not be unfair to Licensed Operators, who can annotate Published Measurements to explain service deficiencies due to other Licensed Operators. The Parameters characterise quality of the Services as experienced by the customers that pay for the Services of a Licensed Operator. These customers may be End Users or other Licensed Operators; correspondingly, the Parameters deal with paths from phones and other terminals (for End Users) or points of interconnection (for Licensed Operators) to representative destinations.

Monitored Services

Different Services may need to be monitored with different Parameters or with the same Parameters but different Targets. The differences in monitoring depend on the following kinds of distinctions:

- **Retail services and wholesale services.** Retail services are offered to End Users; wholesale services are offered to Licensed Operators. An alternative Licensed Operator should receive the same level of quality from a wholesale service of a dominant Licensed Operator as the dominant Licensed Operator does. Only then will the

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alternative Licensed Operator be able to compete effectively with a retail service using the wholesale service. Even the targets for service-independent Parameters such as miscellaneous complaint resolution times and fault repair times may need to be more demanding for the wholesale service than for the retail service.

- **Access network services and transit network services.** Access networks support phone or other terminals of End Users directly and may also have points of interconnection; transit networks carry only traffic entering and leaving them through points of interconnection. (In this document ‘access’ refers to the use of the ‘access network’, not to a ‘Reference Access Offer’ or access to networks in general by Licensed Operators.) An access network usually supports not only a retail service to End Users but also a wholesale service to Licensed Operators so that other networks can carry traffic going to or coming from the End Users; there are then two sets of Targets (one for the retail service and one for the wholesale service).
- **Access network services with different types of technology.** Some access network technologies do not really need to be subject to some quality of service measurement and reporting; for example, dropped calls are much more common in mobile networks than in fixed networks and internet session logins are much more tedious for voiceband access than for broadband access.
- **Services for different types of traffic.** In the draft Regulation and Schedule telephony, internet and transport services are distinguished from one another. The transport services are typically leased line services that direct traffic between points without interpreting the traffic as being due to telephony services or internet services.

In the draft Schedule some of these distinctions between Monitored Services are made so that several Parameters are used in the monitoring of only certain Services. However, more distinctions would be needed for Targets.

Measurement Methods

The Measurement Method for a Parameter provides information about how Measurements are made. The resulting Measurements may provide more information than is needed by the Published Measurement or than is needed to establish whether Targets are reached, but they are expected to be useful in assessing service quality even when there are no applicable Targets.

Fairness for traffic-related Parameters that may be measured by sampling is discussed below.

Complaint-related Parameters

In many countries most complaints concern accounts or disconnections. Network problems (such as packet loss) may be the subject of miscellaneous complaints or fault

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reports. Both account complaints and disconnection complaints are classified further in the draft Schedule. These classifications are proposed rather tentatively, because customer care systems often differ in such details.

Traffic-related Parameters

Measurements for traffic-related Parameters can be constructed in the following ways:

- **Using real traffic.** An automatic data collection system based on network element counters is used to count and analyse the traffic (especially the signalling). The Measurements do not typically match the experiences of users because the traffic is analysed only if it flows successfully along the wireline or wireless links from phones and other terminals into the networks. Moreover, the counts need to be interpreted carefully, because there can be different counting mechanisms and different signalling modifications in different types of exchange.
- **Using test traffic.** Test calls and other transmissions are initiated using phones and other terminals, so the experiences of users can be sampled. Measurements are collected less cheaply and easily than when real traffic is used, particularly if the Parameters have end-to-end definitions (not network-by-network ones).

In both cases the traffic analysed should flow at traffic-weighted times between traffic-weighted locations. (This of course happens automatically if all the real traffic, not just a sample of the real traffic or test traffic, is used for the Measurements.)

For Measurements from different Licensed Operators to be comparable, they should all use either real traffic or test traffic. In addition, Published Measurements for traffic-related Parameters should be designed to be statistically unbiased (so that the results of repeated sampling are representative).

The draft Schedule requires Measurements to use test traffic (not real traffic). For this traffic it requires the minimum sample size to be 1500. (This number is chosen for simplicity; 1537 is actually the number justified statistically.) This is roughly enough to give 95% confidence that, for instance, a Measurement of a percentage resulting in 1.0% corresponds to an 'actual' value between 1.5% and 0.5%, that a Measurement of a percentage resulting in 4.0% corresponds to an 'actual' value between 3.0% and 5.0% and that a Measurement of a time is within 10% of the 'actual' value (if the observed standard deviation is at most twice the observed mean).

In the draft Schedule the tests for traffic-related Measurements are required to be made during the 6 hours when the traffic is expected to be most intense on certain days. Other possible requirements would be to make the tests throughout 12 hours (say) and to make the tests during just 1 busy hour; the first of these would not assess service quality at the time when user experiences are most severely affected by poor performance and the second would not make very efficient use of equipment and staff, particularly for 'drive-around' tests on mobile networks.

The minimum period between successive tests is intended to ensure the release of the network resources and to eliminate the effects of transient network problems.

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The traffic-weighted locations that act as sources of traffic represent phones or other terminals (for End Users) and points of interconnection (for other Licensed Operators). The traffic-weighted locations that act as destinations of traffic represent phones or other terminals and international routes (which are in fact particular points of interconnection). Each Licensed Operator will need to provide phone numbers or IP addresses (as appropriate) that other Licensed Operators can regard as destinations for weighting purposes.

Published Measurements

The Published Measurement for a Parameter indicates the Measurement that is to be published, with the applicable unit of measure (such as percentage, seconds or days). It is rounded so that published differences between Measurements are statistically significant but correspond only with differences in quality that are perceptible to users; for example, fault repair times of 1.1 and 1.9 days are treated as different, but fault repair times of 15.1 days and 15.9 days are treated as the same and written as “16 days”. The rounding is in the direction of a lower level of quality. (The names and definitions of the Parameters in the draft Schedule are designed so that rounding in the direction of a lower level of quality is always rounding up and targets are always upper bounds; doing this should help to simplify comparisons between Licensed Operators.)

TRA’s comments and conclusion

The telecommunications market of Bahrain will work best when consumers are fully informed about what they are buying. Without this, consumers may be reluctant to switch to a new provider, or may make a wrong decision based on incomplete or incorrect information. In reality, consumers in Bahrain have little to assist them in making informed decisions and comparisons between services. This may be because the appropriate information does not currently exist.

In competitive markets, charges and affordability dominate the reasons for consumers to switch to a new provider, but quality of service also features as a major reason and there are clear incentives for providers with good customer service to let consumers know about this, but little incentive for providers with poor customer service to produce accessible and comparable quality of service information. TRA is able through this regulation to require publication of such information.

TRA must be careful to ensure that information presented to consumers is easy to interpret, and ensure that information is made available in a number of different places, not just TRA’s website.

TRA has taken into account all comments received, and adapted the regulation to best suit the current state of the telecommunications market in the Kingdom of Bahrain. We will continue to regularly interact with consumers, licensed operators and any other interested parties to improve both our and the telecommunications market's quality of service to consumers.