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Guidelines on Regulatory Aspects of QoS

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Supplement 9 to ITU-T E.800-series Recommendations

Guidelines on Regulatory Aspects of QoS

Summary

Supplement 9 to ITU-T E.800-series Recommendations provides guidelines on regulatory aspects of Quality of Service (QoS) and it focuses on end-to-end QoS as perceived by the user when using modern mobile and broadband services. Network performance is out of scope of this document.

Keywords

End-to-end QoS as perceived by the user.

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Supplement 9 to ITU-T E.800-series Recommendations

Guidelines on Regulatory Aspects of QoS

1 Scope

This supplement provides guidelines on regulatory aspects of Quality of Service (QoS). The intent here is to assist regulators or administrations who need to achieve desired levels of QoS for one or more ICT services under their jurisdiction.

This supplement focuses on end-to-end QoS as perceived by the user when using modern mobile and broadband services. Nevertheless the guidance provided in this document can correspondingly be used for traditional wirebound and legacy services.

Network performance is out of scope of this document.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[1] Recommendation ITU-T P.10/G.100 (2006), *Vocabulary and effects of transmission parameters on customer opinion of transmission quality / International telephone connections and circuits – General definitions*.

[2] Recommendation ITU-T E.800 (2008), *Definitions of terms related to quality of service.*

[3] Recommendation ITU-T E.803 (2011), *Quality of service parameters for supporting service aspects.*

[4] Recommendation ITU-T E.804 (2014), *QoS Aspects for Popular Services in Mobile Networks.*

3 Overview of Quality of Service

Quality of Service (QoS) is defined as the totality of characteristics of a telecommunications service that bear on its ability to satisfy stated and implied needs of the user of the service (cf. Rec. ITU-T E.800); these characteristics can be measured by objective means (e.g. by a level meter or a delay counter). QoS is frequently confused with elements of Network Performance (NP) because (signalling) functions inside the networks are sometimes referred to as "services"; IETF uses QoS to describe the performance of functional services in network layer models. In order to avoid that confusion, QoS is often more precisely expressed as "end-to-end QoS".

Another confusion should be avoided when network counters and Key Performance Indicators (KPI) are brought into discussions about QoS. Network counters are vendor specific NP parameters which cannot be standardized due to their proximity to specific implementations. A majority of standardized KPIs are describing NP parameters and only a very limited number of such KPIs is truly related to end-to-end QoS.

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Furthermore, the end-to-end QoS of services at the user interface, which is basically summarizing the characteristics of the underlying in-service media streams should not be mistaken for the QoS of non-utilization stages of ICT services, which describe the (customer) "service" surround of ICT services, offered by service providers that are outside the actual usage of services that are of interest and concern to the users, e.g. quality and content of information on a service and its features, the contractual conditions offered by the service provider, provisioning facilities, documentation, and service support after contract with customers (cf. Rec. ITU-T E.803 - Quality of Service parameters of non-utilization stages of ICT services).

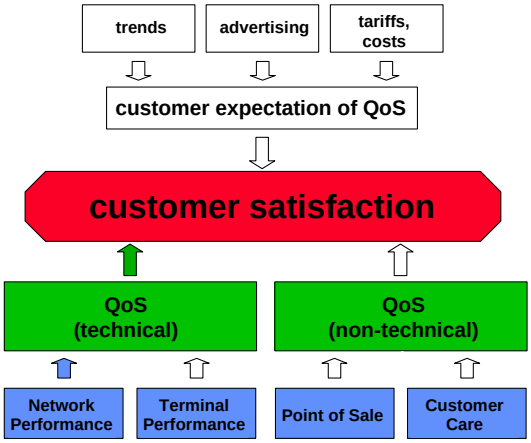


Figure 1 - Influencing factors to customer satisfaction

The (average) user perception of end-to-end QoS can be assessed by subjective testing which is very costly; therefore, objective methods have been developed that help to predict user perception of QoS by objective measurement tools. The most prominent example has been recently standardized in Rec. ITU-T P.863 (Perceptual Objective Listening Quality Assessment) and is intended for QoS assessment of voice services; this is the successor of Rec. ITU-T P.862 (Perceptual Evaluation of Speech Quality). Objective measurement methods for other services are available, e.g. in Rec. ITU-T J.247 (for video). In addition, parametric models have been developed, which allow to estimate the end-to-end QoS perceived by the average user, e.g. the E-model of Rec. G.107 (for a-priori transmission planning) or the series of Rec. P.12xx (parametric assessment of streaming media).

The user perception of quality is, however, not limited to the objective characteristics at the man-machine interface, summarized in the QoS concept. What counts for end users is the quality that they personally experience during their use of a telecommunication service; Quality of Experience (QoE), therefore, takes into account additional subjective parameters stemming from user expectations and from the context, in which the user is embedded during the use of the service, typical examples of context related influences being personal mood and environment. Also, QoE covers the potential discrepancy between the service offered and individual users reading additional features into the service.

4 Global Challenges

With the move from traditional networks, which were based on dedicated service-channels and / or separate networks for each service, towards integrated (transport) services on a single packet based transport infrastructure, which delivers all (transport) services via a single network access point, an access network and a unified so-called backbone, pre-defined transmission planning of QoS has become a major challenge:

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In traditional networks allocation of transmission impairments was based on a simple but effective concept: resources had been divided into the so-called international chain and both of the terminating national networks (including terminals) with heavy regulation in place, modern packet-based network quality parameter requirements are pretty much undefined and the impression is that the responsibility for end-to-end QoS has been lost; basically, in an IP environment, services must be considered as applications executed in the terminal devices; IP networks cannot provide for self standing end-to-end QoS, but only transport classes, which enable QoS differentiation.

The view on QoS related challenges depends strongly on the role of the stakeholders involved:

Standards Developing Organizations (SDOs) like the ITU-T or the European Telecommunications Standards Institute (ETSI) or the Internet Engineering Task Force (IETF) have the collective knowledge and expertise with respect to the QoS related problems inherited with the change of paradigms in networks and terminals and also with the aspects of planning and possible regulation of end-to-end QoS. However, SDOs are contribution-driven, which means that if stakeholders decide to rely on industry standards instead of globally recognized standards, and if stakeholders wish to keep control of their intellectual property and furthermore wish to not invest resources in globally recognized standards, then there is not very much to do for SDOs except to try to convince industry leaders, for example in dedicated events such as conferences.

Network Equipment Manufacturers basically have to rely on the QoS related performance requests (of network and system functions) from network operators and service providers. Ideally, network equipment manufacturers would participate in the QoS work of SDOs in order to standardize the QoS and performance requirements between several parties involved in the network business. Unfortunately, for many network equipment manufacturers there is no visible incentive on the short term which would make them participate in the work of SDOs related to end-to-end QoS; the return of investment (RoI) from this kind of engagement cannot easily be seen.

Terminal Device Manufacturers are confronted with a mass market, today. In the past terminal standards were for example targeting minimum attachment requirements, which were meant to not harm the network. Nowadays, there are terminal standards which target the possibility of provision of high-level end-to-end QoS to the customer. This is a challenge for terminal equipment manufacturers since the acceptance of terminals in the market is based on other factors (e.g. price, other functions of terminals (like mp3 player, GPS, etc.), applications available for that terminal (like games, etc.), brand) rather than end-to-end QoS - at least in the first place; "kids prefer the pink phone!".

Network Operators and Service Providers are faced with the necessity of huge investments in both infrastructure and access technology. They are likely to react partially by investing in new capacity, and partially by rationing existing capacity. From their perspective, traffic management tools play an important role, increasing the efficiency with which operators can manage existing network capacity. "The appropriateness of different approaches to traffic management is at the heart of the Net Neutrality debate. Given the controversial nature of this debate, it is important to bear in mind that traffic management has always beneficial aspects to it. It is commonly used for example to protect safety-critical traffic such as calls to the emergency services. The question, therefore, is not whether traffic management is acceptable in principle, but whether particular approaches to traffic management cause concern."[1]

[1] "Ofcom's approach to net neutrality" http://stakeholders.ofcom.org.uk/consultations/net-neutrality/statement/

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But also there remains the question whether network operators and service providers may or may not use traffic management as a welcome method towards suppressing competition from the so-called "un-managed" (i.e., not differentiating between traffic types, source or destination points) Internet or inhibiting the possibility of content or application providers with which it completes from introducing new innovation products. Opening access and core packet networks as pure bit pipes will probably not provide the revenues to match the huge investments mentioned; therefore; network operators and service providers will aim at providing services on top of the bit stream itself. From the beginning of the development of Next Generation Networks (NGN) which started in the mid 1990s with ETSI project TIPHON the outcome of which finally was harmonized with ITU work in the NGN-GSI, network operators and service providers **claimed** that the so-called "guaranteed QoS" (which is only a statistical guarantee) requires service differentiation in the networks; in fact for the network this would be rather a traffic class differentiation, with different services then requesting a certain transport class from the network.

Regulators and Administrations in general are challenged with their responsibility to consumer protection being affected by the rapid introduction of vendor-specific new services which they have to take into account; in addition they are also required to set a right balance between service competition and infrastructure competition to address the challenges associated with QoS on the network[2]. In the early days of the move towards end-to-end services being no longer provided on a fixed, well-known platform, it still seemed to be fairly easy to require that the new technology provide QoS "not less than in the ISDN era" (quote Austrian regulator); however today it is easy to lose the overview of proprietary services, provided by various network operators and service providers "on-net" and the respectively offered QoS. The real problem seems to be that services are not standardized, which would mean that for interconnection scenarios (one of the major responsibilities of the ITU, and one of the main purposes of the ITRs) one would need specific service agreements for each network-to-network-interface (NNI).

In contrast, Regulators and Administrations have seen in the recent past that the un-managed Internet has led to the creation of new services offered "over the top" (e.g., Skype), which like network operators and service providers are an important factor contributing to the economical benefits of their respective countries; services on the Internet can be created, improved, judged and used by each individual within the legal context without restrictions.

Consequently, Regulators and Administrations have to have a close look on the conditions under which access to these services in comparison to the access to the Internet is being provided; e.g. in the access there may be a certain percentage of the bandwidth or of the capacity reserved for the on-net services which then are not available for the access to the Internet; similarly the packed-based backbone of the network operator may serve for both the provision of their proprietary services (which are intended to secure their revenues) and for the carriage of open Internet traffic (which gives lower revenues); this may lead to a tendency to give lower priority to the open Internet traffic.

Consumers are challenged with their personal affairs of using telecommunication services (i.e. the discrepancy between advertised and actual delivery speeds of the network). In the communications between the European Commission and the Body of European Regulators for Electronic Communications (BEREC), the need for clear and transparent communication of QoS parameters and network management practices has been a recurrent theme.

2 ITU GSR10 Best Practice Guidelines for Enabling Open Access, www.itu/int/ITU/treg/bestpractices.html

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"Consumers may not be able to detect the actual applications of discriminating traffic management techniques and find it difficult to distinguish between the effects of traffic management techniques on QoS from the effects of other quality degrading factors. For instance, a consumer who is observing that traffic is routinely throttled may not know whether this is done by intention, or is caused by other factors such as network congestion, which is leading to the degradation of service. Even if [network] operators or ISPs are required to declare which traffic management techniques and policies are being used, consumers may find it difficult to act upon such information if it is presented in a highly technical way which does not explain the 'real world' effects. Thus, it will be important to monitor the effectiveness of transparency and QoS."[3]

In technical terms the global challenges can be summarized as follows:

Due to the dramatic increase in mobile communication, both in terms of the number of registered devices and of the volume of requested resources it is quite likely that migration scenarios and hybrid connections with existing wire-bound and traditional networks and terminals will be neglected and appropriate QoS standards will not be established or enforced.

Service differentiation in modern packet based networks is facilitated with e.g. Internet Multimedia Subsystem (IMS) which in its QoS part is basically a resource allocation tool. Again, the exact services are not defined or standardized which makes IMS less flexible for services to be offered across multiple packet networks. IMS is under the sole control of the 3rd Generation Partnership Project (3GPP) which is not an SDO in the classical sense; influence on the further development of IMS for ITU members is therefore very limited.

Therefore, the main technical parameters to consider will be:

- speed (data throughput) of the access network
- congestion in the backbone
- end-to-end delay (latency)
- delay-variation (jitter)
- packet loss (loss of information)

This has multiple facet's depending on which kind of gateways are used to interconnect IP networks: jitter is the variation in delay between different packets and its compensation (by de-jitter buffers) converts jitter into additional delay which may build up and increase to unacceptable values, packet loss may be concealed to an extent where essential information is lost.

Bad terminal implementations may destroy reasonable performance delivered from the network(s); users will not be able to judge the difference in end-to-end QoS.

That leads to the current **policy challenges**:

Given rapid growth in the use of the network, there is a need to consider new approaches to anchor national strategies or regulatory frameworks around the multi-facetted concept of QoS, which may

[3] BEREC Response to the EU Commission's consultation on the open Internet and net neutrality in Europe, 30 Sep.2010

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