Standardization Activities for QoS/QoE-related Technologies in ITU-T

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Abstract

In this article, the standardization activities for quality of service (QoS)/quality of experience (QoE)-related technologies in ITU-T (International Telecommunication Union, Telecommunication Standardization Sector), particularly in Study Group 12 (SG12), are introduced. First, the motivation behind efforts to standardize QoS/QoE-related technologies is reviewed, and then some of the key Recommendations are introduced. Finally, the topics attracting the most attention in SG12 are briefly discussed.

Keywords: QoE, QoS, performance

1. Introduction

In the era of conventional telephone services, the International Telecommunication Union, Telecommunication Standardization Sector (ITU-T) investigated and standardized quality assessment methodologies and quality planning rules based on quality of service (QoS). The main purpose of such activities was to guarantee the end-to-end conversational quality of telephone services.

These days, however, it is difficult to achieve the required QoS objectives based only on the predetermined quality planning rules. This is due to the diversity of applications using telecommunication networks, as well as dynamism in the traffic they produce. Therefore, ITU-T has been investigating not only quality of experience (QoE) assessment methodologies for such various applications, but also in-service QoE management technologies, which makes it possible to monitor the QoE of each application and to take necessary actions to solve problems.

The rationale behind the international standardization of QoS/QoE-related technologies is discussed in the following sections, and some important Recommendations and current topics of interest being studied in ITU-T Study Group 12 (SG12) are introduced.

2. Significance of QoS/QoE-related standardization

2.1 Protection of users' convenience

Unlike in conventional telephone networks, it is often extremely difficult to guarantee end-to-end quality in the Internet environment, in which multiple network providers are interconnected in a complex way. However, there is still a need to protect end users' convenience in terms of telecommunication quality from the viewpoint of social fairness.

For instance, the Study Group on the Ideal State of Internet Service Quality Measurements established by the Ministry of Internal Affairs and Communications of Japan has been studying the appropriateness and fairness of various quality indices provided by individual mobile network carriers to end users. This is a good example of the concept of protection of users' convenience that is being considered in the Internet community.

2.2 Uniqueness of quality scales

Before the quality objectives and rules for interconnection can be discussed, it is a prerequisite to agree on common scales of quality. In this sense, it is important to agree on subjective (QoE) quality scales, as well as on objective (QoS) ones. ITU-T plays a

very important role for this purpose as an international organization under the United Nations.

2.3 Achieving better end-to-end quality

Even if the network that one user connects to has very high performance, the end-to-end quality still depends on the performance of the other networks that are accessed towards the destination. Telecommunication is not like home appliances such as refrigerators and microwaves, in the sense that with telecommunication we need to exchange signals with a far-end friend or server. Therefore, we need international rules that define the minimum requirements to achieve reasonable end-to-end quality.

Another example can be found in the situation in which two people are talking over mobile phones. If the nominal sending and receiving levels are not defined at all, users will likely experience speech levels that are too loud or too quiet, which results in very poor QoE.

3. Key Recommendations in ITU-T

3.1 Subjective quality assessment

Subjective quality assessment, in which subjects judge the quality of media such as video, has been studied for many years, and ITU has already standardized various methods of assessing quality for different purposes. Subjective quality assessment, which is a psycho-acoustic/visual experiment, is the most fundamental and reliable way to quantify users' QoE.

The key Recommendation in this category is Recommendation P.800, although there are many other Recommendations that define methodologies for particular evaluation purposes such as speech codec testing. The most typical quality scale defined in Recommendation P.800 is the Mean Opinion Score (MOS), which is the mean evaluation score by many subjects on a 5-point scale (5: Excellent, 4: Good, 3: Fair, 2: Poor, 1: Bad).

3.2 Objective quality assessment

Objective quality assessment is defined as a means for estimating subjective quality solely from objective quality measurements or indices. ITU-T standardized a quality-planning tool for telephony services including voice over Internet protocol (VoIP) and voice over Long-Term Evolution (VoLTE) as Recommendation G.107, which is also called the E-model. The output of the E-model is the transmission rating scale "R." This was also adopted as a standard measure for IP-telephony services in Japan by the Telecommunication Technology Committee (TTC) as TTC Standard JJ-201.01.

In some cases, we need to measure the quality based only on input and output speech signals. For example, in mobile VoIP applications, capturing the IP-packet and measuring the packet-loss rate is often impossible. Therefore, ITU-T standardized Recommendations P. 862 (PESQ: Perceptual Evaluation of Speech Quality) and P.863 (POLQA: Perceptual Objective Listening Quality Assessment). These two Recommendations are essential when estimating the end-to-end conversational quality of VoLTE.

4. Ongoing work

4.1 In-service quality management

As described earlier, in-service quality management is becoming more important than ever because most dominant applications such as web browsing, progressive download video, and VoIP on mobile phones are all provided through best-effort networks. Up to now, ITU-T has standardized QoE monitoring methodologies for speech (Recommendation P.564) and for IPTV (television) (Recommendations P.1201 and P.1202). It has also started working on standardizing the technology for progressive download video such as that seen on YouTube. The code name of this project is P.NATS, and it is expected to be finished in early 2016.

4.2 Terminal characteristics

Many Recommendations have been published for conventional fixed and mobile speech terminals. ITU-T is currently working on the requirements for hands-free terminals for in-vehicle communications, video-telephony, and telepresence, which allow a person to feel as if they were present somewhere else.

4.3 Network performance

Network performance objectives have conventionally been defined as QoS classes in Recommendation Y.1541, for example. However, such an approach apparently has limitations due to the diversity of QoS requirements of various applications.

In addition, network performance indices such as packet-loss rate and delay, which assume a level of performance stability as in fixed networks, cannot fully characterize the spatial and temporal variance of mobile networks. Moreover, the conventional dichotomy of availability and transmission quality does not

hold anymore because of the instability of mobile transmission.

From these viewpoints, we need to introduce new QoS indices that can indicate the characteristics of mobile networks that affect end users' experience.

5. Conclusion

This article summarized the standardization activities of QoS/QoE-related technologies in ITU-T SG12. SG12 has been expanding its coverage from telephone to web browsing, video delivery, network gaming, telepresence, and other applications, in collaboration with various forums and other standardization bodies. One of the most important roles of SG12 is to bridge a gap among these organizations and provide a comprehensive set of technologies for QoS/QoE.

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He received a B.S. in mathematics from Hokkaido University in 1988, an M.S. in electrical engineering from the California Institute of Technology, USA, in 1993, and a Ph.D. in engineering from the University of Tsukuba, Ibaraki, in 2007. He joined NTT in 1988 and has been engaged in the quality assessment of audio and visual communications. He has been contributing to ITU-T SG12 on QoS, QoE, and performance since 1994. He was a Vice-Chairman of ITU-T SG12, a Vice-Chairman of Working Party 3 in SG12, and a Co-Rapporteur of Question 13/12 for the 2009–2012 Study Period. He received the Telecommunication Technology Committee Award in Japan in 2004 and the ITU-AJ Award in Japan in 2005 and 2013. He also received the Best Tutorial Paper Award from IEICE (Institute of Electronics, Information and Communication Engineers) in Japan in 2006, and the Telecommunications Advancement Foundation Awards in Japan in 2007 and 2008.