Chapter 10

Methods for Quality Assessment in Enterprise VoIP Communications

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ABSTRACT

In the last few years there has been a dramatic development in voice communications technology with a significant move towards Voice over the Internet Protocol (VoIP). However, since IP was primarily designed for best-effort networking technology, good quality conversation and intelligibility are not always guaranteed. In this chapter, the authors address the most relevant methods used to evaluate the voice quality in the communications context of modern enterprises, where VoIP is used as an emerging technology with impact in their activity. Relevant factors for service providers and enterprises using VoIP technology are described, such as those related to the measurement of intelligibility and with impact on the overall voice communications quality. In addition, the most important voice quality evaluation methods recommended by the International Telecommunication Union (ITU) are presented in this chapter, along with the main features that can be used to improve voice communications. Fundamental concepts behind voice quality evaluation models are highlighted, such as intrusive, non-intrusive, objective, subjective, and parametric methods. After addressing the most relevant theoretical and methodological aspects, a recent application of voice quality monitoring for VoIP communications is described as the result of a research and development project. After its successful implementation, this monitoring system is now fully operational and integrated in voice quality assessment equipment currently in the market.

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**INTRODUCTION**

In this chapter, quality evaluation of voice services and applications is addressed in the context of modern enterprises. After an introductory background, a description of voice quality evaluation metrics provides the concepts and classifies the most relevant methods ranging from subjective, objective and parametric. Various types of subjective evaluation methods are described, after establishing the Mean Opinion Score (MOS) as the ground-truth voice quality metric. Then, objective methods currently used in quality evaluation processes are presented, including the well-known Perceptual Evaluation of Speech Quality (PESQ) algorithm. Parametric methods are presented based on the E-Model as this is the most relevant parametric method currently used in practical systems. Conformance requirements are also addressed, since this is another relevant aspect that should be taken into account to develop objective quality assessment models for VoIP quality prediction under packet network impairments. Then a practical voice quality evaluation model, based on the knowledge gathered in previous sections, is presented and discussed. Finally, the chapter discusses future research directions and main conclusions.

**BACKGROUND**

Nowadays it is quite evident that a technological revolution was happening in the last few years, spreading over many areas of daily life, which are currently supported by digital technologies. In the telecommunications world, where phone calls play a primary role, migration from the analogue Public Switched Telephone Network (PSTN) to the Integrated Services Digital Network (ISDN) has been witnessed, though both of them were still based on the circuit switching paradigm. Since the emergence of the packet-switching technology was one the most important factors responsible for the enormous success of the current digital telecommunications services, the widespread use of the Internet Protocol (IP) has reached traditional telephony communications in a global scale. As a consequence, Voice over IP (VoIP) is rapidly taking over legacy technologies and the existing IP infrastructure soon appeared suitable for transporting telephony voice signals because of its low cost associated with the flexibility and diversity of other possible services. Call centre integration, directory services over telephones, IP video conferencing, Fax over IP (FoIP) and Radio/TV broadcasting are among an ever increasing number of services and applications (Al-Akhras & Momani, 2011).

According to statistics from the Organization for Economic Co-operation and Development (OECD), the use of VoIP services has been steadily increasing (Borges, 2009). For example, the French Autorité de Régulation des Communications Électroniques et des Postes (ARCEP) unveils that, from the third quarter of 2006 to the corresponding quarter of 2010, the use of the Public Switched Telephone Network (PSTN) for VoIP services rose from 5% to 37% (Postes, 2010). According to (Related, 2008), it is expected that VoIP will replace conventional telephony in a couple of decades and there are market analysis foreseeing that the number of VoIP consumers is increasing from 70 million in the second quarter of 2008 to nearly 200 million by 2012 (Point Topic, 2009). Perspectives outlined by (www.3G.co.uk, 2006) state that the emerging VoIP traffic over the cellular network will represent 23% of the total voice traffic time by 2015 in occidental Europe. There is also a current evolution of voice services towards VoIP over WiFi (VoWiFi) which has recently emerged as promising technology (Mondal, Huang, J. Li, & Kuzmanovic, 2010).
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