

Chapter XV

Perceptual Voice Quality Measurement – Can You Hear Me Loud and Clear?

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ABSTRACT

In the context of multimedia communication systems, quality of service (QoS) is defined as the collective effect of service performance, which determines the degree of a user's satisfaction with the service. For telecommunication systems, voice communication quality is the most visible and important aspects to QoS, and the ability to monitor and design for this quality should be a top priority. Voice quality refers to the clearness of a speaker's voice as perceived by a listener. Its measurement offers a means of adding the human end user's perspective to traditional ways of performing network management evaluation of voice telephony services. Traditionally, measurement of users' perception of voice quality has been performed by expensive and time-consuming subjective listening tests. Over the last decade, numerous attempts have been made to supplement subjective tests with objective measurements based on algorithms that can be computerised and automated. This chapter examines some of the technicalities associated with voice quality measurement, presents a review of current subjective and objective speech quality measurement techniques, as mainly applied to telecommunication systems and devices, and describes their various classes.

INTRODUCTION

There is mounting evidence that the quality of the bread-and-butter product of cellular and mobile communication industry, voice that is,

isn't really very good. Or, at least not as good as their customers would expect by comparing what they get to what they have traditionally been offered. Mobile phone operators today might be trying to convince us that there is much more

than just talking which we can do with our handsets. Intimately, though, this is true particularly in view of the present dynamic business environment, where voice services are no longer sufficient to satisfy customers' requirements. However, they also know that their crown jewel has always been, and continue to be, the provision of voice. The problem is, this valuable commodity existed long before the time mobile networks began to spread all over the world, and enjoyed a relatively good reputation in the hands of their previously dominant providers, the local telephone companies.

In a highly competitive telecommunications market where price differences have been minimised, quality of service (QoS) has become a critical differentiating factor. In the context of multimedia communication systems, QoS is defined as the collective effect of service performance, which determines the degree of a user's satisfaction with the service. However, when it comes to telecommunication networks, voice/speech communication quality is the most visible and important aspects to QoS. Thus, the ability to continuously monitor and design for this quality should always be a top priority to maintain customers' satisfaction of quality. Voice quality, also known as voice clarity, refers to the clearness of a speaker's voice as perceived by a listener. Voice quality measurement, also known by the acronym VQM, is a relatively new discipline which offers a means of adding the human, end-user's perspective to traditional ways of performing network management evaluation of voice telephony services. The most reliable method for obtaining true measurement of users' perception of speech quality is to perform properly designed subjective listening tests. In a typical listening test, subjects hear speech recordings processed through about 50 different network conditions, and rate them using a simple opinion scale such as the ITU-T (The International

Telecommunication Union—Telecommunication Standardization Sector) 5-point listening quality scale. The average score of all the ratings registered by the subjects for a condition is termed the *mean opinion score* (MOS).

Subjective tests are, however, slow and expensive to conduct, making them accessible only to a small number of laboratories and unsuitable for real-time monitoring of mobile networks for example. As an alternative, numerous objective voice quality measures, which provide automatic assessment of voice communication systems without the need for human listeners, have been made available over the last decade. These objective measures, which are based on mathematical models and can be easily computerised, are becoming widely used particularly to supplement subjective test results. This chapter examines some of the technicalities associated with VQM and presents a review of current voice quality measurement techniques, as mainly applied to telecommunication networks. Following this Introduction, the Background section provides a broad discussion of what voice quality is, how to measure it and the needs for such measurement. Sections *Subjective Voice Quality Testing* and *Objective Voice Quality Measures* define the two main categories of measures used for evaluating voice quality, that is subjective and objective testing, describing, and reviewing the various methods and procedures of both, as well as indicating and comparing these methods' target applications and their advantages/disadvantages. The *Non-Intrusive Objective Voice Quality Measures* section discusses the various approaches employed for non-intrusive measurement of voice quality as required for monitoring live networks, and provides an up-to-date review of developments in the field. The section *Voice Quality of Mobile Networks* focuses on issues related to voice quality of current mobile phone networks, and dis-

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