Chapter 77
QoE Prediction for Multimedia Services: Comparing Fuzzy and Logic Network Approaches

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ABSTRACT

This paper is devoted to the problem of evaluating the quality of experience (QoE) for a given multimedia service based on the values of service parameters such as QoS indicators. This paper proposes to compare two self learning approaches for predicting the QoE index, namely the approach based on logic circuit learning and the approach based on fuzzy logic expert systems. Experimental results for comparing these two approaches with respect to the prediction ability and the performance are provided.

1. INTRODUCTION

Nowadays, multimedia services are progressing very fast as multimedia information is usually transmitted using public or private networks. A multimedia traffic is considered to be any combination of audio, image, video or data traffic. One may notice that such multimedia traffic has become a principal traffic source in today Internet. The advancement of networking technologies as well as higher achievable bitrates has helped a lot in the growth and popularity of multimedia traffic. It is expected that video traffic will reach 66% of the global mobile traffic by the year 2015 with one million minutes of video content crossing the Internet every second (Cisco, 2011). On the other hand, multimedia traffic challenges the service providers and network operators, for instance,

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the former is required to have higher bandwidth or stringent QoS requirements (Kumar and et al., 2002). Moreover, it is essential for service providers and network operators to measure the quality of real-time multimedia applications, such as video streaming, mobile IPTV, and other kinds of audio and video applications (Serral-Gracià et al., 2010).

A service that is used to deliver a multimedia traffic to an end-user is considered to be a *multimedia service*, and the quality of such service plays a crucial role when an end-user chooses between two multimedia services. In other words, the service quality is an argument that allows attracting customers and thus, this parameter has to be estimated thoroughly. Usually, the *Quality of a (multimedia) Service (QoS)* is defined as a vector which components are values of given attributes (parameters), such as time delay, packet loss rate, etc. The QoS is the metrics that represents some objective service parameter values that can be, for example, effectively measured based on the traffic analysis (Khirman & Henriksen, 2002). The QoE metrics is more involved with services, since it measures the user satisfaction (Winckler et al., 2013; ITU-T Recommendation G.1080, 2008) and thus, the QoE becomes one of the challenging metrics to evaluate the quality. Moreover, when dealing with Clouds and/or Internet of Things, various multimedia/web service compositions are usually considered. Therefore, new methods and techniques for estimating quality of such compositions need to be provided.

The QoS parameters reflect the objective network and service level performance and they do not directly address the user satisfaction of the delivered service or application. However, it is well known that when the QoS parameters vary, the QoE is influenced as well. The relationship between QoS and QoE is hard to estimate, since this relationship is not linear. Moreover, the higher QoS level does not always yield the higher QoE value. Various QoS/QoE correlation algorithms can be found, for example, in (Rubino et al., 2006; Mushtaq et al., 2012; Wang et al., 2010). The relationship between the QoS and QoE metrics has a number of applications, including multimedia, web, etc., when assessing an end-user satisfaction with a given service (Wijnants et al., 2009; Mushtaq et al., 2012; Pokhrel et al., 2014).

An algorithm for the QoE evaluation has to be adapted to a human's brain in order to 'predict' what a user likes/dislikes. This is the reason why different self-adaptive models and algorithms are now used when evaluating/predicting the QoE of different services (Kushik et al., 2014; Pokhrel et al., 2014). The advantage of a self-adaptive model is that it can be learned or trained by a 'teacher' or by itself according to the feedback from people who use the service. As usual, an initial model/machine is derived based on some statistics that contain a number of user estimations of the service depending on measurable service parameters. Afterwards, the model can 'predict' a user satisfaction of the service for current values of service parameters. Usually, the more statistics are gathered the better is the 'prediction'. Moreover, a model is self-adaptive, and thus, when new statistical data appear for which the model does not behave in an appropriate way, the model is adjusted to this new data. This process is called the model training.

Given a self-adaptive model, different service parameters might be considered. Usually QoS parameters are considered, as their values can be automatically measured. In this paper, we are focusing on predicting the user satisfaction with a multimedia service, i.e., on evaluating the QoE of the multimedia service when a number of objective multimedia parameter values have been already estimated. The parameters considered in this paper are the jitter and the packet loss of the video traffic. Considering self-adaptive models, in this paper, we focus on two approaches for predicting the QoE value: logic circuit based approach and fuzzy logic expert systems. The main objective of the paper is to compare these approaches w.r.t. the QoE prediction ability and the performance.