Strategies for improving the QoE assessment over iTV platforms based on QoS metrics
Ph.D Proposal

Diego J. Botia
Universidad de Antioquia
Medellin, Antioquia, Colombia
Email: dbotia@udea.edu.co

Natalia. Gaviria
Research Group in Telecommunications Applied GITA–ARTICA. Engineering Department
Universidad de Antioquia
Medellin, Antioquia, Colombia
Email: nagaviri@udea.edu.co

Abstract — For network operators (telcos) the quality assessment over multimedia services has become a hot topic in recent years. We propose a model to simplify the assessment and correlation metrics QoS/QoE over video services. We report the development of a methodology that use metrics Full Reference (FR) and Reduced Reference (RR), through network scenarios using QoS strategies (DiffServ). We used a multivariate correlation model and a model based on ANN as PSQA (Pseudo Subjective Quality Assessment) for accurately predicting subjective quality MOS metric of the user, taking into account the QoS defined. Simulation experiments show values that are correlated nicely with each metric and allow validating QoE values adjusted for real user perception.

Keywords— QoE, QoS, NUFI, IQBF, PSQA, Objective Metrics, Subjective Metrics

I. INTRODUCTION

Digital television is developing a new trend in the provision of telecom services, that leads the creation of a wide range of applications such as VoD (Video on Demand), PVR (Personal Video Recorder), Streaming, interactive applications, among others; but in some cases these might be affected by the quality of user experience, due to factors such as network errors, poor network resources planning, or improper use of encoding or decoding mechanisms, that could produce a poor quality over multimedia services. Therefore a new important factor for networks providers is the fulfillment of the user’s expectations regarding the service they receive. It is necessary to apply some mechanism to correlate QoS (Quality of Service) / QoE (Quality of Experience) metrics, for achieving high quality end to end. Factors such as delay, packet loss and jitter, are influencing directly on the image or sound quality perceived by the user. Our major motivation for this project is by small number of standards to assess the quality of experience easily and accurately, also for the few related researches about the correlation of QoS / QoE metrics as there are no suitable models that conform to assess the user subjectivity on multimedia services. For this reason telcos require new mechanisms to facilitate the real assessment of QoE perceived by their users, especially in environments with losses and congestion.

The project initially performed a comparative study of objective and subjective metrics then, it assessed the measuring process of QoE metrics. We also use schemes of QoS through strategies based on active queue management

(AQM) to control the network congestion like WRED. First, we present a regression model based on multivariate data analysis. A correlation between metrics widely employed as PSNR, VQM and SSIM is used. Then a set of parameters such as bitrate, length GOP (Group of Pictures) and PLR (Packet Loss Rate) are applied into the model. On the other hand we propose new metrics based on frames called Quality Index Based Frame (IQBF) and New Undecodable Frames Index (NUFI) that are simple metrics to implement and they require low computer resources. Finally we apply the methodology PSQA (Pseudo Subjective Quality Assessment) [1], based on AI techniques such as, RNN (Random Neural Networks) and Neuro-Fuzzy methods like ANFIS (Adaptive Neuro-Fuzzy Inference Systems)[6], in order to predict the quality perceived by the user through MOS metric. Results between the models will be compared to establish the accuracy level for each model and to assess QoE in a simple way.

This paper is organized as follows; in Section II the main QoS/QoE metrics for iTV platforms are described. In Section III we detail our proposed approach. In Section IV preliminary results of simulations are shown. Finally, Section V mentions our conclusions and future work.

II. BACKGROUND

A. Quality of Service

It is defined as measurement set of quality characteristics of a network that allow it to work efficiently, where requirements vary depending on the application. The main objective of analyzing and providing QoS is to control critical parameters (such as bandwidth, jitter, latency, or packet loss) to ensure the proper transmission of information and being able to give priority to the flows that require it. In [2] three basic elements for network architecture with QoS are proposed. The first one is the use of identification and marking techniques in order to coordinate QoS end to end in the network. The second one is the QoS in the different network devices, applying concepts like queuing, scheduling, and traffic-shaping. Finally, there are QoS policies, management and accounting functions to control and manage traffic end to end.

B. Quality of Experience:

It is the degree of user satisfaction with the service. QoE has been defined in different ways by different authors. Li-yuan et.al[7] showed that QoE involves two aspects: the
form is to monitor the user experience online and the latter is the service control to ensure that QoS can widely know the user requirements. Furthermore, according to [3], QoE is an extension of QoS because the first one provides information about the delivery of services from viewpoint of the end user. According to Winkler et.al [4] in QoE there are subjective and objective measurements for the video transmitted over the network, in which the former depends on the user's expectations and therefore, it takes into account the feelings, perceptions and opinions. According to [1] objective metrics can be classified into non-intrusive and intrusive methods. Full reference intrusive methods or comparing two sequences (original and with distortion after transmitting through the network). PSNR (Peak Signal to Noise Ratio), MSE (Mean Square Error), VQM (Video Quality Metric) and SSIM (Structural Similarity Index Metric) are the most well-known metrics from this category. Non-intrusive techniques are classified as no reference and reduced reference. The pseudo subjective quality assessment (PSQA) model [1] is an example of this category. This model uses a RNN (Random Neural Network) to learn the relationship between video and network characteristics with the quality perceived by users. Initially, in order to make the training process of RNN, it must have a database that contains different sequences to assess their distortions, generated from several QoS and coding parameters. After training RNN should be used to assess any type of sequences (e.g. real time), where predicted MOS can be validated.

III. PROPOSED APPROACH

Fig 1 shows the proposed methodology, which begins by identifying the key QoE/QoS metrics to evaluate. They are defined to simulate different scenarios that for our purposes were based on Besteffort and DiffServ networks. Then we proceed to analyze different correlations between the metrics to establish their relationship with HVS to approach the ideal subjective MOS value. Our first analysis was based on a multiple correlation model. We have evaluated full reference metrics such as PSNR, VQM and SSIM, and then we propose metrics hinged on RR methodology using analysis from frames called IQBF and NUFI, that have demonstrated a better correlation with FR metrics and it also has reduced complexity in measurements and calculations. Having a database with different distorted video sequences and combining them with several encoding parameters (e.g. bitrate and GOP length) and network (e.g. PLR, DiffServ with WRED parameters), they are evaluated through the implementation of some AI techniques as RNN (using the proposed PSQA), ANFIS [5], among others. Then it generates an estimated MOS that will be compared with the other subjective values valued by multiple regression models and to provide greater accuracy with the user perception.

IV. CONCLUSIONS AND FUTURE WORK

Results demonstrate a high correlation between metrics QoS/QoE, which allows to establish models that could calculate MOS score more precisely and it can approach the true perception of the user over received video sequences. The QoS strategies as Diffserv increase quality, especially in environments with losses and congestion. We will continue adjusting the model proposed especially with the application of Machine Learning techniques to assess the values obtained for MOS.

ACKNOWLEDGMENT

The authors acknowledge the support provided by ARTICA (Regional Alliance for ICT applied), as well as Colciencias and Ministry of ICT. We also appreciate the support provided by the Engineering Department of University of Antioquia.

REFERENCES