

Pragmatic Correlations of Quality-of-Experience and Quality-of-Service in IMS-Based IPTV Network

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ABSTRACT

To let the service system react quickly on customers' perception or user experience while using the service, mapping functions between Quality of Experience (QoE) and Quality of Service (QoS) are strongly required in purpose of building up an intelligent QoE control system upon adjusting QoS parameters. This article studies the changing behavior of QoE with respect to changes of QoS parameters in the context of video streaming service in an IP Multimedia Subsystem-based IP Television network (IMS-based IPTV network). The article is, in fact, an extended version of the paper published by the same authors (Thu-Huong Truong, 2012). In (Thu-Huong Truong, 2012), the authors studied QoE in both terms of Mean Opinion Scores and VQM as functions of each single QoS parameter such as: loss, jitter, and delay. In this extended content, the correlation between QoE and multiple QoS parameters will be introduced. The QoE-QoS correlation could be a significant first step to build a smart QoE monitoring and control mechanism as an added value to promote the IMS-based IPTV network.

Keywords: *Computer Science, Internet Protocol Multimedia Subsystem (IP Multimedia Subsystem), Internet Protocol Television (IPTV), Quality of Experience, Quality of Service, Subjective Video Quality Assessment*

INTRODUCTION

With the rapid expansion of networked applications and services along with their underlay ICT infrastructures in recent years, service quality and user satisfaction are important research

interests for researchers and also competitive factors for service providers, especially in the rich content delivery segment. The well-known Quality of Service (QoS) metrics and control methods have been thoroughly studied but they only represent the network-centric view and are moving far from being the effective service management components because of

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the fast-evolving underlying heterogeneous infrastructures while services get converged in the user view (e.g. triple-play, quadruple-play service models...).

Service quality cannot be taken simply as objective quality parameter of the service, but must also take into consideration every factor that contributes to overall user service perception. The known network-centric Quality of Service metrics are not enough to represent the service satisfaction anymore. Consequently, Quality of Experience (QoE) has emerged to be a clear important quality factor, being defined as a user-centric assessment of service expectation and satisfaction and represents the underlying QoS impacts, device capabilities as well as the human perception factors (Jain, 2004; Neil, 2010). Unfortunately, most research in the field of networked services so far has primarily focused on these technical QoS aspects of quality, thus lacking sufficient evidence regarding the user's actual quality perception.

In the quality competition of IP-based service providers, QoE is increasingly important and tractable to help providers to leverage service quality and user satisfaction while being price-competitive, which is critical in the diversified IP-based service provision competition. Service providers naturally desire to control and ensure a good QoE level while keeping the QoS-related network resources optimized and under control.

In this article we put our focus on studying the QoE/QoS relationship for the service context of IMS-based IPTV networks. Internet Protocol Television (IPTV) is one of the most exciting new IP-based services, which started from more than 10 years ago, but majorly boosted from the mass deployment of residential IP broadband and the introduction of Next-Generation Networks (NGN). IPTV has evolved through various architectures and device capabilities, with its standard being harmonized by ITU-T FG-IPTV group since 2006. IPTV technology

its own has been advancing to expand its capabilities as well as to its feature sets to raise the service attractiveness to users.

Recently, IMS (IP Multimedia Subsystem), a 3GPP initiative as a control plane for multimedia services, has been proposed to facilitate modern IPTV networks to provide more flexible service deployment and user control, mobility management with fixed-mobile convergence and seamless integration with other service concepts using SIP signaling like VoIP. (Nguyen Tai Hung, 2010) described the IMS-based IPTV architecture and its service varieties.

IPTV, as a mixed real-time/on-demand bandwidth-exhaustive application, requires a controllable audio/video quality and smooth user interaction. Therefore it raises an important challenge while running on the best-effort, flexible IP networks. The quality problem is more concerned for IMS-based IPTV due to the re-use of IMS functions together with other services and due to new dimensions like mobility and seamless handover.

QoE control for IPTV in general and IMS-based IPTV in particular, therefore, has been an interesting research topic recently. To choose appropriate measures to keep user-perceived service quality above an acceptance threshold, a provider needs to know relationships between QoE and QoS in order to translate user-level QoE perception (e.g., glitches, artifacts, excessive waiting times, blurring, color errors, jerkiness, edge busyness, mosquito noise, blocking/tiling) into QoS parameters (e.g., loss, delay, jitter, reordering, throughput limitations) and vice versa.

As a matter of fact, QoE for multimedia services including IPTV has already been studied in ITU-T (SG12) to seek the requirements and analysis methods. Research on QoE has contributed from foundation ideas to measurement techniques, from qualitative design concepts to quantitative models to identify QoE properties and their links to lower layers, especially to the

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