

# Quality of Multimedia Experience: Past, Present and Future

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## Abstract

This talk starts by defining what is Quality of Experience. It then provides an overview of state of the art in Quality of Experience in multimedia systems. It will finally conclude by presenting challenges and trends that need to be further addressed.

## Categories & Subject Descriptors: H.5.1

[Multimedia Information Systems]: Evaluation/Methodology;  
H.5.2 [User Interfaces]: Evaluation/Methodology

**General Terms:** Algorithms, Measurement, Performance, Design, Experimentation, Human Factors, Standardization, Verification.

The field of multimedia is maturing and one of the positive results of this fact is the increase in the quality of offered products and services. Nowadays, there is no longer only a question of which features are included in a multimedia product or service, but also how well such features are addressed, and even more importantly, which impact they have on end-users. The era of user-centric multimedia has already begun, where quality plays a central role. But what is meant by quality in multimedia services and products, how to measure it, and once measured, how to improve it?

Multimedia applications generally deal with signals that are meant for human consumption and interaction. These signals usually go through many processing stages before consumption by a human including acquisition, processing, coding, transmission, enhancement and restitution. Depending on the used technologies, each of these stages may affect the quality of the multimedia presentation and introduce certain artifacts that may decrease the quality of experience for the observer. Other end-to-end issues such as delays in the interactions, usability, human factors, and context related issues, can further have an impact on the multimedia experience by an end user.

Traditionally multimedia content and service providers have addressed these issues by the notion of Quality of Service (QoS) that objectively measures and guarantees service-related characteristics from the provider

perspective. QoS metrics have been either based on system components characteristics not taking into account human perception, or based on simplified mono-modal models of human sensory system. More recently, the notion of Quality of Experience (QoE) has brought a new and fresh way to look at the notion of quality in multimedia systems. While QoS intends to capture the system-related characteristics, QoE involves aspects related to not only subjective perception, but also user behavior and needs, appropriateness, context, usability and human factors of the delivered content.

This shift towards QoE is more related to the measurement of how a specific user values a given multimedia service or product, and closely related to notions such as usability and perception. The International Telecommunication Union defines QoE as: “The overall acceptability of an application or service, as perceived subjectively by the end-user.”. As QoE is something that is created in the users mind, it is more a qualitative measure than a quantitative one. Therefore it requires comprehensive subjective quality assessment methodologies and objective quality assessment metrics that model the human perception as closely as possible, taking also into account end-to-end system issues, environmental context, user preference, human-machine interaction, and presence, among others.

With the technological evolution in acquisition, transmission, and playback hardware for multimedia content, there is a move from traditional multimedia data such as stereo audio and standard definition television (SDTV) over current multimedia data such as 5.1 channel audio and high definition television (HDTV), towards future media data such as 22.2 channel audio (NHX), ultra high definition television (UHDTV) and 3D television (3DTV). In summary future media content and services will likely provide

- Spatial audio with more audio channel (up to 22.2) and higher resolution (96 kHz)
- 2D video with higher resolutions (up to 7680x4320 pixels) and higher frame rates (at least 60 fps) and higher dynamic range (HDR)
- Stereoscopic, multiview and texture + depth for 3D images and video

- Advanced human machine and media interaction (HMMI) mechanisms
- Immersive media with enhanced user presence

New approaches for assessing the quality of future media content and services are required that focus more on QoE instead of the traditional QoS and should take into account the new types of multimedia data and human computer interaction. Even more importantly, standard and repeatable mechanisms are needed in order to allow any actor in the chain of media delivery (including end-users) to measure the quality of experience provided by a component, a product or a service, together with appropriate certification mechanisms and labels that would guarantee them in a reliable and trusted fashion.

## Bio

Touradj Ebrahimi is currently Professor at EPFL heading its Multimedia Signal Processing Group. He is also adjunct Professor with the Center of Quantifiable Quality of Service at Norwegian University of Science and Technology (NTNU). His research interests include still, moving, and 3D image processing and coding, visual information security (rights protection, watermarking, authentication, data integrity, steganography), new media, and human computer interfaces (smart vision, brain computer interface). He is the author or the co-author of more than 200 research publications, and holds 14 patents. His website is accessible at

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