Development of a software tool for correlating user experience to network QoS in a mobile network

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Introduction

In this era of converging media technologies, value is increasingly migrating from products to experiences as customers seek out truly personalized value to satisfy their situational needs. It is often hard to measure and to predict what the user experience will be during service consumption. This is nevertheless a very important aspect that should be taken into account while developing applications or frameworks.

Hence, the ultimate measure for mobile media networks and services is how the end-user perceives the quality of the new media and services. Measuring end-user perception is very complex given the number of parameters (context, network, activity, device) that can influence this perception. This paper demonstrates the preliminary result of a monitoring probe and interdisciplinary methodology that will capture user experience and correlate this to the wireless reception quality with the goal of quantifying and predicting user experience.

Methodology

QoE dimensions

User experience (QoE) is a multidimensional concept that consists of both social and technical axes [**Error! Reference source not found.**]. User experience is not simply related to technical excellence: "*It is possible to have excellent Quality of Service (QoS) and poor QoE*" [**Error! Reference source not found.**]. Parameters and influences come from different layers and have to be measured in appropriate ways. This includes a multidisciplinary approach where not only objective parameters such as network quality and device capabilities are relevant. Also the more subjective parameters like expectations, emotions, usability, and context must be taken into account.

In [**Error! Reference source not found.**] we defined QoE dimensions in 5 building blocks. These blocks structure the different aspects influencing the user experience: *Quality of Effectiveness* (is the application, network, or device doing what it is supposed to do?), *Quality of Efficiency* (does the application or device work well enough for the user?), *usability* (deals with how easy it is for the user to accomplish tasks), *expectations* (the QoE will be influenced by the degree to which the expectations of the user are met), *context* (different contexts exist that can influence the experience: the environment, the social context, cultural context).

Probe model for data collection on a multidisciplinary level

In order to collect the relevant data, a probe model that measures data across the different dimensions influencing the user experience is created. The concept of this model is shown in Figure 1. Since the dimensions reflect different aspects of classical research domains (technological and social research) we have created a software model consisting of three layers. Each layer consists of one or more software monitoring probes (Figure 1). Each probe fulfils a specific task:

The contextual probes consist of software probes that deal with determining what the context of the application usage is. This can exist of GPS data (environmental context), information coming from the users agenda, or data reflecting the users' mood or activities.

The experience probes consist of the software probes having build-in intelligence in order to capture the user experience. To this end, automatic questionnaires completed by the user on the mobile device before, after, or even during application usage could be a possible mechanism. Other ways are detecting application usage by monitoring keystrokes.

The QoS probes consist of the software probes that will deal with the monitoring of the technical parameters such as network performance (throughput, delay, signal strength), device performance and capabilities (memory usage, screen size), and application properties (video codec).

Partitioning of the monitoring model in these three layers enables collaboration with experts with different backgrounds such as social researchers, engineers, and usability designers.

We have developed a software tool that reflects the probe model. The implementation of the client software was done in C# within the .NET Compact Framework 2.0 and by using Windows Forms. Auxiliary classes were taken from the Smart Device Framework v2.1 from OpenNetCF. For each category of probes, new modules can be created that can reflect new parameters to be monitored during service consumption. This software tool runs during the application usage and is

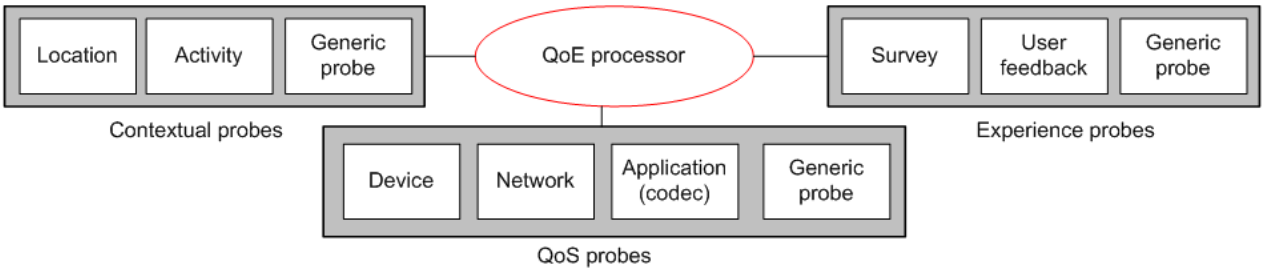

***Figure 1**. Structure of a software model for montoring QoE.*

connected to a backend infrastructure that stores and analyses the data.

User tests

It is of key importance to be able to evaluate the user experience with a large test panel. For this test panel we will use the i-City Living Lab environment (http://www.i-city.be). I-City is a living lab in Belgium that exists of a city-wide wireless WiFi infrastructure with more than 1100 test users. For this we have integrated a software tool (Section II.B) into the i-City service platform. We have also chosen to target a specific application that currently runs on the I-City platform that will be monitored. Users are given a Personal Digital Assisent (PDA) of type HP IPAQ rw 6815. The application that is tested is a Wineguide that assists people in searching and finding information about wines. The application also gives the possibility to create a personal wine collection.

After selection of the application we defined different usage scenarios that had to be completed by the test users. 10 test-users completed the scenarios under different reception levels. During usage of the application we monitored the signal strength (calculated from the Received Signal Strength Indication RSSI). After application usage a short experience-questionnaire of 6 questions was presented to the users on the PDA. In short, the users were asked to report their experiences with the Wineguide application on several dimensions by means of 5-point Likert scales. The data are collected in order to correlate the answers with the reception quality.

Results and conclusions

The method to evaluate user experience needs a lot of data entry points and a multidisciplinary approach. By defining Quality of Experience dimensions and the creation of a multilayered probe model we are able to study the correlation between the different dimensions. In addition, the proposed method integrates a number of fragmented traditions and findings into one meaningful, multidisciplinary approach. Furthermore this system allows researchers from different disciplines to quantify these dimensions of the user experience. Results obtained using the described methodology will be presented at the conference.

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