

OC²E²AN: Optimized Control Center for Experience Enhancements in Access Networks

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The various applications that are used on the Internet become more and more complex, including very different capabilities for communication such as content streaming or progressive download. However, from the users' perspective, the main interest has not changed. The user is interested in the content transported over the network, and simply wants a usable and smooth application.

In today's access networks, the experienced quality for the user of Internet applications is not always optimal. This is mainly due to the different and varying requirements of the services to the network and the fact that the network is not aware of the applications it transports. Consequently, it cannot assess how the user experiences the quality of the network. As a result, video streaming packets that have to be delivered in real time, are treated in the same way as file downloads, which are less time-critical, although it would be technically possible to prefer critical data over other non-critical data.

Within the BMBF research project G-Lab (<http://www.german-lab.de>), the *Aquarema* (Application and Quality of Experience Aware Resource Management) concept was developed to cope with this problem. It specifies, based on application-layer information, a cross-layer resource management for access networks that have limited network resources. The software suite OC²E²AN is a concrete realization of this concept and a direct successor of *AquareYoum* [2]. OC²E²AN minimizes the stalling of YouTube videos, improves the performance of web browsing in the network, and optimizes the quality of video streams by monitoring quality degradations of the applications and adapting the network accordingly. The aim is to improve the quality of experience (QoE) of the users on that network.

Aquarema [1] specifies the components needed for a dynamic resource management that avoids QoE degradation for the end user. The concept defines four logical units: (1) application monitoring, (2) network monitoring, (3) resource management and (4) a network advisor, cf. Figure 1. The monitoring collects information needed on the client and the network, and reports them to the network advisor. In case of the risk of QoE degradation, the network advisor uses this information to coordinate the resource management tools that conduct control or resource management actions to adequately react on the current situation. Further details about *Aquarema* can be found in the original publication [1].

As an implementation of the *Aquarema* concept, we present OC²E²AN. Figure 1 provides an overview on the components of the OC²E²AN framework including different types of application monitors, network monitors, and resource management tools, as well as the network advisor component. Currently, OC²E²AN offers specific QoE-aware resource management for YouTube video streaming, web browsing, HTTP-based file downloads and video streaming with the scalable video coding (SVC) extension of the H.264/AVC standard. As indicated in the figure, it also includes the functionality of *AquareYoum* [2], our proof of concept implementation. But being more than that, OC²E²AN is a fully implemented framework for resource management in access networks and its functionality is

presented at NetSys 2013 in Stuttgart. A sketch of the demo setup and used components are depicted in Figure 2.

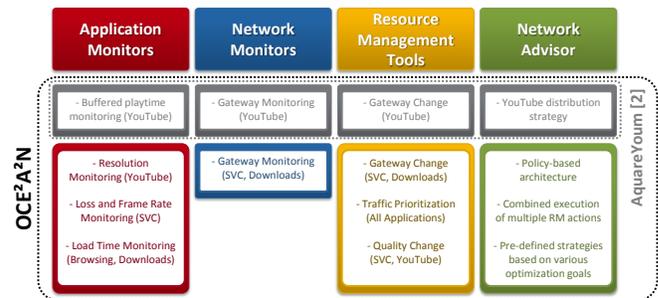


Fig. 1. Overview of OC²E²AN components.

In the following, a sample sequence of a resource management for YouTube and file downloads with OC²E²AN is outlined. According to the QoE model in [3], stalling is by far the main factor influencing the QoE of YouTube. Therefore, an application monitor within OC²E²AN observes the current buffered playtime of a user if he is watching a YouTube video. If the buffered playtime falls below a threshold value of 5 s, the network advisor is informed that a QoE degradation is imminent. Now, resource management is executed by the network advisor and a dynamic prioritization of YouTube traffic over the file downloads is triggered at the backhaul links until the playout buffer is again sufficiently filled.

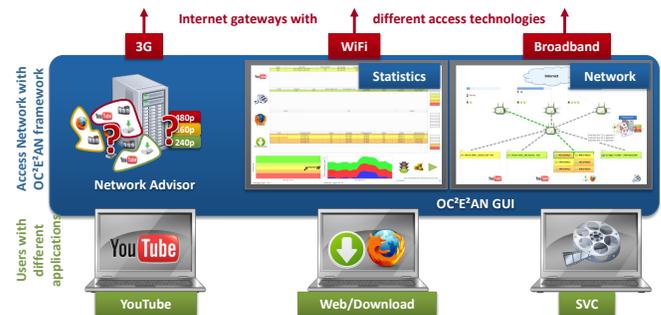


Fig. 2. Setup and components of OC²E²AN

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