Self-adaptation supporting multimedia interaction in large-scale real-time systems

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The Verdione project aims to provide a framework for development of distributed interactive multimedia systems. The objective is to allow people who are distributed around the globe to interact with each other as though they were co-located. Our research is specifically concerned about self-adaptation aspects of the project. Self-adaptation is the ability of a software system to automatically evaluate its internal state and external operation environment and modify its own behavior accordingly [1]. The adaptation behavior is specified as high-level objectives, stating what actions should be taken at run-time to automatically optimize the system, recover from failures, protect from threats, etc.

Although self-adaptation is a well-known idea, there is no known mechanisms that can perform adaptations efficiently considering the characteristics of the applications targeted by Verdione. One example is the World Opera application, which will enable the realization of distributed operas in which singers and musicians from opera houses world-wide participate. In this application, we have to face the challenge of many-to-many dissemination of multimedia data to a highly heterogeneous and dynamic large-scale set of content consumers. Considering this challenge, the objective of our research is to develop novel mechanisms for self-adaptation, that are flexible, dependable and scalable. Our solution is based on two new features that can be integrated to the self-adaptation mechanism:

1. Feedback Control Loop (FCL) design model – A self-adaptive software system can be described as a closed-loop mechanism, where an adaptation engine receives feedback from the software system and from its environment, and adjusts the system accordingly. The control aspects of self-adaptive systems are of key importance during the design phase, and thus FCL governing the adaptation should be treated as a first class entity [2]. This design can improve the flexibility, because the implementation of each control function is not fixed and can be selected at design or run-time. The scalability is also improved, because each function can be independently deployed in different locations in a large-scale systems.

2. Quality of the adaptation – The self-adaptation mechanism is also a software system that can have a set of qualitative requirements, such as constraints for resource consumption and execution time. The self-adaptation mechanism should, itself, be adapted according to variations in its quality levels. This feature can improve the dependability of the self-adaptation solution.

The first step of our research is focused on the first feature. We are investigating the means of designing the self-adaptive mechanism as a FCL entity composed of control functions that can be independently implemented and deployed, and that can also expose qualitative information about its internal operation.

References: