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

L. Provensi, F. Eliassen, and R. Vitenberg
Department of Informatics, University of Oslo

Verdione Project

Develop a platform that allows people who are distributed around the globe to interact with each other as though they were co-located

Self-adaptation

Ability of a software system to automatically evaluate its internal state and external environment and modify its own behavior accordingly

World Opera

• Opera houses spread all over the globe interact to perform distributed operas
• Each house controls a set of subsystems and services offered to the audience
• Sharing of real time media content in a highly heterogeneous environment

Some examples of self-adaptive behavior for World Opera

Dynamic adjustment of media quality according to network condition / device resources
Management of media streams and exchange of media flows for other kinds of lightweight virtual representation
Automatic discovery and configuration of services for audience using mobile devices

Problems with current frameworks for self-adaptation

• Do not consider the adaptation requirements of all stakeholders;
• Scalability of a centralized manager in a dynamic and ultra-large adaptation domain;
• Integration of technologies in a heterogeneous environment;
• Do not allow reasoning about the adaptation process.

Requirements

Novel mechanisms for self-adaptation that are:
• Flexible – can be customized according to the needs, of different stakeholders and executing environment;
• Dynamically tunable – Performance and resource consumption can be controlled at runtime;
• Scalable – Decentralized management of adaptation services.

Solution Outline

Based on two new features that can be integrated into the self-adaptation mechanism:

1. Feedback Control Loop (FCL) design model
   The mechanism is designed as a set of interacting control functions (monitoring, analyzing, planning, effecting) that can be independently implemented and deployed.

2. Quality of Adaptation
   Qualitative properties of the control functions are exposed at runtime (response time, memory usage, etc.) and used to dynamically evaluate the efficiency of the adaptation mechanism.