Quality of Service Mapping as an Optimization Problem

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Description of project

Objectives

The focus of this project is the study of Quality of Service (QoS) mapping as an optimization problem. Through the study of specific applications, we aim at proposing QoS mapping strategies based on the use of mathematical programming techniques.

Our specific objectives are:

• to propose QoS mapping techniques based on mathematical programming techniques and

• to develop QoS specification and mapping software tools.

Background and rationale

The concept of QoS was first introduced in computer communications in order to characterize the performance of data transmission. QoS research activities are mainly conducted in the field of telecommunication networks and multimedia systems. They have led to proposals for QoS management strategies whose purpose is to decide whether and how multimedia streams can be delivered to the user within the given delay, cost or quality constraints. In the case of distributed multimedia systems, QoS cannot be evaluated at the communication level only. QoS can be appreciated by the users, who should have the opportunity to describe their requirements. In multimedia systems, QoS management can thus be viewed

and may be followed by an adaptation phase, since new situations may lead to renegotiation. Finally, it is necessary to examine the actual QoS level and compare it with the initial requirements. Thus any distributed multimedia system must include a QoS monitoring function.

In this project we focus on QoS mapping, that is, the translation of the user's requirements into QoS constraints that have to be supported by the distributed system components. We want to address QoS mapping as an optimization problem and we will study how mathematical programming techniques can be used to develop generic and flexible QoS mapping strategies.

Research plan

We start with the hypothesis that QoS specification can be modeled by constraints similar to those found in mathematical programming models. We wish to investigate whether and how mathematical programming techniques can be applied to QoS mapping.

Our specific objectives are:

• to investigate mathematical modeling of user QoS specification,

• to propose QoS mapping techniques based on mathematical programming techniques, and

• to develop QoS mapping software tools based on this approach.

The problem we propose to address, therefore, is that of designing systems that take into account the specific requirements of individual users while processing their requests in an efficient manner. In distributed multimedia systems, a user QoS specification is translated into values for QoS parameters supported by the different layers. When carrying out the mapping, we are concerned with parameters of performance, as seen from the perspective of the network, the client or the server. The mapping consists of translating the user's requirements into constraints that the different components of the system will have to satisfy.

A user QoS specification encompasses the domain definitions for dimensions as well as the ordering relations between domains, dimensions and categories. Ordering relations between categories and/or dimensions allow users to define trade-offs between their preferences (e.g., response time versus security). These trade-offs need to be considered when processing user operations. This leads us to view mapping as an optimization problem, i.e., the problem of finding the best way to carry out the operations requested by the user while satisfying his QoS requirements.

Mapping techniques must take into account not only the operations to execute but

We shall propose mapping strategies based on this approach and develop the corresponding QoS mapping software tools.

Milestones

Year 1: survey on mathematical programming techniques applicable to QoS mapping;

preliminary mathematical modeling for QoS specification and mapping

Year 2: prototype development for a QoS specification tool;

development of QoS mapping tool based on mathematical programming techniques;