QoS Routing with Efficient Traffic Reshaping and Deadline Allocation in EDF Networks

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Abstract

We consider QoS routing schemes for connections with end-to-end delay requirements in networks that employ the earliest deadline first (EDF) scheduling discipline. More precisely, we consider the class of rate-controlled EDF, for which traffic is reshaped at each node along the path. Previous EDF routing proposals did not consider the possibility of reshaping the traffic with *different parameters at each hop*. Moreover, the two problems of path selection and assignment of deadlines along the chosen path were considered *independently*. On the other hand, it is well known that, by allowing to reshape traffic with different parameters at each hop, better end-to-end bounds can be obtained. Accordingly, in this study we consider the *joint* problem of identifying a feasible path and optimizing the reshaping parameters along the path. This way, we broaden the space of feasible solutions.

Next, we turn to consider the problem of optimizing the route choice in terms of balancing the loads and accommodating multiple connections. Our first scheme identifies a feasible path (if one exists) with the maximum bottleneck residual rate. Then, in order to achieve better utilization of network resources, the second scheme considers the *joint* problem of route selection and assignment of deadlines along the chosen path. By way of simulations, we demonstrate the advantages of our schemes.

I. Introduction

Emerging broadband high speed networks are expected to support real time and multimedia applications, with various Quality of Service (QoS) requirements. Accordingly, a key issue in the design of broadband architectures is how to provide the resources in order to meet the requirement of each connection, and, moreover, how to meet that goal in a networkwide efficient manner. The establishment of efficient QoS routing schemes is, undoubtedly, one of the major building blocks in such architectures.

One of the major problems in the establishment of a connection with QoS guarantees arises from the need to assign some end-to-end requirements, mainly delay, into local requirements, which would indicate how to reserve resources along the route. Obviously, the identification of a feasible, furthermore “optimal” route for such a connection, greatly depends on our ability to perform such an assignment.

The ability to provide end-to-end delay guarantees depends on the scheduling discipline employed in the network. Such disciplines are characterized by bounds on the maximal delay that any link can incur, and hence a corresponding bound on the end-to-end delay can be derived. Such a bound provides a valuable tool for quantifying the quality of a path in terms of its ability to meet the QoS delay requirement. The corresponding routing problem is, therefore, to identify the path that has the best performance, according to that bound and with respect to the QoS requirement.