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Precomputation Schemes for QoS Routing

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Abstract

Precomputation-based methods have recently been proposed as an instrument to facilitate scalability, improve response time and reduce computation load on network elements. The key idea is to effectively reduce the time needed to handle an event by performing a certain amount of computations in *advance*, *i.e.*, prior to the event's arrival. Such computations are performed as background processes, thus enabling to promptly provide a solution upon a request, through a simple, fast procedure.

In this report, we investigate precomputation methods in the context of QoS routing. Precomputation is highly desirable for QoS routing schemes due to the high computation complexity of selecting QoS paths on the one hand, and the need to promptly provide a satisfactory path upon a request on the other hand. We consider two major settings of QoS routing. The first is the case where the QoS constraint is of the "bottleneck" type, *e.g.*, a bandwidth requirement, and network optimization is sought through hop minimization. The second is the more general setting of "additive" QoS constraints (*e.g.*, delay) and general link costs.

The report mainly focuses on the first setting. First, we show that, by exploiting the typical hierarchical structure of large-scale networks, one can achieve a substantial improvement in terms of computational complexity. Next, we consider networks with topology aggregation. We indicate that precomputation is a necessary element for any QoS routing scheme and establish a precomputation scheme appropriate for such settings. Finally, we consider the case of "additive" QoS constraints (*e.g.*, delay) and general link costs. As the routing problem becomes $\mathcal{NP}$-hard, we focus on ε-optimal approximations, and derive a precomputation scheme that offers a major improvement over the standard approach.

Keywords– QoS, Routing, Precomputaiton, Hierarchical networks, Topology aggregation.