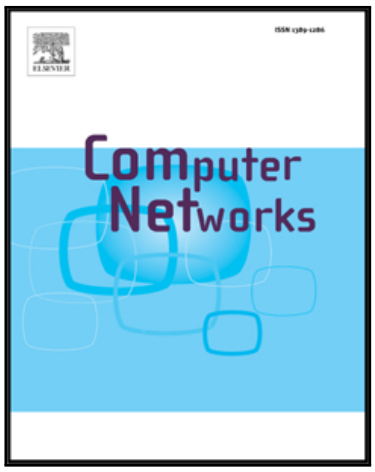

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On Time dependent Routing Algorithms for Open Marketplaces of Path Services with support for In-Advance Path Reservation

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Abstract

Open marketplaces of path services are the next step towards realizing "routing-as-a-service." Such marketplaces will enable users to select from a set of path services offered by multiple competing network providers so as to construct customized end-to-end paths for their applications. This is analogous to online travel marketplaces that allow users to explore travel options and book their travel. We review the requirements for path planners to assist users in stitching together available path services which are time sensitive. We define the problem of finding multi-criteria time-constrained paths in this context, and present algorithms to construct these paths and also provide support for in-advance path reservation.

1. Introduction

Routing algorithms are at the core of network design and operation, and their functionality has evolved over the last sixty years from finding single shortest paths [1] to encompassing a wide range of considerations, including multiple paths [2], quality-of-service (QoS) constraints [3], and various modes of communication beyond point-to-point [4]. Nevertheless, for the most part, these routing algorithms have been designed for use by network providers/operators who have complete control over all aspects of the network. Users of the network typically have no visibility into the network topology or access to the routing function, and their traffic usually follows paths assigned by the network provider – although, using service level agreements (SLAs) they may request paths that satisfy certain properties.

Due to the evolving nature of network applications, requirements of routing functionality are also likely to evolve over time. However, at a time when network customers demand more flexibility in path selection, changes in routing-level components in the Internet require broad consensus among a diverse set of stakeholders and, hence, are increasingly difficult to implement. Accordingly, there has been some work in providing users with options over the routing path [5, 6, 7] in a manner that separates the data plane (the paths that packets follow) from the control plane (routing decisions) and allows the two to evolve separately.

A natural next step in realizing "routing-as-a-service" (RaaS) is the creation of open marketplaces of path services that will enable customers to select from a set of path services offered by multiple competing network providers, and *stitch* them together to construct customized end-to-end paths for their applications. This is analogous to online travel marketplaces, including Travelocity, Orbitz, and Expedia, among others, that allow users to explore travel options, make plans, and book their travel.

At a high level, an open marketplace of path services will consist of the following components [8, 9, 10]:

1. *Service advertisements:* the marketplace provides mechanisms for service providers to advertize their services and modify existing advertisements.
2. *Service repository:* we assume that the repository of path services is updated in real time, and that users and third parties may query the repository to retrieve path services that meet certain criteria.
3. *Path planner:* the planner takes as input user preferences and applies them to select and combine ex-

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