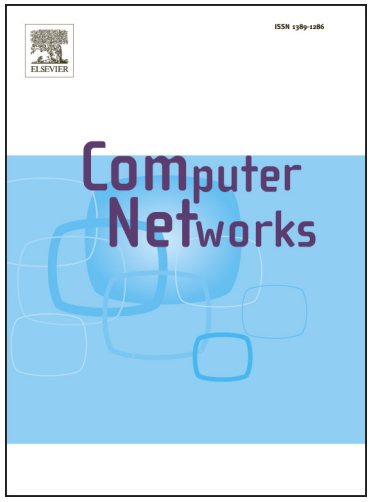

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PII: S1389-1286(14)00196-0
DOI: http://dx.doi.org/10.1016/j.comnet.2014.05.006
Reference: COMPNW 5307

To appear in: *Computer Networks*

Received Date: 31 December 2013
Revised Date: 9 May 2014
Accepted Date: 11 May 2014

Please cite this article as: A.G. Tasiopoulos, C. Tsiaras, S. Toumpis, Optimal and Achievable Cost/Delay Tradeoffs in Delay-Tolerant Networks, *Computer Networks* (2014), doi: http://dx.doi.org/10.1016/j.comnet.2014.05.006

Optimal and Achievable Cost/Delay Tradeoffs in Delay-Tolerant Networks[☆]

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Abstract

Tradeoffs between the packet delivery delay and various types of packet transportation cost are a recurring theme in Delay-Tolerant Networks (DTNs). In this work we study such tradeoffs, first in a general and then in a mobile wireless setting.

In the general setting, we capture the tradeoff between the delivery delay of a packet and its transportation cost (which comprises a transmission component and a storage component) on the cost-delay plane using the Optimal Cost/Delay Curve (OC/DC), for the case when the packet follows optimal routes, and the Achievable Cost/Delay Curve (AC/DC), for the case when a specific (suboptimal) routing protocol is used.

Applying the framework of the general setting to mobile wireless DTNs, we evaluate a novel set of geographic routing protocols with delay-tolerant features against both state-of-the-art routing protocols (using their respective average AC/DCs) and also optimal routing (described in terms of the average OC/DC). Compared to the state-of-the-art protocols, our protocols are shown to achieve cost/delay tradeoffs much closer to the optimal one.

Keywords: Cost/Delay Tradeoff, Delay-Tolerant Networks (DTNs), Dynamic Flows, Evolving Graphs, Geographic Routing, Wireless Networks.

1. Introduction

In Delay-Tolerant Networks (DTNs) packet delivery delays can be large, and often comparable to the time needed for the network topology to change substantially. Although in many DTNs packet delivery delays are not tunable, quite frequently designers conscientiously decide to tolerate larger than absolutely needed delays in order to improve other performance metrics. For example, delay has been traded off with monetary costs [2], energy efficiency [3, 4, 5], and throughput [6, 7, 8].

Motivated by these specific instances of tradeoffs, in the first part of this work (Sections 2, 3, and 4), we develop a *general* DTN framework for studying tradeoffs between the delay in the delivery of a packet and the associated transportation cost. The transportation cost comprises a

[☆] The work was submitted while the first author was with AUEB. A preliminary version of this work appeared in WoWMoM 2012 [1].

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