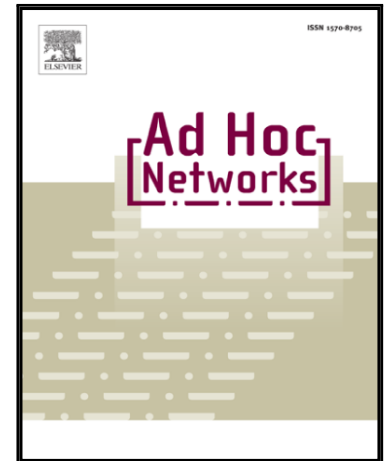


Accepted Manuscript

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PII: S1570-8705(17)30078-1
DOI: [10.1016/j.adhoc.2017.04.006](https://doi.org/10.1016/j.adhoc.2017.04.006)
Reference: ADHOC 1540



To appear in: *Ad Hoc Networks*

Received date: 8 October 2016
Revised date: 4 March 2017
Accepted date: 18 April 2017

Please cite this article as: Muhammad Omer Farooq, Cormac J. Sreenan, Kenneth N. Brown, Capacity and Contention-based Joint Routing and Gateway Selection for Machine-Type Communications, *Ad Hoc Networks* (2017), doi: [10.1016/j.adhoc.2017.04.006](https://doi.org/10.1016/j.adhoc.2017.04.006)

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Capacity and Contention-based Joint Routing and Gateway Selection for Machine-Type Communications

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Abstract

Typically, in machine-type communications (MTC) devices communicate with servers over the Internet. In a large-scale machine-to-machine area (M2M) network, the devices may not connect directly to the Internet due to radio transmission and energy limitations. Therefore, the devices collaborate wirelessly to relay their data to a gateway. A large-scale M2M area network may have multiple gateways, selecting a proper gateway for the devices can have immense impact on the network's performance. We present the channel capacity and contention-based joint routing and gateway selection methods for MTC. Based on channel capacity and contention, our methods select the best gateway on per-packet, per-flow, and per-node basis. We compare the methods' performance with existing methods using simulation and test-bed experiments. We analyse the impact of the number of gateways, physical distribution of transmitters, control overhead, and duty-cycling on the performance of the gateway selection methods. Our results demonstrate that, in duty-cycled operations, the methods' performance depends on control overhead and making a good trade-off between load imbalance to different gateways and a forwarding path's length. Otherwise only the latter impacts the methods' performance. In general, our node-based best gateway selection method makes a better trade-off and exhibits lower control overhead, hence it demonstrates better performance. Moreover, our methods demonstrate better performance as compared to an existing state-of-the-art joint routing and gateway selection method.

Keywords. Machine-Type Communications, Routing, Gateway Selection, Channel Capacity, Contention

1 Introduction

Machine-type communication (MTC) is a form of data communication that allows smart networked devices to communicate with each other without human intervention [1]. It is an essential component for many smart city applications including smart roads and intelligent transportation, smart homes, smart parking, and waste management [2]. It is anticipated that MTC will have significant economic impact, and the total market size by 2025 is estimated to be 30 billion connected devices, with 7 billion MTC devices connected to the Internet through cellular networks [3].

Figure 1 shows a general communication architecture of MTC. We elaborate the architecture with the help of a smart roads and intelligent transportation system. In the system, many smart devices monitor traffic on a network of roads, and may report accidents, traffic rule violations,

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