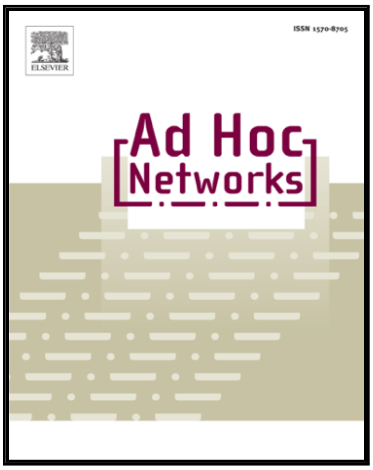
Accepted Manuscript



Maximization of multicast periodic traffic throughput in multi-hop wireless networks with broadcast transmissions

Michał Pióro, Artur Tomaszewski, Antonio Capone

PII: S1570-8705(18)30152-5
DOI: 10.1016/j.adhoc.2018.04.011
Reference: ADHOC 1666

To appear in: *Ad Hoc Networks*

Received date: 5 March 2017
Revised date: 26 February 2018
Accepted date: 23 April 2018

Maximization of multicast periodic traffic throughput in multi-hop wireless networks with broadcast transmissions

Michał Pióro[a,b,*], Artur Tomaszewski[a], Antonio Capone[c]

[a] *Institute of Telecommunications, Warsaw University of Technology, Warsaw, Poland*
[b] *Department of Electrical and Information Technology, Lund University, Lund, Sweden*
[c] *Information and Communication Technology Department, Technical University of Milan, Italy*

Abstract

Although a number of different medium access control (MAC) schemes are adopted for wireless multi-hop networks, time division multiple access (TDMA) approaches based on a periodic frame of time slots are the most common when very high efficiency is needed in terms of use of radio and energy resources. Efficient resource usage is typically based on parallel compatible transmissions from multiple nodes that guarantee interference control at the receivers. Optimization of transmission scheduling in multi-hop packet delivery from sources to destinations for a set of traffic relations can be achieved by minimizing the frame length where all necessary transmissions are organized in compatible sets and assigned to the time slots of the frame. When properly designed, the resulting TDMA scheme guarantees the delivery of packets for each traffic relation at a rate of up to one packet per frame duration regardless of the number of the packet transmissions (hops) necessary from source to destination, and thus it is particularly suitable for periodic traffic.

While similar traffic maximization problems have been studied quite extensively for the case of unicast traffic, its multicast generalization (where each packet should be delivered from the source node to possibly multiple destination nodes) has not been elaborated so far. In this paper we present such a (non-trivial) generalization, namely a mathematical programming model based on the extension of the compatible set concept where the signal-to-noise and interference (SINR) ratio is guaranteed above a threshold at multiple receivers. We first propose an algorithm for solving the problem that generates compatible sets and schedules the frame by splitting the (predefined) multicast routing trees into one-hop transmissions. The high computational efficiency of the algorithm is proven through numerical results on large networks. Next, we enrich the model by adding multicast tree optimization, illustrating its efficiency numerically as well. Finally, we present possible extensions that consider packets of different lengths (requiring multiple slots for transmission), multiple modulation and coding schemes (MCS) requiring different SINR thresholds at the receivers, and packet delay minimization.

Keywords: Wireless multi-hop networks; TDMA; Physical interference model; Compatible sets; Multicast traffic optimization; Integer programming

*Corresponding author

Email addresses: m.pioro@tele.pw.edu.pl (Michał Pióro), a.tomaszewski@tele.pw.edu.pl (Artur Tomaszewski), antonio.capone@polimi.it (Antonio Capone)