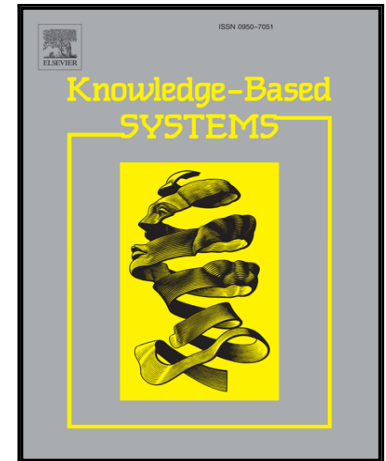


Accepted Manuscript

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PII: S0950-7051(17)30006-0
DOI: [10.1016/j.knosys.2017.01.005](https://doi.org/10.1016/j.knosys.2017.01.005)
Reference: KNOSYS 3782



To appear in: *Knowledge-Based Systems*

Received date: 8 November 2015
Revised date: 31 December 2016
Accepted date: 1 January 2017

Please cite this article as: Ahmed. I. Saleh , An Adaptive Cooperative Caching Strategy (ACCS) for Mobile Ad hoc Networks , *Knowledge-Based Systems* (2017), doi: [10.1016/j.knosys.2017.01.005](https://doi.org/10.1016/j.knosys.2017.01.005)

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An Adaptive Cooperative Caching Strategy (ACCS) for Mobile Ad hoc Networks

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Abstract:

Data caching can remarkably improve the data availability in mobile ad hoc networks (MANETs) by reducing the access latency and bandwidth usage. Unfortunately, due to mobility and resource constraints, caching techniques designed for wired network are not applicable to MANETs. Moreover, frequent data updates, limited Mobile Terminal's (MT's) resources, insufficient wireless bandwidth and MT's mobility make cache management a tedious task. However, as MTs in MANETs may have similar tasks and share common interests, cooperative caching, which allows the sharing and coordination of cached data among multiple MTs, can be used to reduce the bandwidth and power consumption. Hence, a nearby MT can serve requests instead of the distant data source. The originality of this paper is concentrated on introducing an adaptive cooperative caching strategy (ACCS) with a novel cache replacement and prefetching policies. ACCS divides the network into non-overlapping clusters. Unlike other caching techniques that employ reactive routing protocols, ACCS employs a novel built-in table driven routing strategy with no additional penalties. Such behavior significantly minimizing the query delay. The secret lies in collecting the routing information during the clusters formulation, then fill the routing tables accordingly. ACCS has been compared against recent cooperative caching strategies. Experimental results have shown that ACCS outperforms other strategies as it introduced the maximum cache hit as well as the minimum query latency.

Keywords: Ad hoc Networks, Caching, Routing.

1. Introduction

Recently, with the proliferation of portable computing devices as well as the massive development in wireless communication technologies, mobile ad hoc networks (MANETs) have gained a worldwide attention [1]. MANET is a multi-hop wireless network consisting of a collection of small wireless computing nodes such as: conventional computers (e.g., PC, PDA, or laptop), or embedded processors devices such as: tiny, low-cost, and low-power sensor [2]. They dynamically forming a temporary network for instant communication with no centralized administration or any prior infrastructure [3]. Accordingly, MANETs can be easy deployed and expanded allowing the establishment of temporary communications without any pre-installed infrastructure. They are mainly constructed for information sharing as well as task coordination among a group of people. However, due to the lack of infrastructure support, each node in MANET acts as a terminal and a router, so it has the ability to forward data packets for other nodes. MANETs have potential applications in civilian and military environments. For illustration, they are suitable for mobile conferencing, disaster and emergency relief, battlefield maneuvers, wireless offices, and mobile info-stations (in restaurants, tourist centers, and so on), making them an attractive research area [4].

Although the fundamental challenge in MANETs is centralized on enhancing the process of discovering routes among the network mobile terminals (MTs), caching also has become an attractive area of research [5]. This happened as the ultimate goal of MANETs is to provide a reliable data communication among MTs. Recent research in MANETs has recorded several challenging issues in data accessing due to frequent disconnections, limited bandwidth, high mobility of MTs, and the poor power resources (e.g., battery life and storage capacity of MTs) [6].

In MANETs, due to frequent network partition, data availability is lower than that of traditional wired networks. To solve such problem, two approaches can be used, which are; data replication and data caching [7]. Data replication is the maintenance of multiple copies of data at multiple locations. Data caching, on the other hand, is an efficient solution for data availability and query delay problems. It has been widely used in several fields such as: multi-processor, CPU design, memory architecture, and router design. Furthermore, Internet uses cache placement and replacement in proxy servers to significantly reduce the network latency of data queries [8].

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