Chapter 17
Enhancing Data Availability in MANETs with Cooperative Caching

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ABSTRACT
Mobile Adhoc Networks (MANETs) are very popular solutions where network infrastructure installation is not possible. In MANETs, nodes are mobile, and due to this mobility, topology of the network changes rapidly. This dynamic topology reduces the data availability in MANETs. Cooperative caching provides an attractive solution for this problem. In this paper, a new cooperative caching algorithm, ProCoCa, is proposed. This algorithm is based on a proactive approach. Each node will be associated with a zone and the data of leaving node will be cached. The authors simulate the algorithm on OMNET++ simulator, and simulation results show that ProCoCa improves the data availability as well as overall performance of the network.

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INTRODUCTION

In recent years there has been a rapid growth in mobile communication. Mobile Adhoc Networks (MANETs) are very popular solution in the situation where network infrastructure is not available. MANETs can be extended by connecting with some other wired or wireless networks like Internet (Sun et al., 2002). In adhoc networks, mobile nodes communicate with each other using multihop wireless links. As there is no infrastructure support, mobile nodes cooperate with each other to forward data. Each node acts as a router, forwarding data packets for other nodes and mobile nodes have peer to peer connection among themselves. Most previous research in ad hoc networks focused on the development of dynamic routing protocols that can efficiently find routes between two communicating nodes. Although routing is an important issue, but the ultimate goal of ad hoc networks is to provide mobile nodes with access to information. However, MANETs are limited by intermittent network connections, restricted power supplies, and limited computing resources. These restrictions raise several new challenges for data access applications with the respects of data availability and access efficiency. In adhoc networks, due to frequent network partition, data availability is lower than that in traditional wired networks. Cooperative caching provides an attractive solution for this problem. Cooperative caching is a technique that allows the sharing and coordination among the mobile nodes.

However, the movement of nodes, limited storage space and frequent disconnections limit the availability. By the caching of frequently accessed data in adhoc networks we can improve the data access, performance and availability. Due to mobility and resource constraints of adhoc networks, caching techniques designed for wired network may not be applicable to ad hoc networks.

In many applications, mobile nodes in a MANET share common interests. In this scenario, sharing cache contents between mobile nodes offers significant benefits. Typically, nodes cache data items for serving their own needs. Cache sharing, however, allows geographically neighboring mobile nodes to access each other’s cache contents. By doing so, the number of long-distance data accesses to the data center can be reduced. The key to this technique is that a node has to know if there is some node in its vicinity that has cached the data it requires and where it is, if any. One approach to deal with this requirement is to let a mobile node record the caching information about a nearby node while forwarding the data requested by the node. Since MANETs are mobile and constrained by limited energy, bandwidth, and computation power, which is a big concern when designing protocols for such networks.

Consider a scenario in which mobile devices always retrieve data from the data center. This may result in a large amount of traffic in the network. This, apparently, is undesirable as traffic directed to the data center consumes wireless bandwidth as well as power of mobile devices. In addition, a mobile host suffers from high access latency if it is distant from the data center, and packet loss probability for long-distance data access is high. Furthermore, traffic near the data center will be heavy, and this leads to a potential performance bottleneck. These problems are more pronounced when the network size is large, which results in poor scalability of the system. The above observations motivate us to investigate a new data caching technique for MANETs. With data cached in mobile nodes, a data request may be satisfied by a nearby mobile node, instead of being serviced by the data center. By cooperative caching the data we can:

1. Improve the data availability.
2. Improve the data access time.
3. Reduce the traffic near the data center.
4. Reduce the consumption of bandwidth.