

# Aperiodic Cache Exchange for New Network Nodes in Wireless Mobile Ad Hoc Networks

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## Abstract

On demand routing protocols for mobile ad hoc networks exploit route-caching strategies so as to lessen control traffic over a network. For route caches to be effectual they must dynamically adapt to continuing topology changes. A node once having established a cache is able to successfully transmit data traffic, as route information is readily available. However, a new node joining an existing network does not possess such a cache and must build one through the use of route discovery techniques. Such a process leads to bursts of control traffic, from a new node, flooding the network thereby preventing this new node and existing nodes from transmitting data traffic. This paper proposes a scheme that allows a new node joining a network to receive from a neighbour a copy of its cache. This aperiodic cache borrowing will be used to enhance data throughput, as the node possibly, does not have to invoke route discovery techniques for each data packet that it needs to transmit, until an adequate cache has been developed.

## 1. Introduction

An ad-hoc network is a mobile multihop wireless network with no fixed infrastructure. Dynamic topologies due to mobility, limited bandwidth and battery power make routing over ad hoc networks an exigent problem. For a routing protocol to be efficient it must strive to keep the routing overhead to a minimum. On demand routing protocols, such as Dynamic Source Routing (DSR) [1,2] and Ad Hoc On Demand Distance Vector (AODV) [1] attempt to reduce routing overhead by maintaining currently active routes in node caches. However, when a new route is necessary the network must be queried for a path to that destination. This route discovery process is initiated by flooding the network with route discovery packets. This procedure can possibly result in a large volume of control traffic if the source and destination nodes are distant, which also adds to packet latency for data delivery.

Current on-demand routing protocols restrict themselves to manipulating existing route caches through the use of cache types, capacity, timeout policies and periodic cache exchange. The approach presented here concentrates on new nodes joining a network and their effect on data throughput. This scheme will be applied to DSR for the purposes of demonstrating the effectiveness of this method.

## 2. Aperiodic Cache Exchange

Current approaches for caching management strategies [3,4,5] involve optimising techniques for cache types, capacity, and replacement policy. However, these methods are applied to existing caches. Standard DSR, for example, builds its route cache from route replies resulting from self-initiated route discoveries. Also, routing information is extracted from packets that are overheard or forwarded by a node. However, when a node joins a network its route cache is non-existent, consequently, initial transmissions by this node consist solely of control traffic in the form of route discoveries. But before a node can begin transmission it must wait and process ensuing route replies.

This paper focuses on a technique that enables a node entering a network to gain from its neighbour(s) a copy of their route cache. A node's start-up route discovery process, necessary for data transmission, can possibly introduce large volumes of control traffic depending on network topology. The technique proposed in this paper aims to reduce this initial route discovery burst by having a new node advertise its presence through a broadcast, nodes receiving this packet can reply with a copy of their cache. The purpose of this cache borrowing is to possibly allow a node to begin transmitting data packets almost instantly rather than first building a cache through route discovery control traffic and then commencing data transfer. This method will enhance data throughput as nodes joining a network receive an initial start up cache.

A node that supplies its cache as a start up cache will now be used as the next hop for all initial transmissions by this new node. Consequently, a node imparting its cache must decide if this is prudent to do so. This decision must be made with respect to such factors such as the nodes existing load and remaining battery life. Also, does a node relay its complete cache or a partial cache? The new node can possibly receive multiple copies of a cache, so it must decide to accept only the first cache it receives, or all caches. If a node accepts multiple caches, how can it best merge these into a single cache?

This concept of cache exchange has already been employed in other routing protocols, such as Destination Sequenced Distance Vector (DSDV) [1]. DSDV functionality relies on the periodic exchange of routing information, which involves each node periodically broadcasting to its local neighbourhood a copy of its route cache. This periodic route trade in an ad hoc network has a number of disadvantages - in particular it contributes to control traffic and may often be unnecessary as existing route records may still be valid. In addition, periodic exchanges drain battery power as they flood the network, and nodes forward route information unnecessarily. The principle presented here is to provide route information to a new network node in an aperiodic and controlled manner so as to reduce control traffic bursts associated with new nodes having non-existent caches.

Consider a scenario where such a scheme would be beneficial - an ad hoc network that has a server node that advertises the services currently available in the network and provides paths to the nodes offering the services. This server node would have a comprehensive cache of paths as it not only builds a cache using normal DSR procedure, but also nodes advertise services via this node so the server node is aware of their presence even if it is not directly communicating with them or within communications range to overhear their transmissions. A new node joining this network would advertise its presence through the use of a beaconing HELLO message. This new node would initiate a cache borrowing from the server node when it receives an acknowledgement of its HELLO message from the server node. The cache received should enable the node to begin transmitting data packets or service requests

immediately without the need for discovering routes or available services.

The final paper will demonstrate the effectiveness of aperiodic cache borrowing by analysing (i) the control traffic overhead associated with new nodes, (ii) the time needed for new nodes to build a functional cache (iii) the packet delivery delay associated with (i) and (ii) for new nodes. The performance analysis will compare the proposed technique with the standard method of letting the new node discover routes from scratch.

#### References

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