Chapter XII
On the Logarithmic Backoff Algorithm for MAC Protocol in MANETs

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ABSTRACT

In wireless communication environments, backoff is traditionally based on the IEEE binary exponential backoff (BEB). Using BEB results in a high delay in message transmission, collisions and ultimately wasting the limited available bandwidth. As each node has to obtain medium access before transmitting a message, in dense networks, the collision probability in the MAC layer becomes very high when a poor backoff algorithm is used. The Logarithmic algorithm proposes some improvements to the backoff algorithms that aim to efficiently use the channel and to reduce collisions. The algorithm under study is based on changing the incremental behavior of the backoff value. The Binary Exponential Backoff (BEB) is used by the Local Area Networks standards, IEEE 802.11, Medium Access Control (MAC). BEB uses a uniform random distribution to choose the backoff value; this often leads to reducing the effect of window size increment. This paper carries out a deeper study and analysis of the logarithmic backoff algorithm that uses logarithmic increment instead of exponential extension of window size to eliminate the degrading effect of random number distribution. Results from simulation experiments reveal that the algorithm subject to study achieves higher throughput and less packet loss when in a mobile ad hoc environment.
INTRODUCTION

Since their emergence, wireless networks have become increasingly popular in the computing industry. This is particularly true within the past decade, which has seen wireless networks being adapted to enable mobility. There are currently two variations of mobile wireless networks (IEEE, ANSI/IEEE Standard 802.11, 1999), infrastructure, and ad hoc wireless networks.

Infrastructured networks, that is, those networks with fixed and wired gateways, have bridges known as base stations. A mobile unit within these networks connects to, and communicates with, the nearest base station within its communication radius. Typical applications of this type of network include wireless local area networks (WLAN) (IEEE, ANSI/IEEE Standard 802.11, 1999).

Mobile ad hoc networks (MANETs) are getting more and more attention. Unlike wired networks, MANETs are easily deployed, and need no infrastructure (Fang, Bensaou, & Wang, 2002). Such networks can be useful in disaster recovery, where there is not enough time or resources to configure a wired network. Ad hoc networks also are used in military operations, where the units are moving around the battlefield in a random way, and a central unit cannot be used for synchronization (Fang et al., 2002).

In MANETs, a central station is not needed to control the different types of operations taking place allover the network (Sundaresan & Sivakumar, 2004). A node participating in an ad hoc network must have the ability to act as a client, a server, and a router (Fang et al., 2002). Nodes also should have the ability to connect to the network and to automatically configure to start transmitting data over the network. This is the reason why ad hoc protocols, in general, function in a distributed manner (Manaseer & Ould-Khaoua, 2005). The distributed coordination function (DCF) is used for synchronous, contention-based, distributed access to the channel (Bononi et al., 2004). MANETs use a shared medium to transfer data between its nodes.

It is unrealistic to expect a MANET to be fully connected, where a node can communicate directly with every other node in the network. Typically nodes must use a multihop path for transmission, and a packet may traverse multiple nodes before being delivered to its destination.

The wireless medium used by MANETs has a number of problems, including bandwidth sharing, signal fading, noise, interference, and so forth. With such a shared medium, an efficient and effective MAC is essential for sharing the scarce bandwidth resource (Calì, Conti, & Gregori, 1998; Fang et al., 2002). Based on the features mentioned, the design of the MAC protocol is a significantly affects a MANET.

As a part of an efficient MAC protocol, a backoff algorithm is used to avoid collisions, when more than one node tries to access the channel (Manaseer & Ould-Khaoua, 2005). Only one of the nodes is granted access to the channel, while other contending nodes are suspended into a backoff state for some period (Goodman, Albert, Madras, & March, 1985). Many backoff algorithms have been developed in the literature (Sundaresan & Sivakumar 2004; Xu, Gerla, & Bae, 2002). One example is the multiplicative increase linear decrease (MILD) algorithm (Sakakibara, Sasaki, & Yamakita, 2005). This algorithm improves the total throughput of the network, but the cost of this improvement is the need of a perfect knowledge about collisions happening over the network, which is high cost, hard-to-acquire knowledge.

In a normal LAN, the total number of nodes of the network is easily obtained. However, as nodes in MANETs are mobile, knowing the number of nodes may incur a high cost, since this knowledge needs to be updated. One approach to update and keep the knowledge coherent is by exchanging “hello” packets between neighboring nodes (Manaseer & Ould-Khaoua, 2005). Broadcasting “hello” packets over the network generates extra
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