Prototyping Collision-Free MAC Protocols in Real Hardware

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***Abstract*—Collisions are a main cause of throughput degradation in WLANs. The current contention mechanism used in this type of network called Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA) uses a Binary Exponential Backoff (BEB) technique to delay each contender attempt of transmitting, effectively reducing the collision probability. Nevertheless, CSMA/CA relies on a random backoff that while effective and totally distributed, in principle is unable to eliminate collisions; degrading the network throughput as more contenders attempt to share the channel. Carrier Sense Multiple Access with Enhanced Collision Avoindance (CSMA/ECA) is able to create a collision-free schedule in a totally distributed manner by means of picking a deterministic backoff after successful transmissions. CSMA/ECA is able to support many contenders in a collision-free schedule, surpassing the achieved throughput of CSMA/CA and provides short-term throughput fairness among contenders.**

This work reviews CSMA/ECA, providing insightful simulation results revealing its advantages over CSMA/CA. It also shows the first real-hardware implementation tests results of CSMA/ECA under saturated and unsaturated conditions.

***Index Terms*—OpenFWWF, WMP, MAC, Collision-free, CSMA/ECA.**

I. Introduction

Wireless Local Area Networks (WLANs or IEEE 802.11 networks [1]) are a popular solution for wireless connectivity, whereas in public places, work environments or at home. This technology works over an unlicensed spectrum in the Industrial, Scientific and Medical (ISM) radio bands (at around 2.4 or 5 GHz), which is a main reason for its popularity.

The Medium Access Control (MAC) scheme used in WLANs is called Distributed Coordination Function (DCF) and is based on Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA) protocol. It has been widely adopted by manufacturers and consumers, making it very cheap to implement and an ubiquitous technology. Nevertheless, ever-growing throughput demands from upper layers have proven to be limited by WLANs' MAC, which by its nature is prone to collisions that degrade the overall performance as more nodes join the network.

The research community has pushed forward many alternatives to the current MAC in WLANs [2]–[12], but when a proposal deviates too much from CSMA/CA or time-critical operations are modified, its hardware implementation as part of WLANs MAC often becomes unlikely [13]; the standardization process taking many years without certainty of approval [14].

II. Related Work

III. Simulation Results

IV. Prototyping CSMA/ECA

V. CSMA/ECA in real hardware results

VI. Conclusions

VII. Acknowledgements

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