MACAW: A Media Access Protocol for Wireless LANs

Reviewer: Sayandeep Sen

March 28, 2008

1 Summary

This is one of the seminal works in the area of wireless MAC design. The primary goal of the work is to enhance (and fill out the missing details) in a previously reported wireless MAC (MACA) to make it suitable for deployment on their own testbed (pad-cell architecture). This apart they also investigate certain issues (hidden node, exposed node etc.) which are inherent to any wireless media access protocol.

The key concepts introduced by the authors can be summarized as follows:

Backoff Algorithm: They a) change the BEB (Binary Exponential Backoff) backoff algorithm of MACA to a MILD (Multiplicative Increase Linear Decrease). This is done to prevent the huge oscillations in the Backoff counter value based on the success or failure of only the current transmit. b) Make the entire contention domain share a common backoff counter value (by making the pads copy the backoff counter of the sucessful transmitter). The reason for doing this is to ensure that all the nodes get fair share of the transmit bandwidth. However the authors later point out that in case the contention domains are overlapping (a node can receive packets from two base stations), the backoff information from one domain could spread to other resulting in performance degradation(either packet loss due to excessive transmissions or unnecessary backing off). c) The authors also suggest adoption of per-destination backoff counters to ensure that media contention situation present in one part of the network remains local to that part.

Full proof media contention: The goal is to design a medium contention mechanism that does not suffer from a) collisions due to hidden terminals and b) performance degradation due to exposed terminals. The authors add the following sets of messages over the MACA sequence (RTS-CTS-DATA) to achieve this goal

i) ACK: On a successful data reception the receiver sends an ACK, in order to ensure a proper ACK delivery the nodes start their contention one slot after a data transfer is over.
ii) Data Sending (DS): This packet is sent by the sender before the actual data packet to report the specifics of the transfer (equivalent to 802.11 NAV) to all other contenders. This is done to prevent an exposed node from (unsuccessfully) contending for the duration of an ongoing data transfer. As the exposed node would not be able to decipher the CTS for its RTS in presence of the ongoing transfer and would increment its backoff counter needlessly. A point to note in this regard is, that MACAW cannot stop exposed terminal problem.
iii) Request-for-RTS: This packet is sent by a receiver to its sender, whose RTS it could not respond to in the previous slot (due to deferral).

While, there are several flaws in a) proposed solutions (for ex. how do they come up with the exact backoff parameters) b) evaluation methodology etc. the main contribution of the paper is a) pointing out the unique issues one has to face in designing a MAC for wireless (in contrast to wired networks). b) To form a basic framework for building media access protocols for wireless(by extending MACA) . The importance of the work is corroborated by the presence of most of the proposed ideas in the 802.11 standard.