IEEE P802.11
Wireless Access Method and Physical Layer Specifications

Title: The SPM (Simple Power Management) Proposal

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Abstract:

This document shows that the existing Power Management Mechanism is broken, and defines a new, much simpler mechanism, with minimal changes to the foundation protocol.

Introduction

This document proposes a new Power Management mechanism to be built over the existing 802.11 MAC foundation protocol. The reason for this proposal is that we believe that the current Power Management algorithm is broken, complicated and tries to solve problems beyond the scope of the 802.11 MAC.

What's broken in the current proposal?

The current proposal doesn't maintain the frame ordering for Multicast/Broadcast frames, the existing specification indicates that "All Broadcast/Multicast frames shall be buffered", and "Frames destined to stations in the CAM or TAM mode shall be directly transmitted" (IEEE P802.11-93/20b2, Paragraph 7.2.1.5. Access Point Operation). While this shouldn't be a problem for most upper layer protocols, it is against the 802.1 specifications and the author can think on possible Application Layer implementations that could fail under these conditions, following is an example:

A station X reports about an event by sending a broadcast message periodically (let's assume it is sent twice), a Station Y receives the first message (after some delay) and handles it, by giving a command, and station X acknowledges the command. On a correct LAN environment the command acknowledge by X will always be received after the broadcasts, so the event is handled only once.

With the existing Power Management proposal, the broadcast messages and the unicast messages order could be reversed, in that case Station Y may receive the event report (after the command was acknowledged), so it will think that this is a new event, and handle it again.

Please note that even when this could be solved on the Application level, the 802.11 group intention is to give the same capabilities than a wired LAN.

What's out of the Scope of 802.11?
Extreme Low Power Devices Power Management is out of the scope of this standard effort. This kind of devices may or may not be connected using wireless technology, and keeping an upper layer connection active while their receiver is powered down is application specific.

The correct solution for this kind of applications is application specific, and the AP cannot know the application requirements to handle it correctly.

For example, if I want to receive Email on my pager, instead of setting the AP parameters to store my data, I'll probably setup a "proxy" station that will store my email messages (and obviously not all the broadcasts), and I'll poll this station instead of the AP.

What could be done better?
If we recognize that Extreme Low Power Stations are out of the scope of the 802.11 effort, then we could define a Power Management algorithm that will not need to keep buffers for each Low Power Station. As a matter of fact the current proposal is a Power Management Application built over a non power efficient MAC protocol, the idea of this proposal is to change the protocol to be Power Consumption efficient.

The SPM (Simple Power Management) Proposal

The idea behind this proposal is to use the Network Allocation Vector (NAV) information to turn off the station receiver whenever other stations' transactions take place.
The idea is that every time the station "hears" and RTS/CTS or Data Transaction not addressed to its destination address to enter "sleep" mode, and wake up by the end of the transaction.
The problem with this approach is that, paradoxically the stations save power when there is traffic on the WLAN, but waste power when the WLAN is quiet.

On a fully loaded WLAN (using 400 byte long packets) the station would have the receiver on for 500 microsec (DIFS + Preamble + RTS + SIFS + Preamble + CTS), and turn the receiver of for 3510 microsec (SIFS + Preamble + Data + SIFS + Preamble + ACK), this means that the receiver will be on just 12.5% of the time.
For 1500 byte long packets the receiver would be powered on 4% of the time.

The only problem is that when there is not traffic, then the receiver is open 100% of the time.

Trivial solution 1
This could be easily solved if one station (in the infrastructure case, obviously the AP), would sacrifice itself and transmit dummy packets using a IFS longer than DIFS, that meaning that nobody else wants to transmit, and the AP itself has no real data to transmit.

This is easily implemented, but has the limitation that introduces a delay element for any station that suddenly wants to transmit.

The SPM Solution
The Power Consumption Manager (the AP) sends a Power Saving Start (PSS) message instead of a dummy message, this PSS frame (sent with an IFS longer than DIFS), has a "duration" field, which tells the Power Saving nodes that no traffic will be addressed to them during this period (similar to NAV), any node willing to transmit may transmit if the addressed station is not a Power Saving node, or if the To_AP bit is set.

This mechanism provides a power saving of about 85% of the receiver power consumption, with minimum overhead on the AP.

PSS Frame Format

Fixed Header	NID	Duration	CRC8