WLAN Power Save Mode in Linux

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Outline

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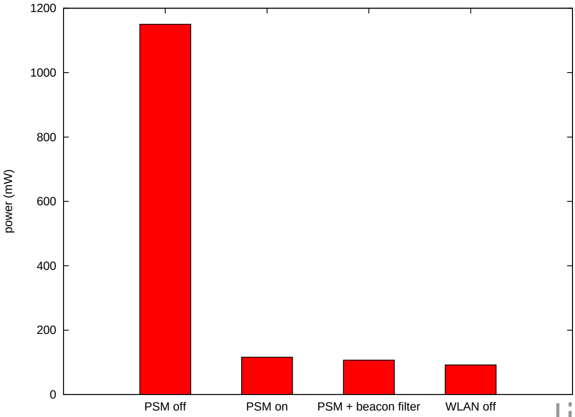
Introduction

Why?

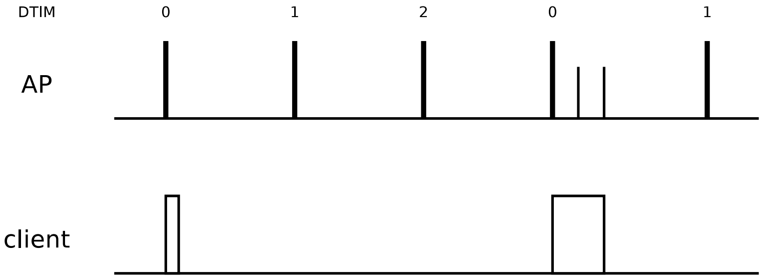
- Total system power consumption of Nokia N800 (stlc45xx, mac80211, 2.6.29-omap-wl):



Power Save Mode (PSM) simplified

- client informs Access Point (AP) of the PSM status with a flag in Frame Control header
- AP buffers all unicast, broadcast and multicast frames
- AP informs of buffered unicast frames with TIM bits in beacons
- AP sends broadcast and multicast frames immediately after the DTIM beacons with a special TIM bit set
- AP sends buffered unicast frames either when client wakes up or requests them with a PS-Poll frame

PSM example



Downsides

- few ms latency in transmission due to firmware wakeup (depends on hardware)
- hundreds of ms latency in receive, depends on:
  - beacon interval
  - DTIM period
  - how often client wakes up for beacons
- broken APs → strange packet loss
- broken firmware and/or HW, timing is very delicate

Status

Dynamic and Static PSM

- timeout $> 0 \rightarrow$ Dynamic PSM
  - stays awake a certain period after a last transmission
  - wakes up with Nullfunc
  - should not affect throughput
  - in certain cases increases latency considerably, but user won’t notice in practise
- timeout $= 0 \rightarrow$ Static PSM
  - goes immediately to sleep after transmitting a frame
  - fetches buffered frames with PS-Poll frame
  - decreases throughput
  - increases latency significantly

Status

- Wireless Extensions have power and power timeout:
  - iwconfig wlan0 power timeout 200m
  - the dynamic PSM timeout value
- no support in nl80211, yet
- network latency PM QoS interface
  - /dev/network_latency
  - how often hardware wakes up for beacons

Status

- supported HW types:
  - HW supports PSM (IEEE80211_HW_SUPPORTS_PS)
  - Stack must create Nullfunc and PS-Poll frames (IEEE80211_HW_PS_NULLFUNC_STACK)
  - HW has timers for dynamic PSM transitions (IEEE80211_HW_SUPPORTS_DYNAMIC_PS)
- drivers supporting PSM:
  - ath9k
  - rt2x00
  - iwlwifi (was disabled due to bugs, just re-enabled today)
  - stlc45xx (staging, patches pending)
  - wl1251 (patches pending)
- PSM enabled by default for the drivers which claim to support it, default timeout 500 ms

Status

- unknown, any comments?

Status

- in softmac beacons are normally forwarded to the host CPU
- wakes up CPU unnecessarily
- some HWs support a feature to only forward beacons which have chaned in relevant parts
- HW sends an event when beacons are lost

Future

Unscheduled Automatic Power Save Delivery (U-APSD)

- also known as WMM Power Save
- needs QoS support from the applications, otherwise legacy PSM is used

Future

- an interface for the applications to influence the timeout value
  - use PM QoS network_latency somehow?
- more advanced algorithm for adaptation
  - academic papers available

Future

- nl80211 support
- wpa_supplicant:
  - support to disable PSM?
  - configure timeout value?
- more QoS information from applications?

Thanks for listening.

Questions?

http://wireless.kernel.org/