Linux 802.11 Solutions for Mobile Platforms

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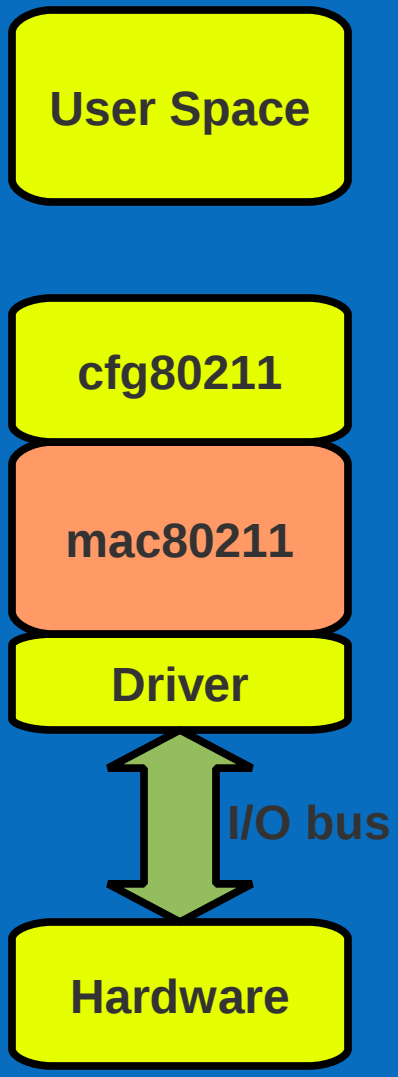
What are we talking about ?

- Mobile platforms: Phones, MIDs, tablets, PDAs.
- Linux solutions: kernel.org drivers.
- Full MAC vs Soft MAC devices.

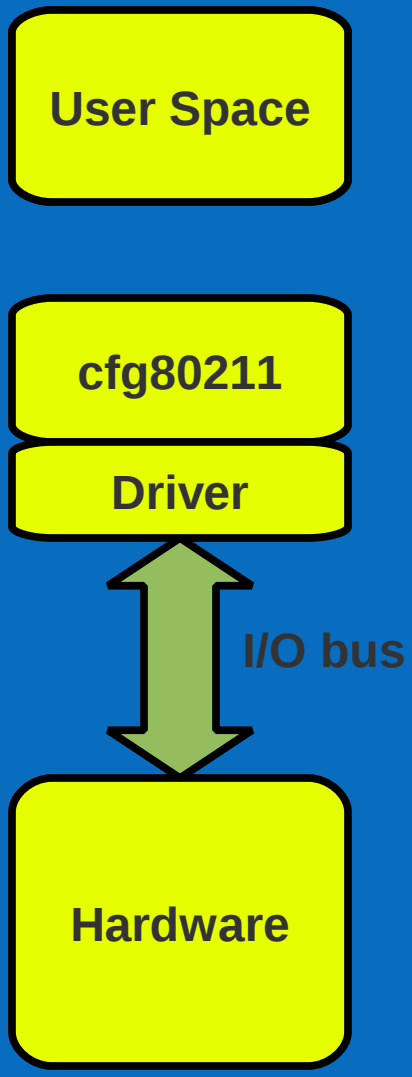
Soft MAC 802.11 devices

- 802.11 partly done in kernel.
- 802.11 partly done in HW.
- Hardware talks 802.11.
- Smaller chips.
- Typical 802.11 design.



Full MAC 802.11 devices

- 802.11 fully done in HW.
- Hardware talks 802.11 or 802.3.
- Fat chips.
- Unusual designs.



Mobile 802.11 specific requirements

- Power consumption
  - Battery killer.
  - Idle, associated, full speed.
- Roaming
  - Streaming while moving around APs.
- Radio coexistence
  - One antenna, several radios.
- Throughput
  - Use cases driven: WWW, VoIP, video streaming.
  - More is not better.

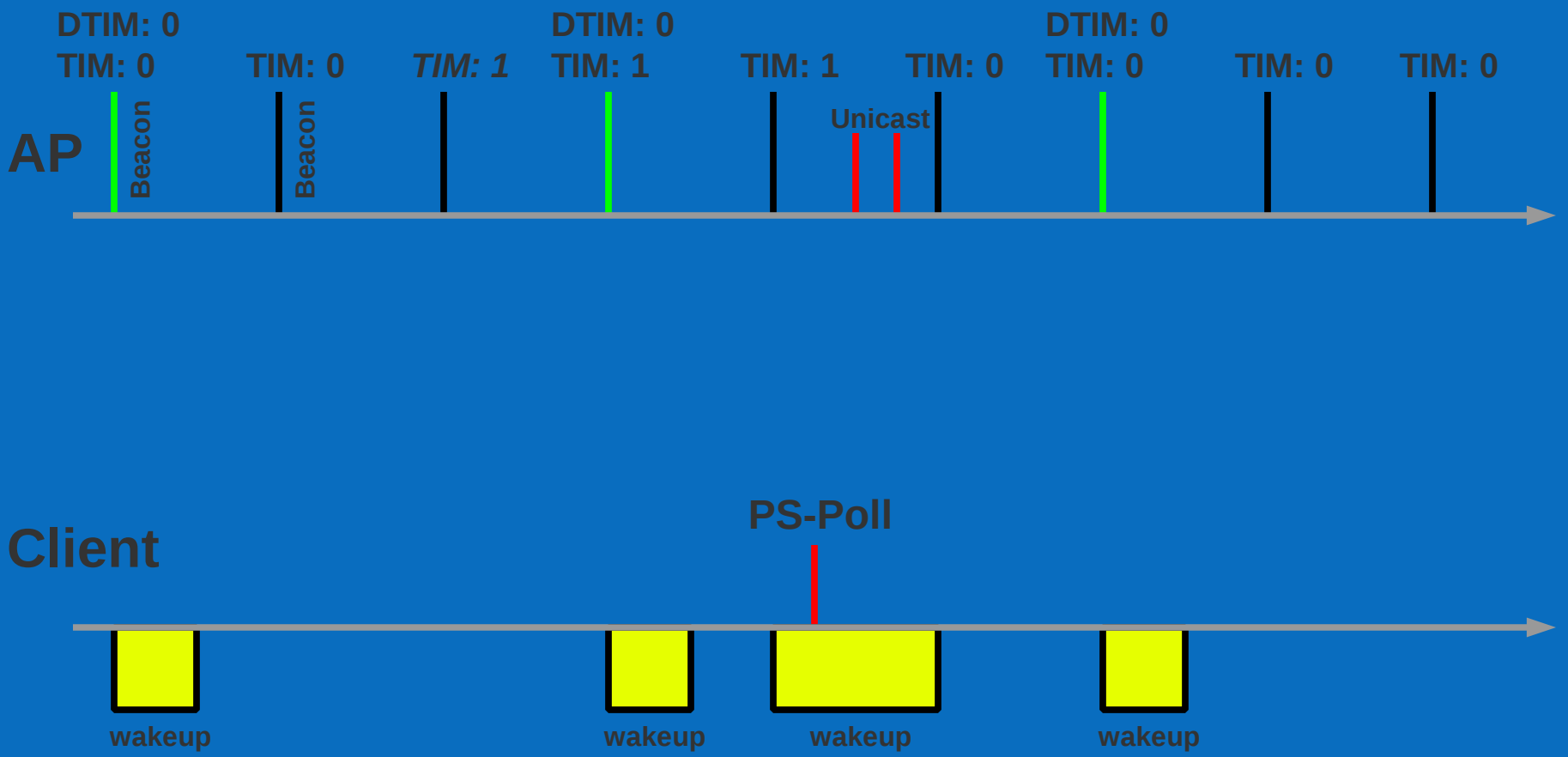
Host and target power savings

- Host controller power savings
  - Low footprint host controllers: Serial, SPI, SDIO.
  - High speed clocks, small packet overhead.
- Target power saving
  - Target deep sleep for idle and associated modes.
  - Partial sleep while traffic is running.

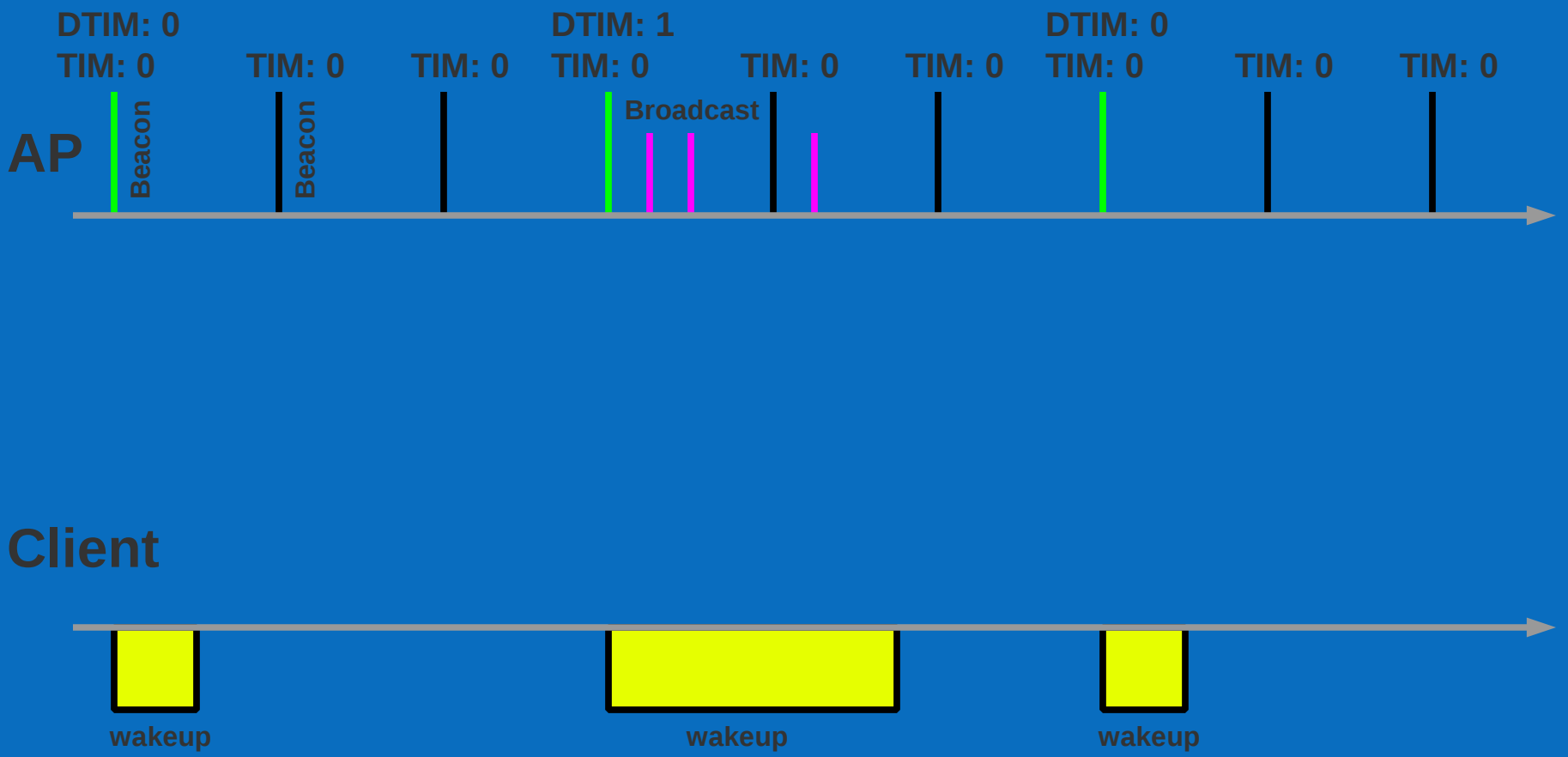
802.11 power savings

- 802.11 power save mode (PSM)
  - The client initiates PSM and notifies the AP about it.
  - The AP starts buffering all frames.
  - Unicast frames: The client sends a PS-Poll frame to fetch them.
    - TIM bits in every beacon (Traffic Indication Message)
  - Broadcast frames: The AP sends them right after DTIM beacon
    - DTIM bits every N beacon (Delivery Traffic Indication Message)

802.11 power savings: Unicast case



802.11 power savings: Broadcast case



802.11 power savings

- Client must wake up for every DTIM beacon.
- Client can sleep between DTIM beacons.
- Client decides when to wake up for unicast frames.
- Broken AP, broken FW: packet losses.
- Biggest power saver.

mac80211 power savings

- Only for Soft MAC devices.
- Beacon filtering
  - Firmware only forwards relevant beacons:
    - DTIM or TIM changes.
    - Host stays asleep, target wakes up.
  - Beacon losses notification.
  - Significant power savings.
- DPSM (Dynamic Power Save Mode)
  - Host and target stay awake for a while after the last TX.
  - Helps throughput, helps latencies, may help power saving.

Firmware power savings

- Need firmware support for beacon filtering and DPSM.
- Full MAC devices:
  - Scanning: Only get new scan results.
  - DTIM and beacon filtering.
  - Packet filtering: Much less traffic when idling.
- Packet aggregation
  - Keep the host awake longer, but less often.
  - Helps throughput and saves power.

Roaming

- Roaming is scanning:
  - Periodic background scanning for fast roaming.
- Roaming decision:
  - Soft MAC: All the way from HW to user space.
  - Full MAC: Can live in HW, user space notified asynchronously.
- Full MAC advantages:
  - Scanning and roaming in HW: Faster and lighter on your battery.

Radio Co-existence

- Typical use cases: WLAN/Bluetooth coexistence.
- One antenna:
  - 2 radios: Needs MAC and HW support.
  - 1 radio: Integrated MACs, needs full MAC.
- Radio broker for mac80211.

The winners

Driver	MAC	Bus	802.11 PSM	Coexistence	Roaming	Manufacturer support
iwmc3200	Full	SDIO (SPI)	Yes	Yes [1]	Yes	Yes
wl12xx	Soft	SDIO SPI	Yes	Yes [2]	No [3]	No
libertas	Full	SDIO SPI	Yes	No	No	No

[1] MAC support for BT/WiFi/WiMAX coexistence.

[2] Firmware support for Bluetooth coexistence with 802.15.2 compliant BT modules.

[3] Firmware can provide beacon losses and low signal events.

The losers

- ar6k: Atheros Full MAC SDIO device
  - Atheros working on an upstream mergeable version.
  - Openmoko driver.
- P54spi (a.k.a. cx3110x): Discontinued HW.
- bcm4325: Broadcom Full MAC SPI/SDIO device
  - Some open source driver laying around.
  - Upstream hopeless.

Questions?

Questions?

- http://wireless.kernel.org/
- linux/drivers/net/wireless/iwmc3200wifi/
- linux/drivers/net/wireless/wl12xx/
- http://wireless.kernel.org/en/users/Drivers/ar6k/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