

Precise Power Characterization of Modern Android Devices

Wei Lin <weilin@andrew.cmu.edu>

Joshua Wise <jwise@andrew.cmu.edu>

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In brief...

- Android power consumption is bad
 - “The Galaxy S is great... but the problem is that you stop having a Galaxy S around 10 PM!”
- Hardware vendors keep blaming Google
- Google keeps blaming hardware vendors
- *Where is the power going?*

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Overview

- *Motivation*
- *Overview*
- *State of the art*
- *Deficiencies in current mechanisms*
- *Goal: cold hard numbers!*

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Measuring power today

- *Android is just a Linux machine...*
 - *...so use Linux power instrumentation tools!*
- *PowerTOP*
 - *Measures CPU wakeups per second*
 - *How deep is the CPU sleeping?*
 - *http://www.lesswatts.org/projects/power_top/*

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PowerTOP

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PowerTOP version 1.13 (C) 2007 Intel Corporation

On
C0 (cpu running)          Avg residency          P-states (frequencies)
                        ( 0.0%)                Turbo Mode             2.81 Ghz             1.2%
polling                   0.0ms ( 0.0%)          2.14 Ghz              0.0%
C1 wait                   0.0ms ( 0.0%)          1.60 Ghz              0.0%
C2 wait                   0.1ms ( 0.0%)          800 Mhz               98.7%
C4 wait                   62.9ms (100.0%)

Wakeup: from idle per second : 17.4 interval: 20.0s
no ACPI power usage estimate available

Top causes for wakeups:
41.7% ( 9.2) [kernel core] hrtimer_start (tick_sched_timer)
17.3% ( 3.8) [extra timer interrupt]
12.1% ( 2.6) [eth0] <interrupt>
11.6% ( 2.5) [kernel scheduler] Load balancing tick
 5.2% ( 1.1) [acpi] <interrupt>
 4.6% ( 1.0) events/0
 2.3% ( 0.5) events/1
 0.9% ( 0.2) [kernel core] dev_watchdog (dev_watchdog)
 0.7% ( 0.1) init
 0.7% ( 0.1) upowerd
 0.5% ( 0.1) flush-btrfs-2
 0.5% ( 0.1) flush-btrfs-1
 0.5% ( 0.1) bdi-default
 0.5% ( 0.1) btrfs-transacti
 0.2% ( 0.1) btrfs-submit-0
 0.2% ( 0.1) syslogd

^ SATA device is active 33.3% of the time:
host1

Q - Quit R - Refresh S - SATA Link Power Management
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Android built-in

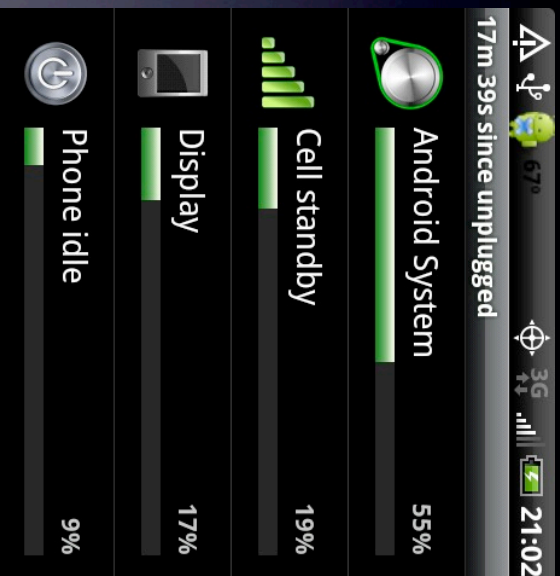
- Android has built-in power monitoring
- “battery usage”
- Provides figures for:
 - screen consumption
 - cell consumption
 - per-app battery consumption

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Android built-in



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Status quo: not good enough

- These tools only *give part of the picture*
- Android tool has potential
 - ... but in reality, is poorly tuned
 - ... but in reality, has poor knowledge of real CPU usage / power correlation
- PowerTOP can assist
 - ... but does not translate to power usage

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Towards a *real* model

- We propose to produce a detailed model of various devices on an Android system and their power impact
 - specifically, the HTC EVO 4G
 - because it's the phone that Joshua has
- Spend time with a current probe, measuring the system...
 - in idle; waking up often, but doing little; waking up often, but doing lots; with various radios on; with various radios doing various amounts of traffic

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End result

- A *tool* to measure power over time on a specific Android phone
 - probably a sense resistor, a DAC, and an FPGA or some such sampling the DAC
 - connected to battery port, not to USB!
- A *model* to take a known usage pattern and predict power
 - answer: *where is all the power going?*

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Q & A

<http://moroso.emarhavil.com/~joshua/743wiki/>

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