

Precise Power Characterization of Modern Android Devices

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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?*

Overview

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

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/powertop/>

PowerTOP

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PowerTOP version 1.13      (C) 2007 Intel Corporation

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

Wakeups 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)
 0.9% ( 0.2) 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

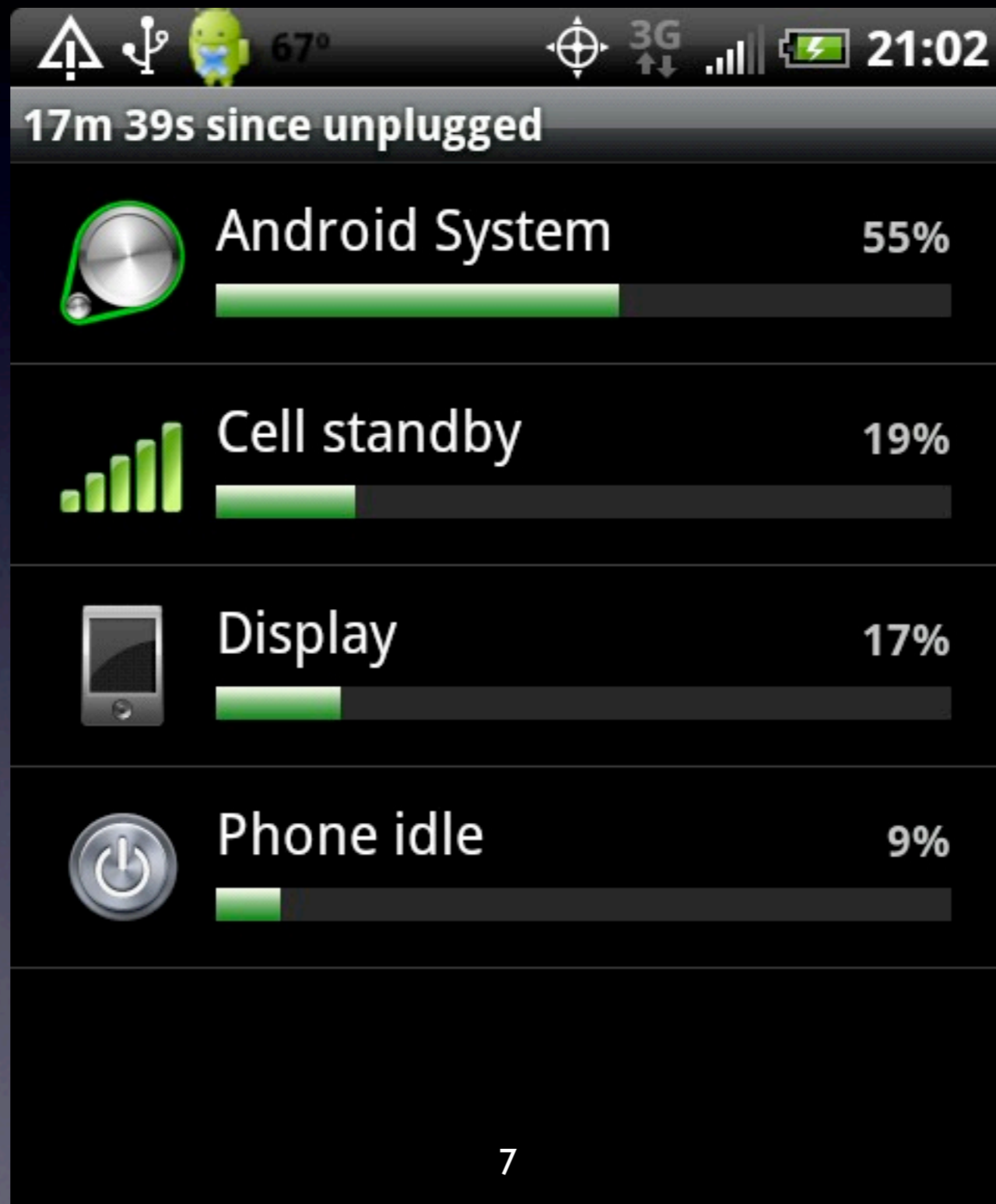
A SATA device is active 33.3% of the time:
host1

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

Android built-in



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

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

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?*

Q & A

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