

Peak Current Management in x86 based Smartphones

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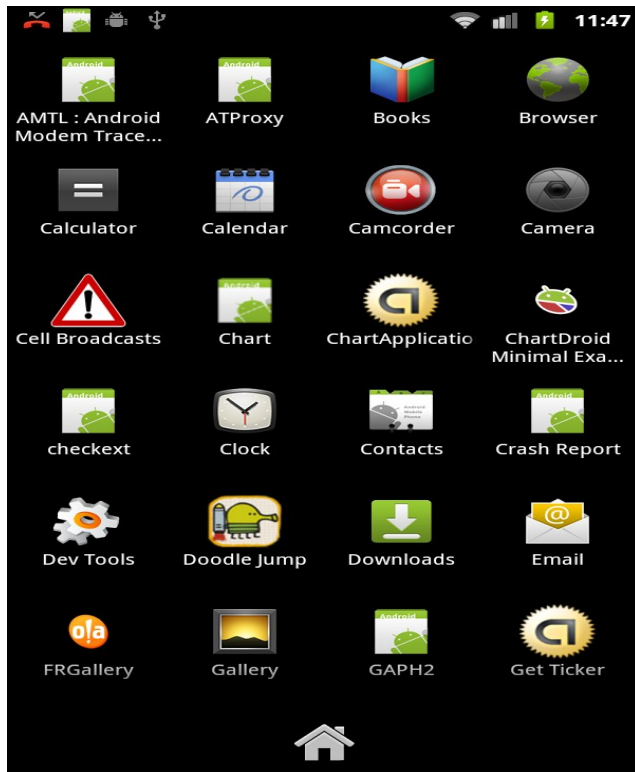
Acknowledgements

- Hari, Rajeev, Ramesh
- Brad, Darren, Reed
- Pascal, Renaud, Yaney
- Jenny, Pavan, Rama, Saranya

Agenda

- Peak Current issues on phones
- Addressing Peak Current on x86 phones
- Proposed Extensions..
- Call to Action

Peak Current issues on phones



- ~1500mAH, Single cell Li-ion Battery



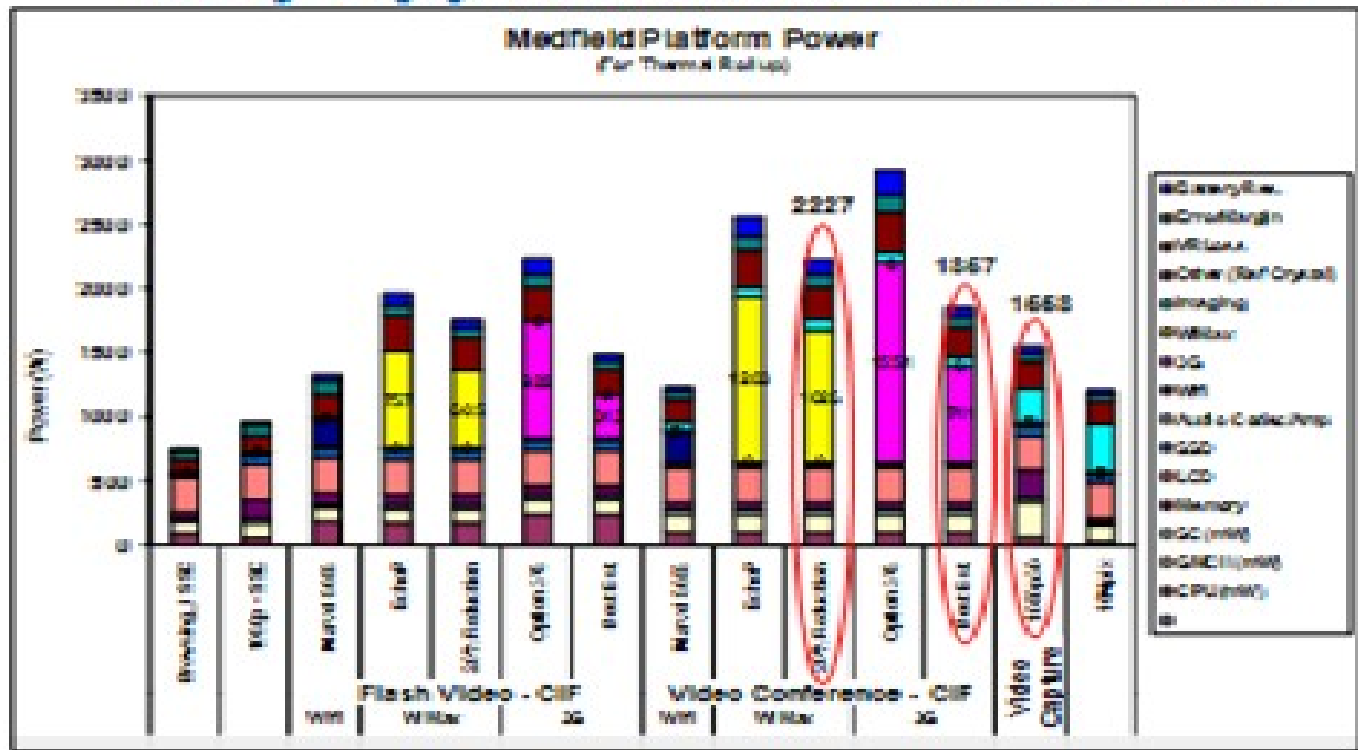
- ~7000mAH, dual cell battery

Peak Current issues on phones...

All components are active, almost all time!!

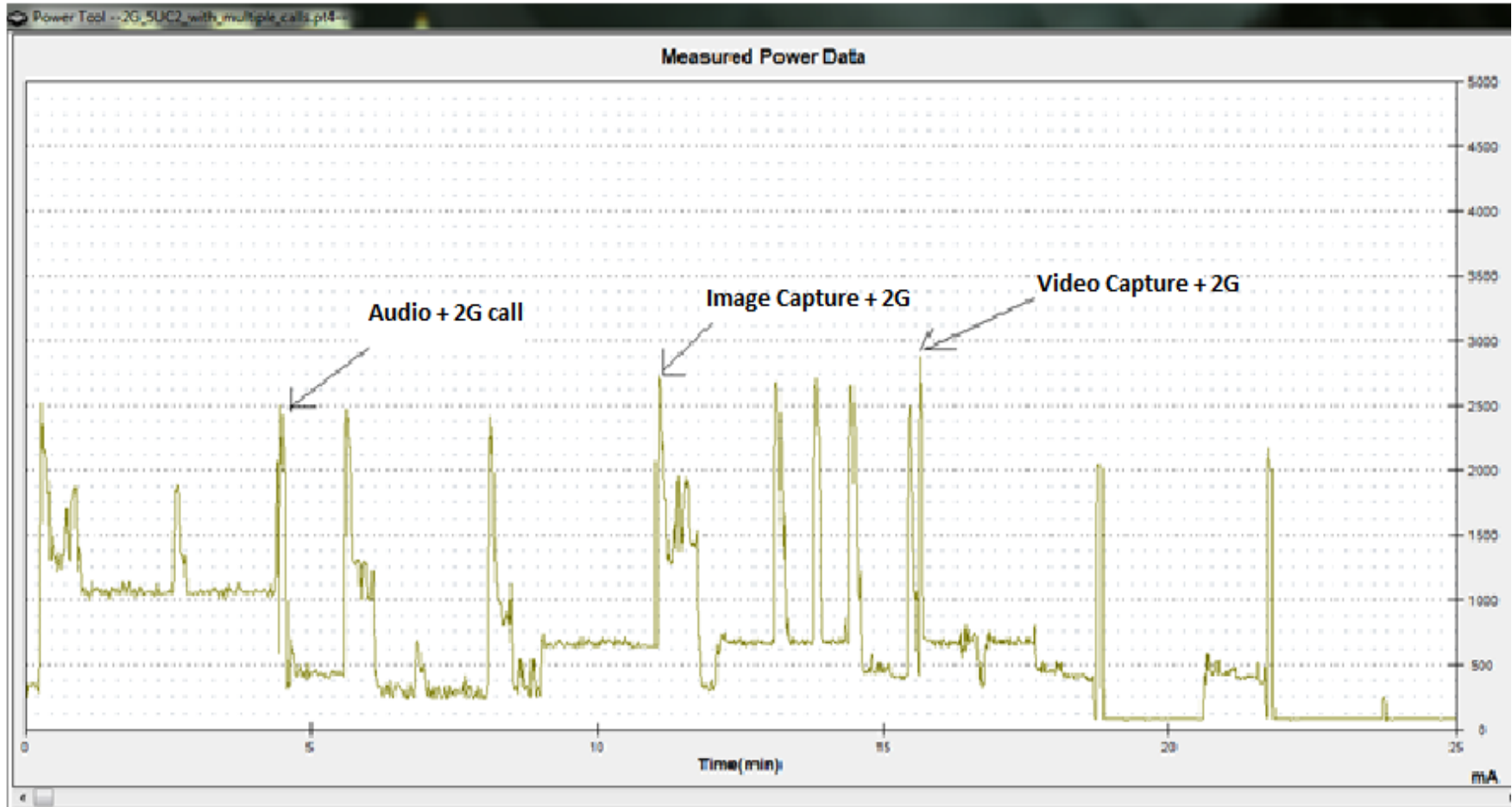
Applications

Key Applications scenarios



Peak Current issues on phones...

IBATT: The maximum current the battery can sustain



Peak Current issues on phones...

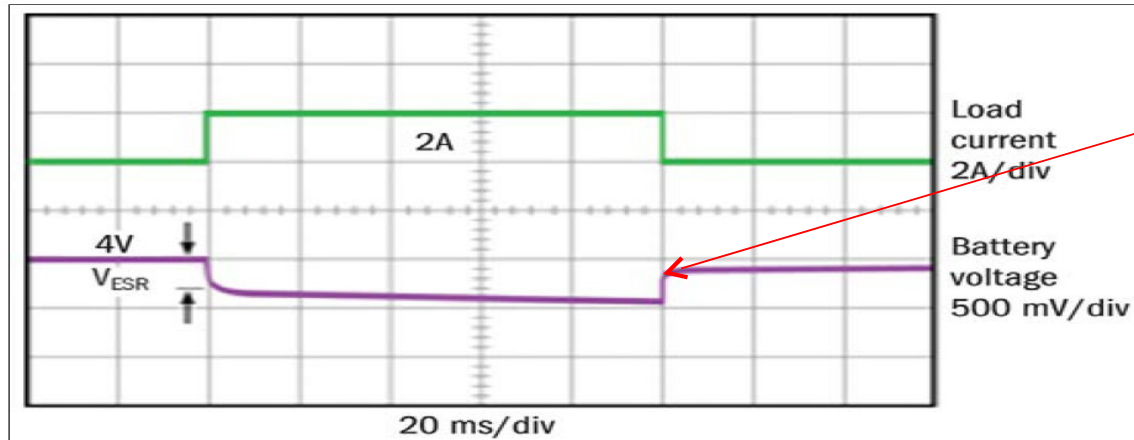
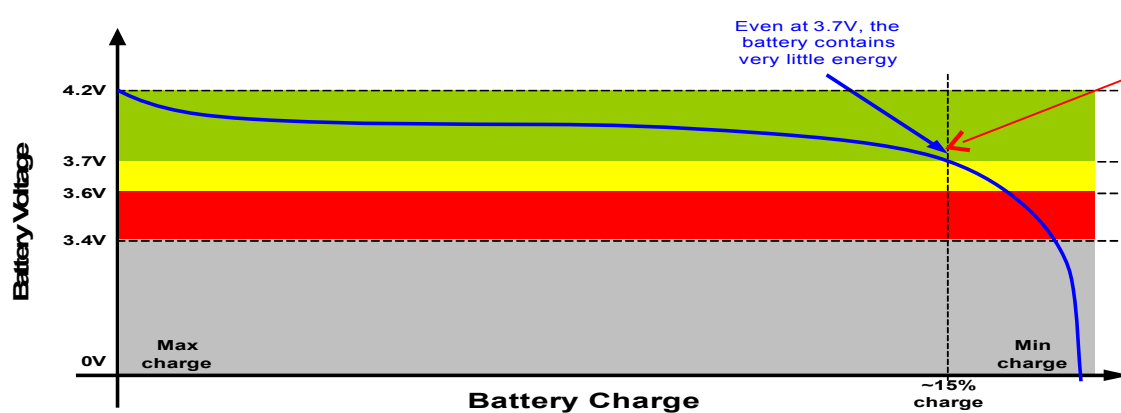


Figure 1: Shown is the effect of a 2A load transient on Li-ion battery voltage.



On Low batt charge (~20%)
High transient Ct can cause
system shutdown (resulting
Instability)

Peak Current issues on phones...

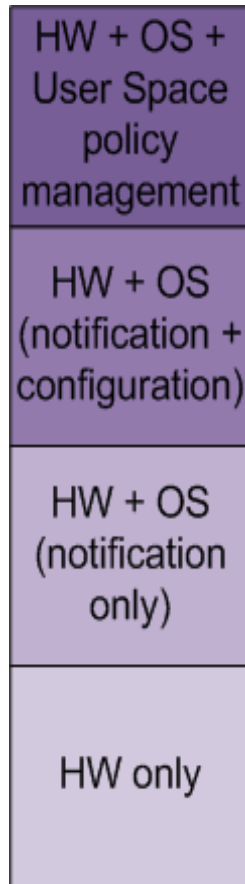
“Take a Picture with a Flash, while playing Audio in the Speakers”

Phone	What we observed
Phone 1	Audio Playback stops when <i>we open Camera App</i> , but resumes once picture is taken.
Phone 2	Picture taken <i>without a Flash</i> . Audio stops <i>but does not resume</i> .
Phone 3	Audio Playback stops when we open Camera App, but does not resume once picture is taken.
Phone 4	The volume suddenly reduces for that time span and then after the flash, the volume returns to its original level.

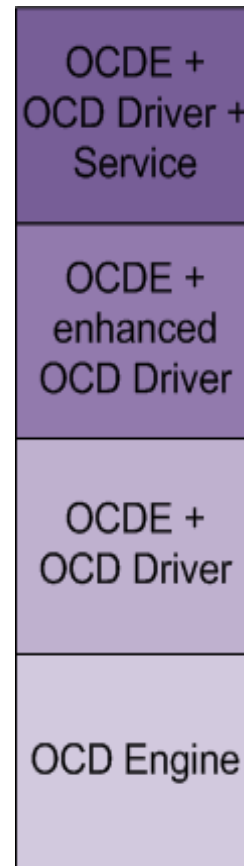
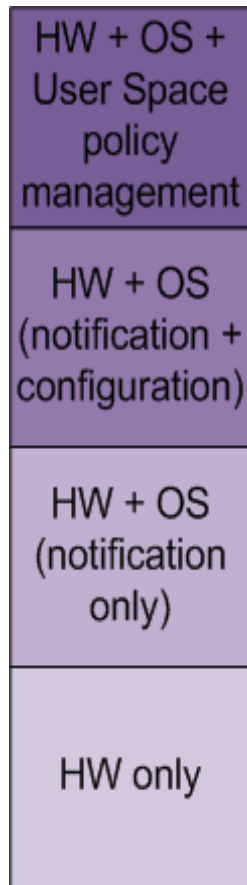
Additional Constraints...

- Burst occurs for a very short period of time
- Completely Unpredictable !!
- Degree of adversity varies with Bat. Capacity

Addressing Peak Current



Addressing Peak Current



What is the Enhancement ??

Overview of OCD Driver

- Now, a Platform driver...
 - <http://comments.gmane.org/gmane.linux.drivers.platform.x86.devel/1197>
 - drivers/platform/x86/intel_mid_oed.c
- Handles the interrupt from the OCD Engine
- Stores three sets of data for three different Bat. levels
- Exposes sysfs:
 - current_warning/shutdown
 - Timer_warning/shutdown
 - Warning_count
 - Crit_shutdown (bool)
 - Action_mask
 - Batt_level (user space talks to this interface)

Hwmon Feedback...

- Initially submitted to hwmon..
- <http://lists.lm-sensors.org/pipermail/lm-sensors/2010-November/030623.html>
- <http://lists.lm-sensors.org/pipermail/lm-sensors/2010-November/030628.html>
- No mechanism for reporting instantaneous current draw
- “Seems to be a lot of chip specific stuff, Nothing genericisable” -- comment
- What we lacked ?
 - Problem not really noticed/understood by many
 - Many HW pieces not doing this kind of thing..

Regulator Feedback...

- Battery → Not a regulated Supply
- Current limits generally have single trip point
 - But, we need more (ABI change)
- Regulator drivers don't do current 'limiting'
- Other 'current' drivers need Registration and notification support
- Need to talk to power-supply subsystem
- Not all devices have regulators

Platform drivers..

- Revisiting this, one year later....
- Platform-drivers not a good option:
 - Now, more platforms with this kind of engine
 - Hence, more maintainability and code duplication
 - No standard API/ABI
- We are able to generalize certain things ... !!

Proposed OCD Framework

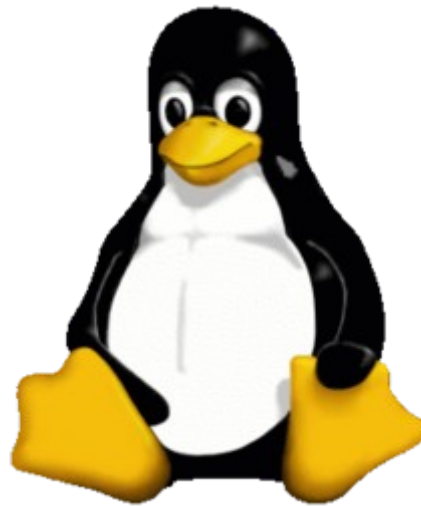
- Generic Framework:
 - Creates sysfs interfaces, with standardized ABI's
 - Handles configurable policies
 - Every platform specific driver registers with this
 - Standard interface for other drivers to register & receive notifications (In-kernel notifications)
 - Register & Receive power-supply notifications
 - User Space notifications, if needed

Call To Action..

- Initial Discussions:
- <http://www.spinics.net/lists/linux-embedded/msg03667.html>
- <http://www.spinics.net/lists/linux-embedded/msg03671.html>
- <http://www.spinics.net/lists/linux-embedded/msg03678.html>
- <http://www.spinics.net/lists/linux-embedded/msg03679.html>
- Mail me @ durgadoss.r@intel.com

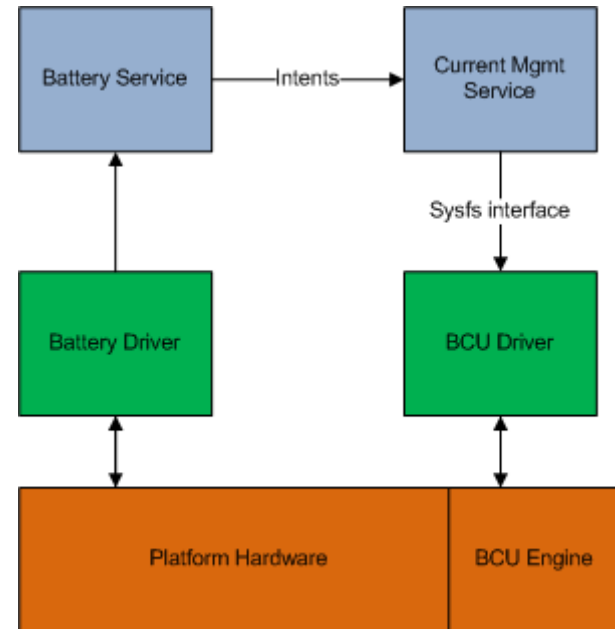
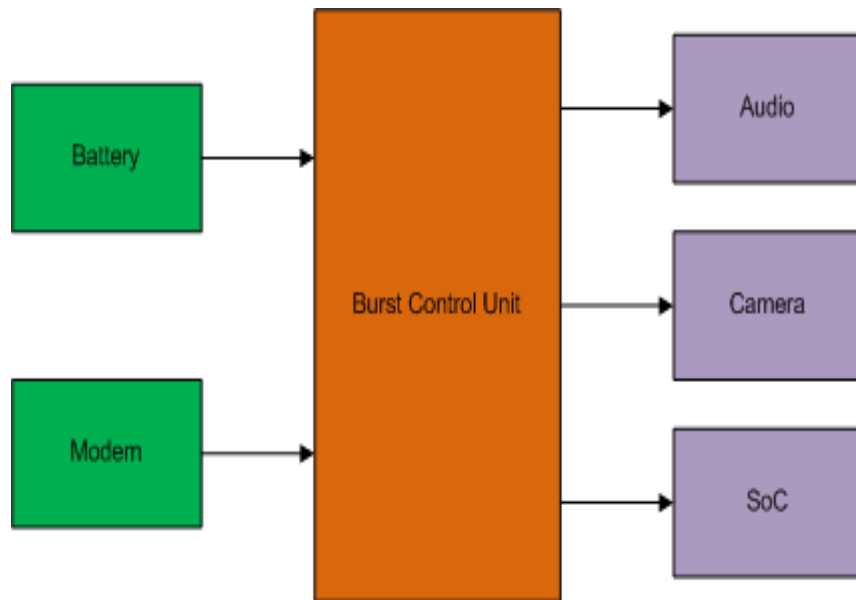
Q & A

- Mail me @ durgadoss.r@intel.com



Back up

- A HW engine → monitors platform current consumption
- Has Programmable registers, Raises signals or interrupts on a current violation



Back up

- How are the other platforms solving it ?
- <http://www.theinquirer.net/inquirer/news/21>
- Most phones do not have Camera Flash (A major current consumer)