ACPI 5.0 in Linux

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Linux Plumbers Conference

August 2012, San Diego
Agenda

• ACPI Architecture
  • ACPICA Architecture
• Large Changes
• Small Changes
• Smaller Changes
  • If you can read this, you are sitting to close
Advanced Configuration and Power Interface (ACPI) - Overview
ACPI Architecture

- Operating System
- ACPI
- BIOS
- Hardware
ACPI Component Architecture (ACPICA)
ACPICA (ACPI Component Architecture)

• OS-independent reference implementation
• Open Source at www.acpica.org
• All non-MS ACPI OS's today use ACPICA
• Intel OTC keeps Linux kernel in sync
  • drivers/acpi/acpica/
• ASL/AML compiler dis-assembler etc.
Large Features and Changes
Memory Power Management
(INTC-003)

- MPST – Memory Power State Table
- PMTT – Platform Memory Topology Table
- Comprehends HW autonomous states

Implications on:
- Physical Memory Allocation
- Hot Plug
- NUMA

ACPIICA: shipping; Linux: Not yet supported
HW-reduced ACPI Mode 1/3

(MSFT-001)

- FADT.HW_REDUCED_ACPI bit
  - “ACPI HW Specification” (ch4) optional
  - UEFI FW for boot (no legacy BIOS)
  - Boot into ACPI mode (no legacy mode)
  - No OS sharing w/ SMM or EC (no global lock)
  - No need for OS sleep state coherency mgmt.
  - No SCI, SMI_CMD, no GPEs, no fixed events
HW-reduced ACPI Mode 2/3

(MSFT-001)

- SW-based alternatives added/used:
  - GPIO replaces GPE
  - SLEEP_CONTROL replaces SLP_TYP
  - FADT.LOW_POWER_S0_CAPABLE bit
    - If platform offers STR when idle is better, this bit suggests that OS avoid STR.
  - Preferred_PM_Profile.Tablet added
HW-reduced ACPI Mode 3/3

(MSFT-001)

• FADT.CMOS_RTC_Not_Present
  - Use Control Method Time & Alarm device instead

• IRQ descriptors get wake property
  - Replacing wake GPEs

• EC: GpioInt() replaces _GPE

• ACPICA: shipping

• Linux: in development
Generic Interrupt Controller (MSFT-002)

- MADT “APIC” table retained
  - Function unchanged, language now generic
- MADT grows a GIC structure

- Linux: not yet implemented
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Add Fixed DMA Descriptor (MSFT-004)

- Support large number of request lines
- Support large number of DMA channels
- Support flexible (static) mapping
- ASL macro: Fdma()

- ACPICA: Supported since 12/2011
- Linux: not yet supported
GPIO Abstraction 1/2 (MSFT-005)

- General Purpose input/output pin support
- HW_REDUCED requires GPIO (no GPE)
- But GPIO does not require HW_REDUCED
GPIO Abstraction 2/2 (MSFT-005)

- ASL: Gpiolo, GpioInt resource macros
- ASL: GPIO OpRegions
- ASL: _AEI – ACPI Event Information to map
- ACPICA: supported
- Linux: prototyped, not yet upstream
SPB: Simple Peripheral Bus
(MSFT-006)

- Controllers enumerated in ACPI Namespace
  - Resource type: I2C, SPI, UART
- Peripherals list _*RS as resources
  - Easily describe non parent-child connections
- ASL can use OperationRegions for access
- ACPICA: supports
- Linux: prototyped, not yet upstream
Platform Communication Channel
(MSFT-007)

- Allows AML communication with BMC (Baseboard Management Controller)
- Referenced by MPST, CPPC, RASF
- PCCT – Platform Com Channel Table
- Sub-space for different channels
- SCI doorbell (HW-REDUCED, not)
- Linux: not yet implemented
CPPC  (MSFT-008)

- Collaborative Processor Performance Cntrl
- Replaces MHz based P-states, T-states
  - Platform has percentage performance metric
- ASL: _CPC controls: mmio, MSR, or PCC

- Linux: not implemented
Time & Alarm Device (MSFT-009)

• RTC/CMOS declared burdensome

• New Time & Alarm device abstraction
  • FADT.No_legacy_CMOS_RTC
  • Device: ACPI000E
  • ASL access
    – GCP/GRT/SRT/GWS/CWS/STP/STV/TIP/TIV

• Linux: not yet supported
Small Features and Changes
Fine Grain Device Id (MSFT-003)

• To ease porting PCI drivers to ACPI
  • _CLS returns PCI class code
  • Expand vendor string format
    - eg. MSFT1234, 80860003
  • Reserved vendor strings
  • _HRV returns HW revision
  • _SUB returns subsystem-vendor/device-id

• ACPICA: shipping; Linux: prototyped
BMC Requested Shutdown (HP-001)

- Previously required OS specific driver, or resort to hard shutdown
- _OST (OS Status indication)
  - Additional Notification value
  - Additional source event code
- Linux: not yet implemented
Firmware Performance Data Table (INTC-001)

- Creates “FPDT”
- Expose pre-OS BIOS boot time metric
  - Measures reset vector to OS hand-off
  - Resume time from suspend-to-ram included
- Linux: no support yet
Error Injection (EINJ) (INTC-002)

- Add Error Location
- Allow Vendor Specific Errors

- Linux: supported
HW Error Notification Types (HP-002)

• Support “firmware-first” notifications

• Linux: not yet supported.
RASF – RAS Feature Table (INTC-009)

- Allow OS to discover RAS features
- References PCC
- Currently only HW patrol scrub described

- Linux: waiting for RASF to be useful
Table Definition Language (INTC-004)

- ASL -> AML compiler already specified
  - For DSDT and SSDT
- ACPI “Data Table” compiler now too
  - All non-ASL tables

- ACPICA supports as of release 20100702
New Reserved Table Signatures 

(IMSFT-009)

- BGRT – Boot Graphics Resource Table
- CSRT – Core System Resource Table
- MSDM – MS Data Mgmt. Table
- SLIC – MS SW Licensing Table
- WPBT – Windows Platform Binary Table
- DBG2 – Debug Port Table 2
- TPM2 – Trusted Platform Module 2 Table
Enhance _ADR for SDIO (MSFT-0013)

• For SDIO Bus Devices:
  • _ADR: Slot number; Function number

• Linux: prototyped
Boot Graphics Resource Table
(MSFT-0014)

• For boot splash management
  • Previously a Windows-specific table.

• Linux: not implemented
Extended GPIO Event Numbers
(MSFT-0016)

• ASL: _EVT support 65,536 events
• (GPE limited to 128/block)

• ACPI: supported
• Linux: prototyped
Locking Targets from AML (MSFT-0018)

- AML access to SPB targets via OpRegion
  - Simultaneous AML vs. OS/driver access
  - Requires locked read-modify-write
  - _DLM – Device Lock Mutex

- ACPICA: supported
- Linux: not yet prototyped
Generic Timer Description Table

(MSFT-0019)

• GTDT describes ARM GIT (Generic Timer)

• Linux: not implemented
Enumeration Power Controls

(MSFT-0020)

• D3Cold can break enumeration
  • eg. SATA ports = Devices

• _PRE – Power Resource for Enumeration
  • _PR0, but just for enumeration

• _PSE – Power State for Enumeration
  • _PS0, but just for enumeration
TCG D-RTM Resource Table
(PTEC-002)

- D-RTM – Dynamic Root of Trust for Measurement
- “DRTM” table signature reserved
Clarifications and Errata fixes.
D3 Cold Errata fix (MSFT-0015)

- Clarify _DSW – Device Sleep Wake
  - Target system state is 0 - 4
- Clarify _SxW – Sx Device Wake State
  - If no _PR3, then 3 == D3
  - If _PR3, then 3 == D3Hot, 4 == D3Cold

- Linux: supported
PLD Clarification  (MSFT-0017)

• Physical Location Description updated for handhelds
  • “front” holds the display
  • Origin is lower left of portrait view
ROM Clarification (AMD-002)

- ROM (Get Display ROM Data)
- If _ROM is present, it is preferred over PCI

- Linux: TBD
ASL Package Description (INTC-005)

- Updates spec to reflect reality since v2.0
- Interpreter & Compiler handle two types of ASL “packages”, fixed and variable length.

- ACPICA & Linux: supported since v2.0.
Fixed _OSC Example (INTC-006)

• ASL example would not compile

• Documentation clarification only
ASL Constant Descriptions (INTC-010)

• Documentation clarification for ASL writers

• Linux: Reflects what ACPICA already does
Clarify ERST, EINJ (INTC-011)

- Updates ERST, EINJ Documentation
  - Offsets are decimal, not hex
  - Specifies reserved fields must be zero
Update AML Opcode Table (INTC-012)

- Add some missing entries to AML byte stream documentation.

- ACPIA compiler/interpreter already supports.
Document Missing ASL Operators
(INTC-013)

- ASL reference **AccessAs** and **Offset**
  - They are both **Operators**, not **macros**

- Update document to reflect reality
Fix PCMCIA reference  (INTC-0014)

- PCMCIA URL was stale.
ACPI0009 Errata Fix (MSFT-0012)

- ACPI0009 was doubly defined
  - ACPI0009 remains I/OxAPIC
  - ACPI0010 is User Presence Detect Device
Done.