ACPI 2.0 Specification Technical Update

Therien
Software Architecture Manager
Mobile Architecture Lab
Intel Corporation

Tony Pierce
ACPI OnNow Technical Evangelist
Microsoft Corporation

February 27 – March 1, 2001

© 2001 Intel Corporation.
Agenda

- ACPI 2.0 Overview
- ACPI 1.0 -> ACPI 2.0 Key Information
- ACPI 2.0 Errata Overview
- ACPI 2.0 Key Errata Review
- Microsoft OS Implementation Update
- Other OS Vendors ACPI Support Update
- Summary
- Call to Action
ACPI 2.0 Overview

- 4-bit processor / addressing support added
- Processor / device performance states added
- Functional Fixed Hardware concept defined
- Many server related enhancements added
  - hot-pluggable CPUs, memory, GPE Blocks
- Legacy Reduced HW IA-PC support included
- SM Bus CM interfaces rewritten
- General readability/consistency enhancements
- ASL examples updated (corrected)
ACPI 2.0 Key Information

Requirements removed
- Design guides will now specify required ACPI 2.0 defined interfaces / platform features

No hardware changes are required for ACPI

Fixed hardware register locations expanded

ACPI system description table definitions contain significant changes
- New XSDT
- New FADT fields
- New MADT structure entries

New Device Notifications added for
- Processor, Thermal, and PCI Hot Plug
ACP 2.0 Key Info. – cont.

ASL / Definition Block changes

- \_PR and \_TZ scopes obsoleted - Processors and thermal zones now defined under \_SB

- Server Support
  - Processor, Memory, Module, & GPE Block Devices
  - \_FIX, \_MAT, \_PXM, \_HPP, \_SEG objects added

- Mobile Support
  - \_EDL object added that enables multiple dock support

- Processor Object’s Object List
  - \_PTC, \_CST, \_PCT, \_PSS, \_PPC, device related objects

- Thermal Zones
  - \_TZD, \_TZP, and \_HOT objects added

- New CMOS and PCI BAR target operation regions

- Many Useful ASL grammar enhancements
CPI 2.0 Key Info. – cont.

Added _GTS and _BFS control method invocation on sleep and wake

Battery related updates
– Smart Battery System Manager
– Control Method Battery clarifications

Update your Control Method Battery Implementations Accordingly
ACPI 2.0 System Description Tables

- RSDP Structure
- RSDT
- SSDT
- XSDT
- SSDT
- FADT
- DSDT
- XSDT

Diagram from IDF Fall 2000 ACPI Presentation
PI 2.0 System Description Tables
(Windows 2000 Compatibility)

SDP Structure

RSDT

SSDT

FADT

DSDT

XSDT

SS

FADT

Two FADTs are required!
Roagrammer’s New Cube
Current Errata Document revision is 1.4

Errata document includes:
- Correction of system description table format and field values
- Correction of ASL / AML grammar errata
- Necessary ASL grammar changes
- 32-bit vs. 64-bit integer size default AML assumption
- Clarifications
- Correction of spelling, grammar, and section reference errors
System Description Table Changes and Clarifications

**ADT**
- SCI_INT field contains global system interrupt number of the SCI interrupt on non-8259-based systems
- Only non-zero values of PSTATE_CNT and CST_CNT fields are written by OSPM
- PM1_CNT_LEN field is 2 (not 1) bytes
- IA-PC Boot Architecture Flags
  - Reserved field bit offset starts at bit 2 (not bit 3)
System Description Table Changes and Clarifications - continued

ADT

Local APIC Address Override Structure length field is 12 (not 16) bytes

I/O SAPIC Structure length field is 16 (not 20) bytes

Local SAPIC Structure is significantly changed
– Reserved field added
– ACPI Processor ID field length changed from 2 to 1 byte
– field order re-arranged
### Table 5-26 Processor Local SAPIC Structure

<table>
<thead>
<tr>
<th>Field</th>
<th>Byte Length</th>
<th>Byte Offset</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>1</td>
<td>0</td>
<td>7–Processor Local SAPIC structure</td>
</tr>
<tr>
<td>Length</td>
<td>1</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>ACPI Processor ID</td>
<td>1</td>
<td>2</td>
<td>The Processor Id listed in the processor object. For a definition of the Processor object, see section 16.2.3.3.1.17, “Processor (Declare Processor).”</td>
</tr>
<tr>
<td>Local SAPIC ID</td>
<td>1</td>
<td>3</td>
<td>The processor’s local SAPIC ID</td>
</tr>
<tr>
<td>Local SAPIC EID</td>
<td>1</td>
<td>4</td>
<td>The processor’s local SAPIC EID</td>
</tr>
<tr>
<td>Reserved</td>
<td>3</td>
<td>5</td>
<td>Reserved (must be set to zero)</td>
</tr>
<tr>
<td>Flags</td>
<td>4</td>
<td>8</td>
<td>Local SAPIC flags. See Table 5-18 for a description of this field.</td>
</tr>
</tbody>
</table>
ASL Grammar Changes

ASL Type conversion function names changed to avoid legacy name collision
- Buff > ToBuffer
- DecStr > ToDecimalString
- HexStr > ToHexString
- Int > ToInteger
- String > ToString

CMOS Region Space Keyword renamed to SystemCMOS to avoid legacy name collision

Copy function renamed to CopyObject to avoid legacy name collision

Generic Register Descriptor
- Single byte Reserved field inserted at byte offset 6 to match the Generic Address Structure (GAS)
ASL Grammar Changes

ASL Type conversion function names changed to avoid legacy name collision

- Buff > ToBuffer
- DecStr > ToDecimalString
- HexStr > ToHexString
- Int > ToInteger
- String > ToString

CMOS Region Space Keyword renamed to SystemCMOS to avoid legacy name collision

Generic Register Descriptor

- Single byte Reserved field inserted at byte offset to match the Generic Address Structure (GAS)
2-bit vs. 64-bit Integer AML Assumption

Existing AML may contain an inherent 32-bit assumption.

OSPM will therefore use the definition block’s Revision field to determine how integers are evaluated.

- Field value 2 means 64-bit integer assumption.

ASL DefinitionBlockTerm’s ComplianceRevision field must be set appropriately by the ASL writer.
**Clarifications**

**Functional Fixed Hardware**

- OEMs may specify interfaces as Functional Fixed Hardware ONLY as specified by the CPU manufacturer!!!
- Requires coordination with the OS vendor

Load and Unload operators do not apply to the Differentiated Definition Block

New thermal zone trip point object is named HOT (not _CS4)

System description tables may exist beyond 4GB address range

- Supports 64-bit systems
Microsoft OS Implementation Update

Tony Pierce
ACPI / OnNow Technical Evangelist
Microsoft Corporation
Windows XP is not an ACPI 2.0 implementation.

Windows XP implements ACPI 1.0b and supports a few new features defined in ACPI 2.0.
Microsoft OS Implementation Update

CPI 2.0 features supported in Windows XP

- Processor Performance State Objects
- ACPI 2.0 64-bit Fixed System Description Tables
- _HPP (Hot Plug Parameters) object

CPI 1.0b features added to Windows XP

- Complete implementation of Video Extensions
  - Brightness Control objects are supported in addition to Display Output Control objects
Windows XP Processor Performance

State Control Implementation

Legacy applet interface is used on 440BX and 440MX-based systems

CPI 2.0-defined objects can be used on ICH-based systems

- Place objects in the Processor Object’s object list under the \_PR Scope (_PCT, _PSS, _PPC)
- Provide control value in PSTATE_CNT field in FADT at byte offset 55
Windows XP Processor
Performance Control Policy

Performance state control policy is linked to Power Scheme

Control policy types include:

- None
  - Highest performance state
- Constant
  - Lowest Performance state
- Adaptive
  - Performance state chosen according to demand
- Degrade
  - Lowest performance state + additional linear performance reduction as battery discharges
## Windows XP Processor Performance Control Policy

<table>
<thead>
<tr>
<th>Power Scheme</th>
<th>AC Power</th>
<th>DC Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home/Office Desk</td>
<td>None</td>
<td>Adaptive</td>
</tr>
<tr>
<td>Portable/Laptop</td>
<td>Adaptive</td>
<td>Adaptive</td>
</tr>
<tr>
<td>Presentation</td>
<td>Constant</td>
<td>Degrade</td>
</tr>
<tr>
<td>Always On</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Minimal Power Management</td>
<td>Adaptive</td>
<td>Adaptive</td>
</tr>
<tr>
<td>Max Battery</td>
<td>Adaptive</td>
<td>Degrade</td>
</tr>
</tbody>
</table>
Windows XP FADT Support

Use PSTATE_CNT and CST_CNT fields as defined in ACPI 2.0

Set FADT revision field = 2

- ACPI 1.0b + legacy reduced hardware enhancements
IRQ Routing Problem Discovered

IO devices that overlap with PCI link devices must have _DIS methods.

Example: The _PRS method for PCI device returns IRQ 6 in the resource list. As a result, the OS assigns IRQ 6 to the PCI device. If the FDC does not have an _DIS method that disconnects the interrupt, an inescapable interrupt storm will occur.

PCI devices include resources that overlap with resources of SIO devices, the _DIS method under the SIO device must disconnect the interrupt routing!!
Microsoft Call To Action

Test with Windows XP beta 2

Do not provide CPU performance state control through any means other than the OS

- “Designed for Whistler” Logo requires use of OS native processor performance state control

Provide ACPI 2.0-defined Fixed Tables in Intel® Itanium™ Processor-based systems

- “Designed for Whistler” Logo requires ACPI 2.0-defined Fixed Tables for 64-bit systems
Intel® ACPI Component Architecture (ACPI CA)

- Provides an OS independent implementation of ACPI support in source code form
- Widely adopted by Itanium™ processor architecture OS vendors
- Linux and FreeBSD contain ACPI CA
- Includes ACPI 2.0 compliant ASL compiler

See: http://developer.intel.com/technology/iapc/acpi/
Warning: Use of ACPI 2.0 grammar elements must be supported by the target operating systems! Consult with your OSV to learn their implementation schedule.
Linux 2.4.0 kernel is released and contains ACPI CA-based experimental ACPI support.

- Includes ACPI hardware subsystem initialization, Control Method Battery, and power source device support.
- Device power management architecture is under development.

See: http://phobos.fachschaften.tu-muenchen.de/acpi
Call To Action

Download the ACPI 2.0 specification and its errata
- http://www.teleport.com/~acpi/

Include ACPI 2.0 support in your emerging platforms
- Ask your BIOS vendor for ACPI 2.0 support
- Request / implement devices performance state support

Download and use the Intel® ASL compiler
ACPI 2.0 Specification
Technical Update

Guy Therien  
Intel Corporation

Tony Pierce  
Microsoft Corporation

February 27 – March 1, 2001

Please remember to turn in your session survey form.