The ACPI Project for eComStation

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About Me

- I am primarily a hardware developer. I started my career designing hardware for IBM 360 mainframe clones.
- I then joined a small company building Cray compatible computers where I did a little of everything including microcode and embedded systems hardware and software.
- Since then I have worked on projects from auto industry process controllers, to home automation, to radiation effects testing for satellite electronics.
- I have been using OS/2 and developing software for OS/2 since the beginning.
- Being an experienced hardware developer gives me an advantage in writing device drivers.

This Presentation

- What is ACPI?
- What is the ACPI Project?
- What does the ACPI Project software do?
- The Big Picture
- The benefits and limitations of the ACPI Project software
- How to work around problems
- Using ACPI in your applications
- Questions

What is ACPI?

- ACPI stands for Advanced Configuration and Power Interface
- ACPI is supplied by your computer vendor and is part of your computer's BIOS.
- ACPI provides a standard interface to your computer's hardware through a list of objects and methods called the ACPI tables.
- Software can use the ACPI tables to learn about what hardware is available
- Software can use the ACPI tables to do things in the system.
- ACPI is an extremely large and complex topic and is not really the subject of this presentation.

What ACPI Looks Like

- Your computer vendor writes some code that looks like this.

```
Device (LNKA)
{
    Name (_HID, EisaId (“PNP0C0F”))  // _HID: Hardware ID
    Name (_UID, 0x01)  // _UID: Unique ID
    Method (_STA, 0, NotSerialized)  // _STA: Status
    {
        If (And (PIRA, 0x80))
        {
            Return (0x09)
        }
        Else
        {
            Return (0x0B)
        }
    }

    Method (_DIS, 0, NotSerialized)  // _DIS: Disable Device
    {
        Or (PIRA, 0x80, PIRA)
    }

    Method (_CRS, 0, NotSerialized)  // _CRS: Current Resource Settings
    {
        Name (BUF0, ResourceTemplate ()
        {
            IRQ (Level, ActiveLow, Shared, _Y02) {0}
        })
```

- What is actually stored in your BIOS is a compiled binary form of this source code called the ACPI tables.
- The ACPICA code in the PSD interpretes this binary table.

What is the ACPI Project?

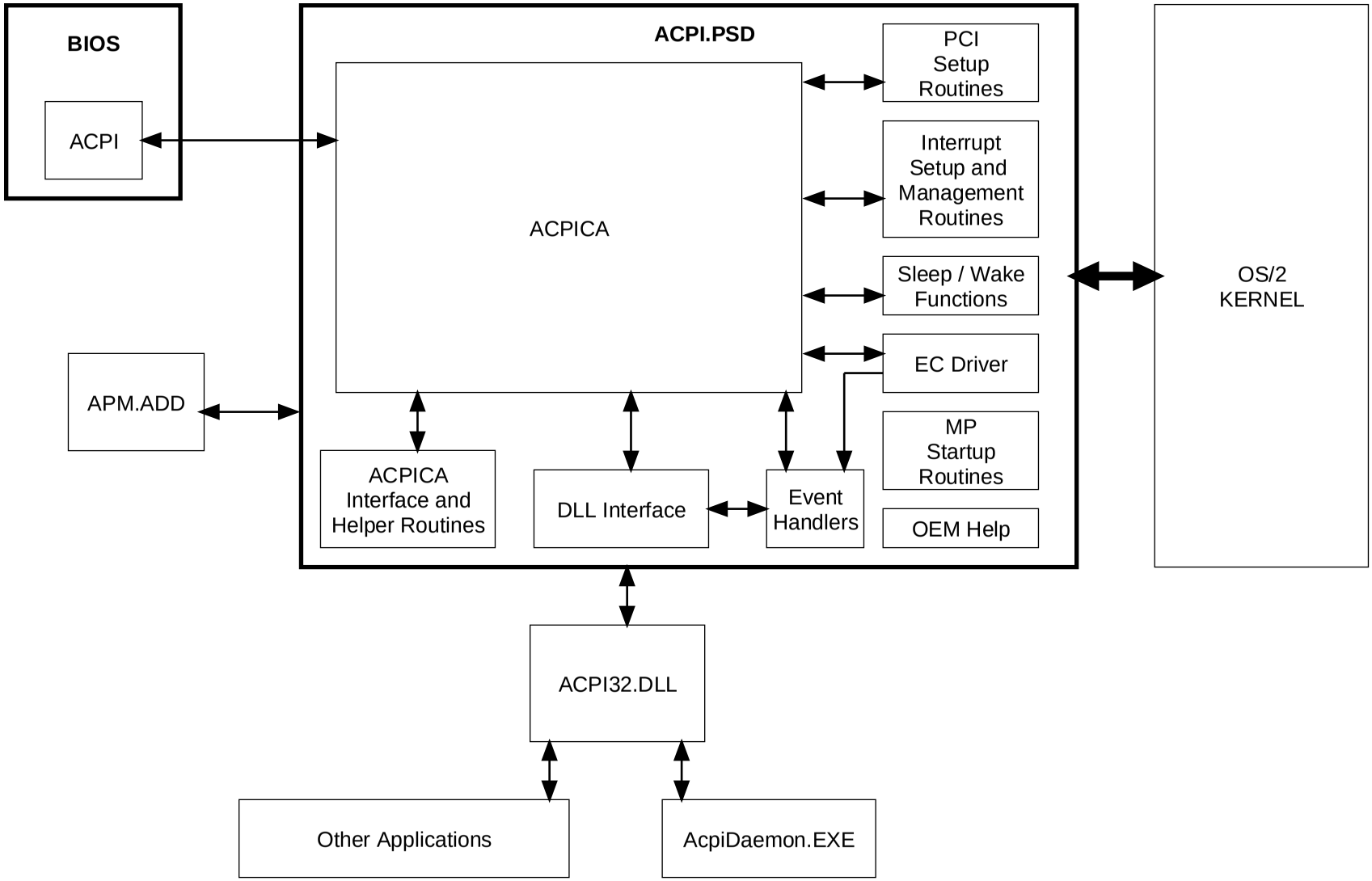
The ACPI Project produces the software that uses the ACPI in your computer to setup and operate your system.

- ACPI.PSD - the Platform Specific Driver that sets up and controls the hardware, and also implements the ACPI Component Architecture which is the interface to your computer's ACPI.
- ACPI32.DLL - The interface between ACPI.PSD and other programs so that they can use the ACPI functions in the PSD.
- APM.ADD - An Advanced Power Management interface that emulates some APM functions using ACPI.
- AcpiDaemon.EXE - A program that implements certain system functions like CPU throttling, power button handling, various events like lid open/close events, suspend/resume, etc.
- ACPID.CFG - The configuration file for AcpiDaemon.exe.

What does the ACPI Project software do?

- The PSD is a driver that can be thought of as a kernel plugin.
- The PSD configures the system using information from ACPI.
  - Sets up the interrupt controllers
  - Attempts to fix errors made by the BIOS in setting up PCI
  - Enables Multiple CPUs
  - Sets up the system so ACPI will work.
- The PSD contains the ACPICA code from Intel.
- The Daemon is optional and handles things that need to happen after the system is booted.
- The Daemon has the code that does Suspend / Resume
- The Daemon has a thread that does power management
- The Daemon has threads that handle ACPI events such as special button presses, lid open / close, etc.
- The ACPI32.DLL provides access to ACPI through the PSD.

The Big Picture



Benefits of using the ACPI Project Software

- Allows you to run multiple CPUs
- Allows the use of APIC hardware
- Implements Idle Time Halt
- Implements power management for some systems
- Gives applications access to ACPI functions
- Adds some additional functionality
- Others...

Limitations of the ACPI Project software

- The PSD is a generic driver intended to operate on any system. It is not custom tailored for a specific hardware configuration.
- It can only do what is described in the ACPI tables.
- Requires that the BIOS do the resource allocation
- It is not directly involved with the execution of any application or driver.
  - Except if the application specifically calls an ACPI function.
- The PSD does not check for certain types of hardware.

Handling Problems

- Keep in mind what the PSD can and cannot do so you can correctly identify where a problem is.
- Simply trying your system with and without the PSD is not evidence that there is something wrong with the PSD.
- The key is to find out what is really wrong.
- The PSD changes the operating environment
  - Different interrupts - For troubleshooting try /PIC or /VW
  - Multiple CPUs - For troubleshooting try /MAXCPU=1
- Some software may not be able to handle the changed environment. This does not mean that there is a problem with the PSD!
- Problems that are probably not caused by the PSD:
  - stability issues
  - driver failures
  - anything that happens after the desktop is loaded

Common Complaints

- Hyperthreading is a problem.
  - Not specifically supported and not specifically unsupported.
  - Hyperthreading is just broken on some systems.
  - Not compatible with the OS/2 scheduler.
- Driver _____ doesn't work.
  - The PSD is not involved with the execution of any driver.
  - The driver has Interrupt issues?
  - The driver has Memory issues?
- Poor quality hardware does not work.
  - Lower quality hardware is often not standards compliant and requires custom drivers to operate properly.
  - Get better hardware.
- Suspend / Resume
  - Known to work correctly in the Daemon and the PSD.
  - Any problem is probably in a driver, your hardware, or your ACPI.

Some Useful PSD Switches

- /CPUMASK=n
  - Specifies which CPUs to use.
- /MAXCPU=n
  - Limit the maximum number of active CPUs to n
- /NOHLT
  - Disables idle time halt.
- /PIC
  - Limits the PSD to use the system as setup by the BIOS.
- /VBE
  - Initialize video BIOS on resume (after sleep)
- /VW
  - Allows the PSD to setup the Local and IO APIC hardware, but limits the PSD to only allow interrupts to be handled by the PIC hardware through the APICs.

Some Useful Switches for the Debug PSD

- /BAUD=n
  - Set the baud rate for debug output to the serial port. Default=115200.
- /DBGBRK
  - The PSD will execute an interrupt 3 at a certain points in the initialization process.
- /DBGLVL=n
  - Set the verbosity level of debug output. The default debug verbosity level is 1.
- /OV
  - Turns on debug output to the video display.
- /On
  - Turns on debug output to the serial port. n can be 1 for COM1, 2 for COM2, or an I/O address.

Using the AcpiStat Utility

- AcpiStat with no parameters

```
The version of ACPI.PSD that is installed is 3.20.05
The system is operating in Symmetric mode (Mode 2)
The kernel is 14.106_SMP
The retail PSD is installed

Number of IRQs available: 24
IRQ 00 count 78955
IRQ 01 count 3789
IRQ 08 count 2232848
IRQ 09 count 1853
IRQ 14 count 260
IRQ 16 count 717
IRQ 18 count 1060
IRQ 19 count 52470
IRQ 20 count 12631
IRQ 22 count 178
IRQ 23 count 34515

========== CPU0 ==================
ACPI name [CPU0]
IPIGenCount = 94968      IPICount    = 54310
IPIHLT      = 0          IdleCount   = 2569064    BusyCount   = 153840
========== CPU1 ==================
ACPI name [CPU1]
IPIGenCount = 54310      IPICount    = 94968
IPIHLT      = 0          IdleCount   = 80851      BusyCount   = 80850

This system does not support CPU Performance Control via ACPI.

This system does not support CPU Throttling.

Thermal information:
  No Thermal information is available for this computer

No AC status is available for this computer
```

Using the AcpiStat Utility

- AcpiStat CheckDrivers

```
APM.ADD is not installed. Results may not be accurate.
Driver E100B$
  ACPI suspspend/resume support: No <<< Requires APM.ADD.
   APM suspspend/resume support: Yes
Driver UNIAUD1$
  ACPI suspspend/resume support: Yes
   APM suspspend/resume support: Yes
Driver SSM$
  ACPI suspspend/resume support: Yes
   APM suspspend/resume support: No
Driver MOUSE$
  ACPI suspspend/resume support: Yes
   APM suspspend/resume support: Yes
Driver ATAPI$
  ACPI suspspend/resume support: No <<< Requires APM.ADD.
   APM suspspend/resume support: Yes
Driver IBMS506$
  ACPI suspspend/resume support: No <<< Requires APM.ADD.
   APM suspspend/resume support: Yes
Driver INTL$BIO
  ACPI suspspend/resume support: No
   APM suspspend/resume support: No
Driver USBD$
  ACPI suspspend/resume support: Yes
   APM suspspend/resume support: Yes
Driver IBMKBD$
  ACPI suspspend/resume support: Yes
   APM suspspend/resume support: No

Failed to communicate with APM.ADD. Results may not be accurate.

This system will not support suspend/resume as configured.

3 driver(s) require APM support so APM.ADD must be installed
for suspend/resume to work on this system as configured.
```

Using the AcpiStat Utility

- AcpiStat PowerOff
  - Shuts down the file systems and powers off the system.
- AcpiStat Suspend
  - Suspends the system.

Using ACPI In Your Applications

- Create a connection to the PSD (if needed)
  - AcpiTkStartApi()
- Walk the ACPI tree to find the things you want
  - AcpiTkWalkNamespace()
- Get information about objects
  - AcpiTkGetObjectInfoAlloc()
- Evaluate methods
  - AcpiTkEvaluateObject()
- Close the connection to the PSD (if open)
  - AcpiTkEndApi()

Example: Printing the System Temperature

- Walk the ACPI tree to find the things you want.

```
AcpiTkWalkNamespace(
    ACPI_TYPE_THERMAL, // Thermal objects only
    ACPI_ROOT_OBJECT,   // Start object
    ACPI_UINT32_MAX,    // Max depth
    CallbackFunction,  NULL, NULL);
```

- In the CallbackFunction, evaluate the _TMP method to get the temperature.

```
AcpiTkEvaluateObject(ObjHandle, "_TMP", NULL, &Buffer);
```

- Print the result.

```
printf("Temp=%d C", (Object.Integer.Value - 2732)/10 );
```

Useful ACPI Project Links

- The Wiki page at the ACPI Project development home contains a lot of useful information about the eCS ACPI Project, including troubleshooting help, and the ticket system: **http://svn.netlabs.org/acpi**
- Information about the ACPICA can be found at: **http://acpica.org**
- The ACPI specification can be found at: **http://www.acpi.info**