Linux ACPI (Advanced Configuration and Power Interface) subsystem

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The ACPI is an industry standard started by Intel, Microsoft and Toshiba. Primarily it deals with power management, probing hardware, and configuring of the hardware. From 2013, it is handled under the UEFI Forum, http://www.uefi.org.

The maintainers of the Linux ACPI subsystem are Rafael J. Wysocki and Len Brown.

Mailing list: linux-acpi@vger.kernel.org

Mailing List archives:

http://www.spinics.net/lists/linux-acpi/

Git repo of ACPI kernel tree:

git://git.kernel.org/pub/scm/linux/kernel/git/rafael/linux-pm

Website:

https://01.org/linux-acpi

Documentation: http://lxr.free-electrons.com/source/Documentation/acpi/

ACPI Links:

ACPI for ARM?

Article by Jonathan Corbet, 2013

https://lwn.net/Articles/574439/

ARM, SBSA, UEFI, and ACPI:

Article by Jonathan Corbet, 2014

https://lwn.net/Articles/584123/

ACPI, kernels and contracts with firmware

- Article by Matthew Garrett , 2014

http://mjg59.dreamwidth.org/32369.html

Implementing and Detecting an ACPI BIOS Rootkit

https://www.blackhat.com/presentations/bh-europe-06/bh-eu-06-Heasman.pdf

The BIOS Implementation Test Suite (BITS) – a project by Josh Triplett:

http://biosbits.org/

https://lwn.net/Articles/641244/

Article by Jake Edge, 2015, about the BITS project.

apd-tools (ACPI Platform Description) from Cumulus Networks:

https://github.com/CumulusNetworks/apd-tools

A Tour beyond BIOS Implementing the ACPI Platform Error Interface

with the Unified Extensible Firmware Interface (White Paper)

https://firmware.intel.com/sites/default/files/resources/A_Tour_beyond_BIOS_Implementing_APEI_with_UEFI_White_Paper.pdf

A list of ACPI Links:

http://www.uefi.org/acpi

ACPI: Design Principles and Concerns Lo¨ıc Duflot, Olivier Levillain, and Benjamin Morin

http://www.ssi.gouv.fr/uploads/IMG/pdf/article_acpi.pdf

ACPI on ARMv8 Servers:

https://www.kernel.org/doc/Documentation/arm64/arm-acpi.txt

Presentations:

ACPI 6 and Linux by Rafael J. Wysocki slides (August 19, 2015)

http://events.linuxfoundation.org/sites/events/files/slides/ACPI_6_and_Linux_0.pdf

You can find the ACPI spec here:

http://www.acpi.info/

ACPI in Wikipedia:

https://en.wikipedia.org/wiki/Advanced_Configuration_and_Power_Interface

The ***/proc/acpi/event*** interface has been deprecated and does not exist anymore (TBD: since which kernel?)

The *acpid* daemon provides an alternative, based on netlink socket; previous (1.x) versions of *acpid* relied on /proc/acpi/event.

http://sourceforge.net/projects/acpid2

ACPI implementation:

You should start with becoming familiar with the ***acpi_device*** structure:

http://lxr.free-electrons.com/source/include/acpi/acpi_bus.h#L355

Every ACPI object, except the root object (ACPI_ROOT_OBJECT) has a parent.

See: the *acpi_get_parent()* method:

http://lxr.free-electrons.com/source/drivers/acpi/acpica/nsxfobj.c#L120

ACPI Node is represented by an ***acpi_namespace_node*** object:

http://lxr.free-electrons.com/source/drivers/acpi/acpica/aclocal.h#L161

Traditionally, the ACPI core uses the pnp_dev struct for every device which is not PCI device. Another option, which is quite new, is to use platform device

ACPI layout:

Under *drivers/acpi/acpica* you will find the files related to ACPICA components.

So, for example, *utinit.c* is of ACPI utilities, and nsinit.c is of ACPI namespaces.

The ACPICA main components are:

- debugger
- disassembler
- dispatcher
- events
- executer
- hardware
- namespace
- parser
- resources
- tables
- utilities

Then you can look on some simple ACPI drivers under

http://lxr.free-electrons.com/source/drivers/acpi

Most of the ACPICA implementation is under

http://lxr.free-electrons.com/source/drivers/acpi/acpica/

To start with leaning about ACPI power management, you can start with drivers/acpi/device_pm.c:

http://lxr.free-electrons.com/source/drivers/acpi/device_pm.c

You can find the ACPICA version on your Linux machine by:

```
cat /sys/module/acpi/parameters/acpica_version
20141107
```

You can see the ACPI tables entries under/sys/firmware/acpi/tables:

For example,

```
ls /sys/firmware/acpi/tables/
APIC    DSDT      ERST  HEST   SLIT   SSDT1
BERT    dynamic   FACP  HPET   SPCR   SSDT2
DMAR    EINJ      FACS  MCFG   SRAT   WDDT
```

ACPI 5.1 was released in July 2014.

- The spec is 940 pages.

ACPI 6.0 was released in is April 2015

- The spec is 1012 page.

Simple ACPI monitoring tools:

http://smackerelofopinion.blogspot.com/2010/01/simple-acpi-monitoring-tools.html

Creating a DSL file:

```
cat  /sys/firmware/acpi/tables/DSDT  > dsdt.dat
```

```
iasl -d dsdt.dat
```

This will generate a file named *dsdt.dsl*

iasl is Intel ASL compiler/decompile.

See also:

http://lxr.free-electrons.com/source/Documentation/acpi/method-customizing.txt

Note: On many distros you have a package including the iasl tool. Thus, in CentOS 7, you can install it by

yum install acpica-tools. This package includes other ACPI utils, like acpidump-acpica.

There are 5 entries for ACPI Object caches under

/sys/kernel/slab; they are created by: ***acpi_ut_create_caches();*** *see:*

http://lxr.free-electrons.com/source/drivers/acpi/acpica/utalloc.c#L96

/sys/kernel/slab/Acpi-Namespace

/sys/kernel/slab/Acpi-Operand

/sys/kernel/slab/Acpi-Parse

/sys/kernel/slab/Acpi-ParseExt

/sys/kernel/slab/Acpi-State

UEFI (Unified Extensible Firmware Interface)

TBD

Take Control of Your PC with UEFI Secure Boot –

An article by Greig Paul AND James Irvine, September 2015, Linux Journal.

_CID: (Compatible ID)

_CRS: Current Resource Settings

_PRS: Possible Resource Settings

_SRS :Set Resource Settings

ACPI Acronyms:

ACPICA: ACPI Component Architecture

AML: ACPI Machine Language

APEI: ACPI Platform Error Interface

ASL: ACPI Source Language

ASWG: ACPI specification working group

BERT: Boot Error Record Table.

CE: Corrected Error

CPPC: Collaborative Processor Performance Controls

EINJ: Error Injection Table

GPE: General Purpose Event

HEST: APEI Hardware Error Souce Table

HPET: High Precision Event Timer

LPSS: Low Power Subsystem

MADT: Multiple APIC Description Table

NFIT: NVDIMM Firmware Interface Table

OSL: os services layer

PCC: Platform Communication Channel.

PMIC: Power Management Integrated Circuit

SBS: Smart Battery System.

SCI: System Control Interrupt

See: http://www.uefi.org/workinggroups

UC: Uncorrected Error

TBD:

ACPI Thermal Zone versus lmsensors

acpi_call: A kernel simple module that enables you to call ACPI

methods by writing the method name followed by arguments to /proc/acpi/call:

https://github.com/mkottman/acpi_call

acpidump is a utility to dump ACPI tables.

In Ubuntu (15.04), acpidump belong to the acpica-tools package.

You can get more debug messages by setting CONFIG_ACPI_DEBUG to y.