

The Ghost in the Machine

***A quick introduction to ACPI
Power management and all that
jazz***

In the beginning there was the BRS

- Early machines just had the **Big Red Switch** for power management
- Down was “Off” and Up was “On”
- Okay for desktops
- But then came concerns about power usage
- And laptops/notebooks

So they invented APM

- “They” were Intel and Microsoft
- APM was/is **Advanced Power Management**
- Introduced in early 1990s
- Only controlled from BIOS
- Typically a BIOS page allowing you to set:
 - Time to set display to energy saving mode
 - Time to spin down hard disk(s)
 - etc.
- System would wake up on keyboard action

Problems perceived with APM

- Only controlled from BIOS
Operating System did not know about its actions
- Possible clashes with Opg. Sys.
 - e.g. screen power save and screen saver
- Vendor specific
 - bugs fixed by one vendor not necessarily fixed for another vendor
- Need to re-flash BIOS to fix bugs
- Not enough capacity in BIOS for a comprehensive power management scheme

So ACPI was developed

- **Advanced Configuration and Power Interface**
- Introduced 1999-2000
- This time “They” included Microsoft, Intel, Compaq/HP and Toshiba
- No Linux representation
 - we just live with the results
- Early versions were “flaky”
- Not just power management:
 - Thermal management
 - State management
 - Speed control

ACPI Design

- Basis is a set of tables in BIOS
- Much more elaborate than APM
- Designed “by a bunch of monkeys on LSD”
- Use cannot be avoided on many/most recent notebooks/laptops
- Some desktops also require use of ACPI
 - When hyperthreading is implemented (P IV)
 - Itanium chips
 - Possibly Core Duo (no personal experience)
- Supported by all 2.4 and 2.6 series Linux kernels

ACPI and System States

- **G0** Power on
- **G1-S1** Power On but devices can power down
- **S2** Processor Off
- **S3** Suspend to RAM
- **S4** Suspend to disk
- **G2-S5** Power Off but wakeable
- Windows working
- No equivalent
- Standby
- Hibernate
- Shutdown

A bit more about system states

- Not all machines support all states
- **S3** state – processor power is off, but RAM still has power.
 - Very quick to resume full working state from this state
- **S4** state – snapshot of memory written to disk
 - Slow to get to working state – particularly for large memory
- **S5** state – can be woken , e.g. by LAN or serial port request

Control of System State

- System state can be changed via:
- Action during system shutdown
 - depends on the distro.
- Other actions, such as:
 - Closing laptop lid
 - Pressing the Power button
 - Using the Sleep button
- Typically, closing laptop lid causes move to S3
- This machine with Xandros is very confused about what is to happen when the lid is closed/opened

Performance States

- **P0-Pn Performance states**
- Speedstep (Intel Pentium M) Cool 'n Quiet (AMD)
- Processor speed reduced/increased either on command or by operating system
- Processor slowed when full processor power not needed
- Why? - reduced power drain (battery) and cooler
- **T0-Tn Throttling states**
- P Processor stops for a proportion of time
- Cooler, but no real change in battery drain

Thermal Control

- Basic control- Passive or Active
 - Active – fan to exhaust heat
 - Passive – no fan control
- Trigger points
 - Temperatures at which actions take place
 - e.g. 100C typical for shutdown
 - Fan on/fan off may be set as trigger points
- Many modern motherboards also have fan speed control
 - Not aware of a Linux program to support it

What about Linux


- All 2.4 and 2.6 series kernels have ACPI support
- Some distros. have ACPI compiled as modules i.e. have to be loaded separately
- Intel Speedstep is a program available only for 2.6 series kernels
- Boot parameter to control ACPI
 - `acpi=on|off|force`
- Some machines will not work properly or at all unless you pick the “correct” value for ACPI
- APM and ACPI are mutually exclusive


Finding out about ACPI support
























- The larger distros. usually enable/disable ACPI correctly
- If you are curious, you can see values in `/proc/acpi`
 - thermal, battery, fan, AC etc.
- A free Windows program Sandra Lite from Sisoft can show a lot of ACPI information in digestible form


APM & ACPI Information - SiSoftware Sandra

This window shows information about the power status of the system as well as other power related settings (APM, ACPI, PMBus).

Main Battery 

Backup Battery 

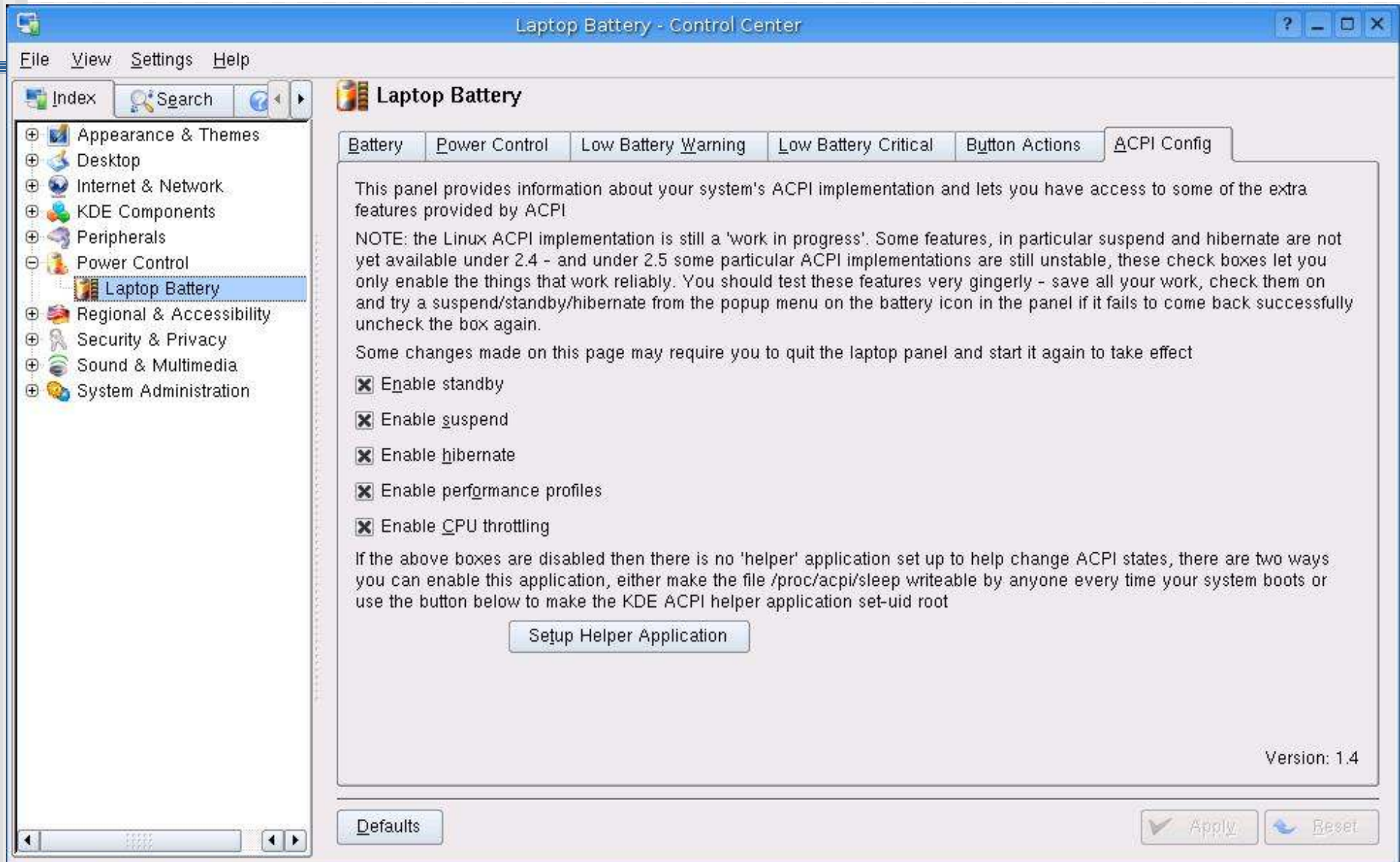
Item	Value
 ACPI BIOS	
 Version	1.00
 Manufacturer	PTLTD
 Revision	0.01
 MP APIC	No
 SCI ACPI IRQ	9
 Advanced Power Management Information	
 Supported S(leep) States	S1, S3, S4, S5
 UPS	No
 Thermal Zones	Yes
 Power Button	Yes
 Sleep Button	Yes
 Lid Button	Yes
 Display Dimming Supported	No
 Hibernate Supported	Yes
 Wake Capabilities	
 Timer Wake State	S3
 Processor Power Management	
 Processor Throttling Enabled	Yes
 Throttle Range	25% - 100%
 Drives Power Management	
 Drives Spin Down Enabled	Yes
 Drive Spin Range	3 seconds(s) - 3600 seconds(s)



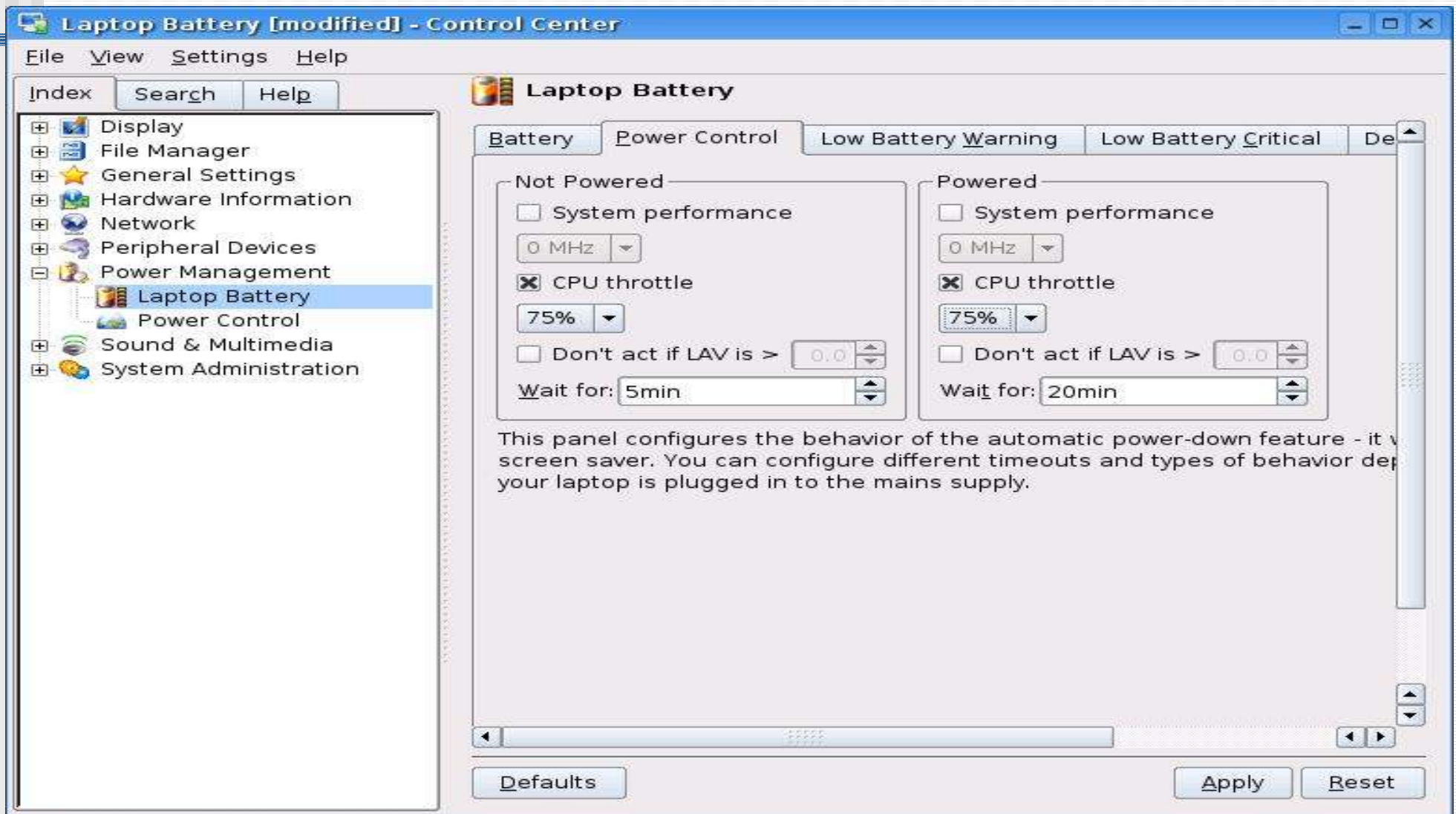
KDE Power Control

- For laptops you can find it in **Control Center**
- The ACPI tab has warnings about risks
- Several reports of problems with setting up the ACPI helper application
- Can run as a command
- **klaptop_acpi_helper** <parameter>
 - --suspend
 - --hibernate
 - --etc.

KDE - Laptop Battery



KDE - Power Control



Should I worry about ACPI

- Mainly of interest to laptop/notebook owners at the moment
- With multi-core machines ACPI may be mandatory for all types
- If your machine runs well, does not run hot and does not chew batteries, observe the old maxim
- **If it ain't broke don't fix it**
- In which case you can file this information – perhaps for future use