Power to the people

Roger Gann on managing and monitoring the power in your system.

Most of the breakthroughs in power management came, not surprisingly, from notebook developers, keen to extend battery life. It seems that every time there's a breakthrough in battery technology, it is more than matched by developments on the hardware front, such as faster processors and bigger colour displays, which absorb all the extra power at a stroke.

The first real breakthrough in mobile power management was in 1989 with the introduction of Intel's SL technology (first seen on the 386SL and still included in all of today's Pentium processors) which allows embedded code within the CPU to slow down, suspend or shut down part or all of the system platform — or even the CPU itself — in order to preserve and extend battery life.

SL technology had two drawbacks, though: it could power-down devices or the CPU only after certain periods of inactivity and the operating system did not know what devices were powered up or powered down. For instance, the operating system might try to access the hard drive, not knowing that it had already been shut down.

Two years later, in 1991, Intel and Microsoft introduced Advanced Power Management (APM) which allowed the OS and the SL-embedded code to talk to each other. But APM was still a time-based system and peripherals would often shut down after a period of inactivity, even though this wasn't wanted.

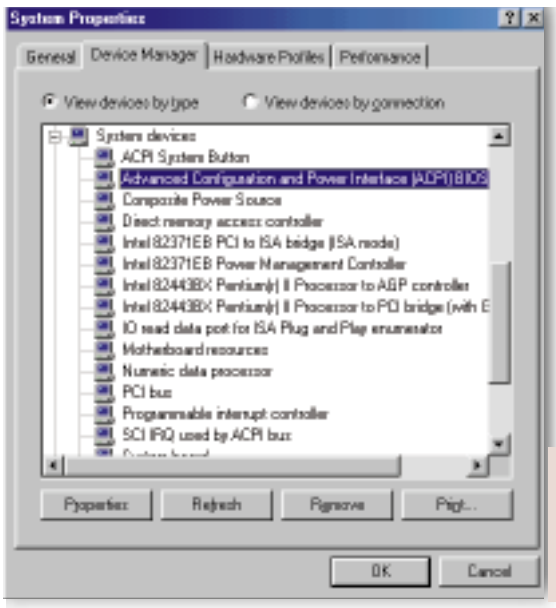
The Advanced Configuration and Power Interface (ACPI) was introduced back in 1997 by Intel, Toshiba and Microsoft, although it is only now becoming common. For the first time, it moves away from the time-out power management concept.

ACPI enables demand-based power consumption. It allows for the collection of power consumption information from the entire computer and gives complete device activity control to the operating system, thereby enabling it to provide power only to those devices that need it, when they need it.

ACPI enables demand-based power consumption

The potential of ACPI

The Advanced Configuration and Power Interface is an open-industry, all-encompassing, PC hardware operating system and peripheral device interface specification. In other words, it specifies a certain manner in which the OS, motherboard hardware and peripheral devices (such as CD-ROMs and hard disks) talk to each other about power usage. Its primary goal is to enable Operating System Directed Power Management (OSPM) whereby the operating system manages all power activities, providing power to devices only on an as-needed basis. Previous power management systems were BIOS based, turning off devices only after certain periods of inactivity.



◂FIG 1 ONCE ACPI SUPPORT IS INSTALLED, A WHOLE RAFT OF ACPI-RELATED SYSTEM DEVICES ARE ADDED

ACPI defines five power 'S' stages:

- **S0** is the normal running state. Your PC consumes more than 50W of power.
- At **S1** the CPU stop clock is switched off, reducing power consumption to around 30W.
- At **S2,** the CPU is completely switched off.
- At **S3,** the PC is in a 'suspend to RAM' state, consuming less than 5W.
- **S4** is the 'suspend to disk' state. Zero Watts of power are consumed.
- **S5** is the 'Soft-Off' state.

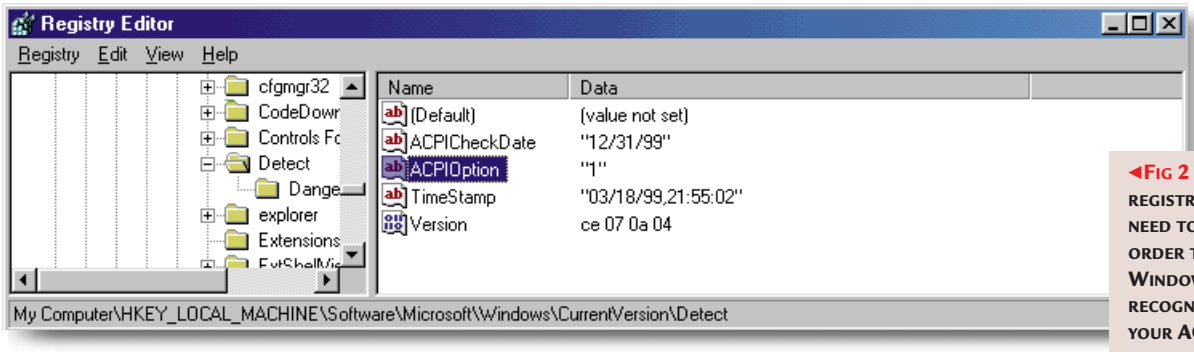
By working with operating systems which support Direct Power Management, such as Windows 98, ACPI will enable your PC to run around the clock, yet still satisfy current energy saving standards.

A future, ACPI-compatible operating system will be able to:

- **Reduce** the CPU clock speed when it determines that running applications do not currently need the CPU to run at full speed.
- **Control** motherboard and peripheral device power consumption by turning on devices only when needed.
- **Regulate** applications activity through a continually updated demand analysis of running software.

One major benefit of ACPI is that it will permit your PC to be essentially 'off' but ready to wake up rapidly when triggered by some event. For example, this would enable intelligent agents or 'bots' on your PC to wake your machine in the middle of the night and go onto the internet to gather news or information for you to read when you wake in the morning.

Many PC systems are sold configured with both fax and answering machine capabilities. Often these features rarely get used because the machine needs to be left on all the time in order to perform the tasks. Now the PC can be left on, but consuming hardly any power. And because a PC is 'always on', when you revive it you're not actually booting it up



◄**Fig 2 This is the registry hack you need to make in order to make Windows 98 recognise your ACPI BIOS**

so the apparent time to 'bootup' will appear very short.

Funnily enough, while equally big gains in power management are to be expected in the notebook arena, particularly in respect of the Smart Battery System, there is a possibility that ACPI may actually reduce battery life, not extend it, at least in the short term. When you turn on ACPI, you must essentially turn off the existing hardware power management. So, existing hardware will need to perform various hidden tasks underneath ACPI in order to minimise any power wasting.

Windows 98 and ACPI

Windows 98 was the first operating system to include support for ACPI (Windows 2000 will support it, of course). As a result, power management is greatly enhanced under Windows 98 although sadly Microsoft's ACPI does not provide a significant improvement to battery life in portables compared to the older APM standard. However, ACPI essentially puts power management under the control of the OS, so applications that have been specially written can better control power-saving features. Note that some power management features require an ACPI-enabled PC: specifically, you will need an ACPI-compliant BIOS.

At present, even if your PC has an ACPI BIOS, when you install Windows 98 it won't necessarily install ACPI support — you'll just get plain vanilla APM. Bearing in mind the somewhat flakey provenance of APM so far, Microsoft has erred on the side of caution and opted to only install ACPI support automatically on those BIOSes which have been fully validated by the Microsoft hardware compatibility labs.

ACPI will permit your PC to be 'off' but ready to wake up

It's easy to tell whether ACPI support is enabled: open Device Manager in Control Panel and expand the System hardware tree [Fig 1]. Slap bang at the top of the list will be Advanced Configuration and Power Interface (ACPI) BIOS. If it just says Advanced Power Management, then you've been short-changed. Note that it is a purely Windows 98 feature and is not supported under Windows 95.

In order to use the ACPI features in Windows 98, you must first have an ACPI-compatible BIOS. If you do have it; on bootup the BIOS description will usually say 'ACPI BIOS'. Once you know you have it, proceed to disable APM in the BIOS to prevent possible conflicts.

If you've got a motherboard with an ACPI BIOS, how do you install Windows 98 support? Well, it is possible to delete the APM System device and use 'Add New Hardware' to explicitly add ACPI BIOS, but this is not recommended. Microsoft actually recommends a re-install of Windows 98, this time using an obscure switch to turn on detection of an ACPI-compliant BIOS. Simply kick it off thus:

```
SETUP / P J <CR>
```

A less bothersome way [Fig 2] involves a Registry hack (if you do this, please take care!).

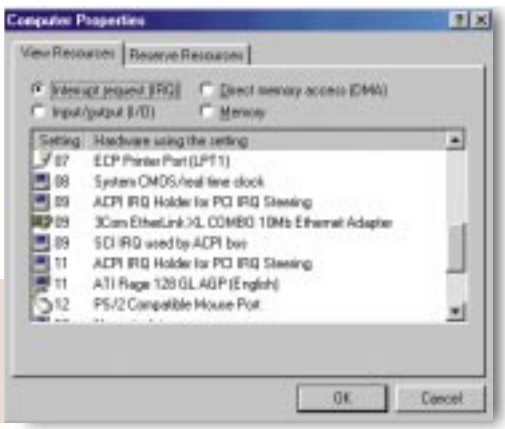
To enable ACPI after Windows 98 is installed, run Regedit and go to the following key in the registry:

```
HKEY_LOCAL_ MACHINE\Software\
Microsoft\ Windows\Current
Version\Detect
```

Create a new DWORD value called 'ACPIOption' and set it equal to 1. Quit Regedit. In Control Panel, run Add New Hardware and choose hardware detection. ACPI should be detected and installed.

After the system is rebooted, all ACPI-enumerated devices will be set up again, which means the Plug and Play slate is wiped clean and Windows 98 re-detects everything in your system. After a few reboots, you'll be done. I've performed this successfully on two of my ACPI motherboards: an ABIT BH6 and an ASUS P5A.

While you're at it, check to see if there's not an updated BIOS for your motherboard at the manufacturer's web site: ACPI is still in the 'movable feast' category, so expect some bugs to start with.



►**Fig 3 With ACPI support installed, your IRQ usage will change. For a start, ACPI needs its own IRQ**

With ACPI enabled and those extra System devices installed, you'll notice a couple of subtle changes in your PC's configuration. For a start, ACPI support requires its own IRQ. It also requires a modified version of PCI or IRQ steering. Depending on your BIOS' implementation of ACPI, your power management options will be different.

In my case, for instance, they were between my ABIT and ASUS boards. The ABIT BH6 power management regime now supports 'Always On', which means that the PC is effectively never switched off, just placed in a low-power snooze. The Advanced tab allows me to choose how the 'power' button on the system unit front bezel behaves: it can either initiate a shutdown, or put the PC into standby or hibernation. However, the hibernation option is missing on my ASUS P5A motherboard.

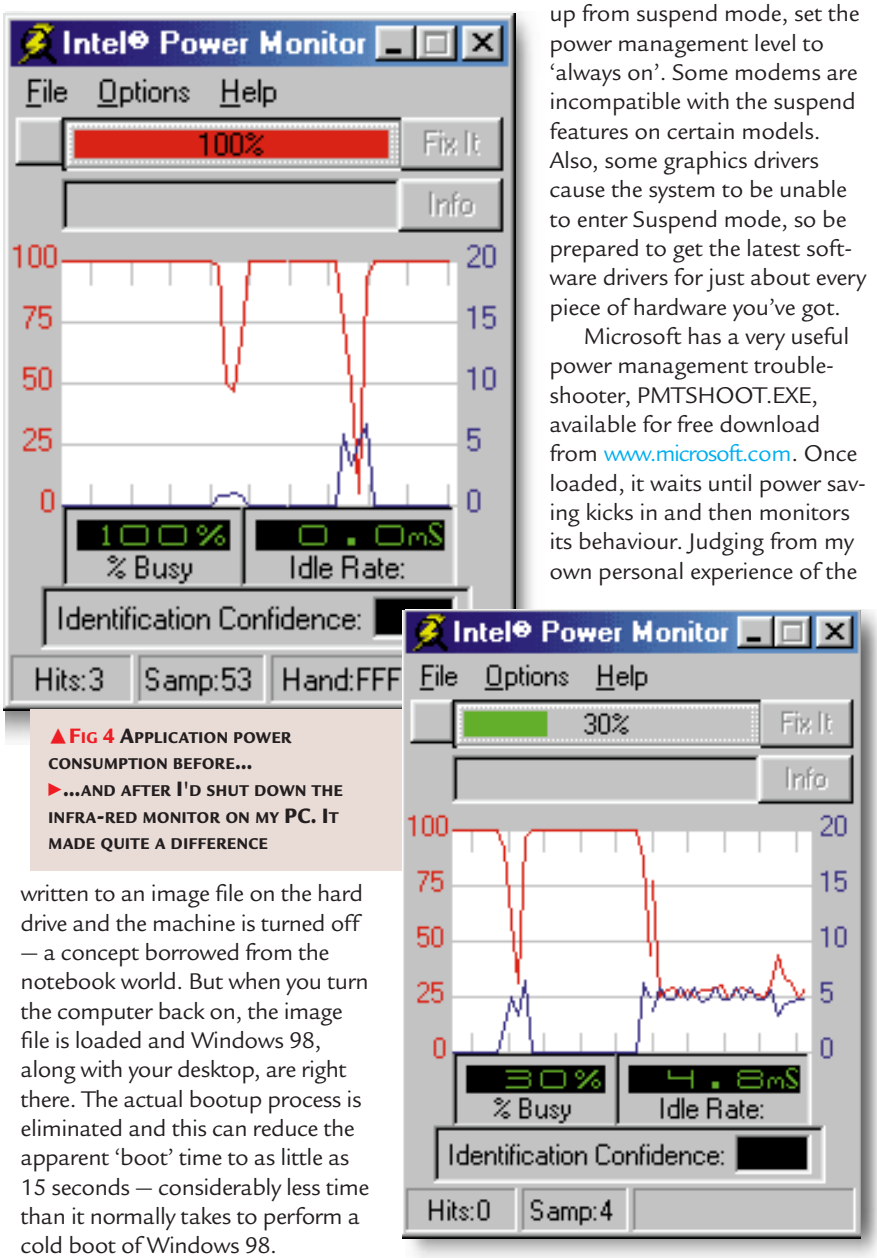
The hibernation mode is part of a feature which Microsoft calls OnNow. Essentially, when the computer goes into hibernation, everything in memory is written to an image file on the hard drive and the machine is turned off — a concept borrowed from the notebook world. But when you turn the computer back on, the image file is loaded and Windows 98, along with your desktop, are right there. The actual bootup process is eliminated and this can reduce the apparent 'boot' time to as little as 15 seconds — considerably less time than it normally takes to perform a cold boot of Windows 98.

I'm afraid to say my previous experience of APM wasn't too hot and initial experiences of ACI are not much better, with systems being variously un-rousable from their ACPI slumbers. I've also had problems with the 'soft' power button as a result. When it's set to initiate a standby or hibernation, if the machine hangs, then your ultimate sanction if the three-fingered salute doesn't work (flicking the Big Red Switch isn't available any more) it's yank-the-lead-out time.

When a power-hungry application starts, an alarm is triggered

If your system crashes when waking up from suspend mode, set the power management level to 'always on'. Some modems are incompatible with the suspend features on certain models. Also, some graphics drivers cause the system to be unable to enter Suspend mode, so be prepared to get the latest software drivers for just about every piece of hardware you've got.

Microsoft has a very useful power management troubleshooter, PMTSHOOT.EXE, available for free download from www.microsoft.com. Once loaded, it waits until power saving kicks in and then monitors its behaviour. Judging from my own personal experience of the efficacy of all power management schemes, I should have this running all the time!



▲ FIG 4 APPLICATION POWER CONSUMPTION BEFORE...
▶...AND AFTER I'D SHUT DOWN THE INFRA-RED MONITOR ON MY PC. IT MADE QUITE A DIFFERENCE

Intel Power Monitor

While meandering around the Intel web site I came across an interesting developers' tool; the Intel Power Monitor (IPM). This 3.8Mb free download can be found at channel.intel.com/mobile/techforum/sw.htm. This is strictly a developer utility but it does provide some interesting information on how applications affect power consumption... yes, *applications*. It seems that the next stage in the battle to save every last drop of power is to design applications which shut down their components as they're not used: for example, word processors which shut down their spell checker because it's not used continuously. Incidentally, Office 2000 will be one of the first power-conscious applications on the market, making it a must for the mobile user.

The Intel Power Monitor helps you observe how applications consume power when open. Another window in IPM lets you monitor hardware power consumption, too. The idea is to run IPM in the background while using your PC. When a power-hungry application starts, an audible alarm is triggered.

Note that while IPM is running, your PC may seem sluggish and unresponsive. I ran it on my Win98 system and saw some depressingly high power consumption scores recorded on the moving graph. Wondering what was causing such high CPU consumption, I shut down one or two background tasks. When I shut down the Windows 95 infra-red monitor, CPU consumption dropped to a more reasonable level. As you can see in Fig 4, the difference is dramatic!

PCW CONTACTS

We welcome your comments about the Hardware column. Send them to Hands On at the PCW editorial office (address, p10) or email hardware@pcw.co.uk

Power management web sites:
- *www.microsoft.com/hwdev/desinit/acpifaq2.htm*
- *www.microsoft.com/hwdev/onnow.htm*
- *www.teleport.com/~acpi*
- *http://developer.intel.com/technology/iapc/*