

**new power  
management  
on hp pcs**

whitepaper

[www.hp.com/go/desktops](http://www.hp.com/go/desktops)



**i n v e n t**

## Why is Power Management Important?

Power management is essential because it:

- Helps cut power costs by reducing the amount of energy used by PCs
- Allows the PC to meet and even exceed energy consumption regulations worldwide.

## APM

Advance Power Management (APM) was the first major open industry standard developed to meet power management needs in personal computers.

APM is controlled from the PC's BIOS. The BIOS establishes a connection with an operating system driver and in this way provides power management instructions to the operating system.

APM was provided on all HP PCs, and has been successful in reducing the energy consumption of millions of PCs worldwide. However, the computing world has changed radically in the few years since APM was developed. Recent leaps in technology and new uses for PCs have rendered APM ill-equipped to deal with power management tasks.

These emerging APM drawbacks include:

- Difficulty in meeting the increasingly strict power saving regulations
- Diminished availability. Computers are increasingly being used for demanding tasks requiring 24-hour availability. A PC that goes into an APM low power mode is unavailable for use and remains so until it has gone through the lengthy wakeup or startup procedure.

Typically, there has been a strict trade-off between PC availability and the energy saving achieved.

## ACPI

The latest technology is ACPI (Advanced Configuration and Power Interface). This is an open industry standard created by, among others, Microsoft and Intel. It addresses the drawbacks in APM and incorporates many improvements.

Unlike APM, ACPI is controlled by the operating system. This allows easier control and configuration of power management (since the operating system is more accessible).

ACPI also drastically reduces the trade-off between energy saving and PC availability. Now you can have

a PC that is available 24 hours a day, with highly reduced wakeup times, yet still save energy by using low power sleep modes.

The specific advantages of ACPI over APM include:

- **New Hibernate mode**

This is a very low power consumption mode that also allows the PC to be quickly available. In Hibernate mode the PC appears to be switched off (power off). The PC system context is saved to hard disk and then reloaded (after the BIOS is initiated) for a fast wakeup. This is implemented in Windows 2000 and can be used in any recent or new HP PC.

- **Resistance to power failure**

The Hibernate mode is resistant to power failure as the OS state is saved to hard disk, so power out during Hibernation will not cause memory loss. The OS and current program states are saved until power is restored when the PC can automatically reload the last state and continue operation.

- **Suspend to RAM**

This is similar to the Hibernate mode described above, only there is less power saving and wakeup is faster, since the system context is saved in main memory. This is available on selected HP PCs.

- **Highly configurable**

Since control is centered in the operating system, you can configure ACPI power management parameters more easily. (APM is centered in the BIOS and requires you to restart the PC to configure power management.) ACPI also provides more features, with a wider range of configuration parameters, offering higher flexibility and greater user control. This is advantageous to both users and systems administrators (for desktop management tasks).

- **A configurable power switch**

This feature allows system administrators to choose what the PC does when the user presses the power switch. You can select very low power sleep states (Hibernate) or ultra-fast wakeup (Standby) for increased availability. This is discussed in "The Power Button and Unexpected Wakeup" on page 6.

- **More open to evolution**

The ACPI standard not only allows the operating system and hardware to perform coordinated power management, it also allows power management technology to evolve independently in the operating system and in the PC hardware.

- **More robust and reliable**  
ACPI allows improved coordination between the operating system and the PC hardware, as well as centralized control by the operating system, making it more robust and reliable.












These advantages are only available if you are using an ACPI-based operating system, such as Windows 98 Second Edition or Windows 2000.

## How Does ACPI Work?

### Hibernate Mode

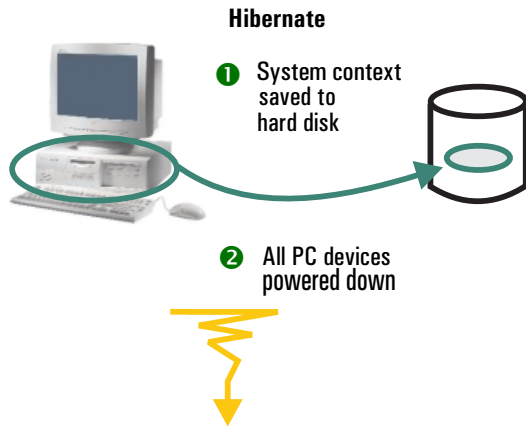
The Hibernate feature is an example of how ACPI power management is implemented in Windows 2000.

The PC can be configured to go into Hibernate mode when the user presses the power button, or after a preset delay when the PC is not being used.

ACPI Power Management States		This table shows the ACPI power management states. You can use this as a guideline when configuring power management to achieve power saving goals.			
State	Operating System Name	Explanation	Wakeup by Network Possible	PC Power Use (proportional)	Time Required by the PC to Become Available
S0	On	The PC is in this state during normal use. All devices in the PC are usually powered on.	✗		
S1	Standby	The lightest sleep state. The PC hardware maintains its context. Usually, only the monitor and disks are powered off. The operating system goes on Standby.	✓		
S2	—	Similar to S1 except CPU and cache are also powered off. <i>This state is not currently used.</i>	Not Used		
S3	Standby/ Suspend	In ACPI, called 'Suspend to RAM'. System context is saved to main memory and is then used for a fast wakeup. This Standby mode S3 is used instead of mode S1 on PCs that support it.	✓		
S4	Hibernate	All devices in the PC are powered off. PC context is saved to hard disk and is then used for a fast startup. The operating system shuts down. During wakeup from mode S4, the BIOS re-initializes and the operating system performs a fast startup using the disk image.	✓		
S5	Shut Down	In ACPI, called Soft Off. The operating system shuts down. During wakeup from S5, the BIOS re-initializes and the operating system performs a complete reboot. See "The Power Button and Unexpected Wakeup" on page 6.	✓ [see note*]		

\* **Remote Power On from S5 State:** Current Operating Systems (up to Windows 2000, Service Pack 2) do **not** support RPO from S5. However, new HP BIOSs will support RPO from S5 mode. Check the HP websites dedicated to your PC model (see page 6) for news and BIOS updates.

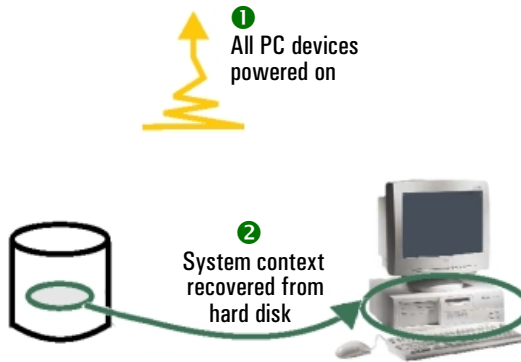
This illustration shows how the Hibernate mode works.



The PC's system context (contents of main memory, position of all programs, etc.) is stored on hard disk and then all devices are powered off. The PC goes into state S4.

When the PC gets a wakeup command, it initiates the BIOS then reloads the system context from the hard disk. In this way the PC starts up very quickly from where it left off, becoming quickly available for the task at hand.

#### Wake Up from Hibernate



The events that trigger the PC to wake up from Hibernate mode are:

- Pressing the PC's power button (or the space bar on PCs that support this feature)
- A scheduled event (such as a late-night backup)
- A wakeup command from the network (typically, for desktop management tasks such as an automatic software upgrade)
- An incoming call on a modem.

### Suspend to RAM Mode

The new "Suspend to RAM" mode (S3) works in a similar fashion, except that the system context is saved to main memory. This state uses more power since the

main memory must be maintained to preserve the system context. However, since main memory is faster than the hard disk, wakeup takes less time from "Suspend to RAM" mode.

The same events that trigger the PC to wake up from Hibernate mode also work for Suspend mode. Additionally, pressing any key on the PS/2 keyboard can also wake the PC up from Suspend to RAM mode (this keyboard wakeup can be disabled in the OS power management options).

Under Windows 2000, ensure the OS option "Suspend to RAM" has been selected in **Start > Settings > Control Panel > Power Options** if you want to activate this mode.

## Which Operating Systems Support ACPI?

Operating System	ACPI Mode Supported			
	S1	S3	S4	S5
Windows NT 4	No integrated power management			
Windows 95	APM only			
Windows 98 Gold	APM recommended			
Windows 98 SE	✓	✓	✗	✓
Windows 2000	✓	✓	✓	✓
Linux	APM only			

### Windows 2000

Windows 2000 is currently the operating system that has the most complete ACPI power management features.

From the Windows Start menu, the user has the option to Shut Down (S5) or go into Hibernate mode (S4) if this is enabled in Power Management, or go into Standby (S3 or "Suspend to RAM").

Windows 2000 power management options are configurable from the **Power Options** icon in **Start > Settings > Control Panel**. Here you can set the action of the PC's power switch to instigate Standby (S1 or S3), Hibernate (S4), or shut down the PC (S5).

You can also select the devices allowed to signal a wake-up to the system. The wake-up is carried out when an event is received from any of the devices you have set as 'active' in the **Power Management** tab of **Device Manager** (the **Device Manager** can be opened from **Start > Settings > Control Panel > System > Device Manager**).

To set a device input to wake-up the PC under Windows 2000, from your desktop right-click on the **My computer** icon. Select **Properties > Hardware > Device Manager**. Click on the device to select it (for instance **Keyboard**) then right-click on the highlighted device and select **Properties**. Go to the **Power Management** tab and toggle the option "Allow this device to bring the computer out of Standby".

Check that the BIOS Power Management options are configured correctly to enable ACPI with OS control. The available BIOS options depend on the version of BIOS in your PC (see tables on page 6). It is worthwhile to view the BIOS Setup to confirm which options are available and active, particularly if you have upgraded to Windows 2000 from an earlier OS.

## Windows 98

Windows 98 Second Edition also implements ACPI power management, although the features are not as rich as Windows 2000. In particular, there is no Hibernation mode in Windows 98.

Windows 98 First Release also supports ACPI power management. However, most of the HP PCs shipped with Windows 98 First Release have an APM BIOS by default. If you use Windows 98 First Release on these systems, HP recommends that you use APM power management.

## Windows 95

Windows 95 supports APM but not ACPI. If you use Windows 95, APM power management is recommended.

## Windows NT 4

Windows NT 4 does not include any built-in support for power management. However, HP provides Soft PowerDown, a Windows NT utility offering a useful power management feature.

## For More MS Windows Information

For more information about Windows operating systems, refer to Microsoft's web sites:

[www.microsoft.com/windows](http://www.microsoft.com/windows)

## Linux

APM is supported. Recent Linux kernels support ACPI. LINUX v2.4 with ACPI will be available early in 2001. For full information see LINUX documentation for your version and/or FAQs on line (many sites).

## Implications and Recommendations for the HP PC User

From the user's point of view, many of the features provided by APM and ACPI are similar but they do not always work in the same way.

### Standby Modes S1, S2, S3

Operating Systems may refer to the modes S1, S2 and S3 as 'Standby' without always making clear the differences between these three modes.

When the user selects a Standby option in the OS, the software will decide which of these modes is compatible with the software/hardware environment and also checks the wake-up capabilities of the hardware present, as some hardware can only be woken from mode S1. The sleep-mode compatible with these parameters and also providing the greatest power saving (deepest sleep) is selected.

This selection is necessary as some hardware cards do not support S3, which is a relatively new standard.

When not sure if a PC is in mode S1 or Suspend to RAM mode S3, test by opening the CD tray using the pushbutton control. If the tray opens, this indicates that the PC is in mode S1.

## hp moves forward with acpi

HP is fully committed to ACPI and its advantages. All new HP PCs support most ACPI features and ship with Windows 98 Second Edition or Windows 2000, Microsoft's latest operating systems which support ACPI.

In fact, HP has been committed to ACPI for some time. Most HP PCs shipped in the last few years have both APM and ACPI implemented in the BIOS, allowing you to choose the power management scheme to best fit your needs. So you can even benefit from many of the advantages of ACPI when you update to Windows 98 SE or Windows 2000.

To learn if your HP PC supports Windows 2000, consult the white paper "HP Windows 2000", available at [www.hp.com/desktops/windows2000](http://www.hp.com/desktops/windows2000)

Power States available to HP PC models

HP PC model	The PC Supports these States				RPO* for APM and/or ACPI
	S1	S3	S4 (Hibernate)	S5 (Shut Down)	
HP Vectra VLi8	S1	-	S4	S5	ACPI check BIOS version
HP Vectra VL400	S1	S3	S4	S5	ACPI check BIOS version
HP Vectra VL600	S1	Does Not Support S3	S4	S5	ACPI check BIOS version
HP Vectra VL800	S1	S3	S4	S5	ACPI check BIOS version
HP Kayak XU800	S1	Does Not Support S3	S4	S5	ACPI check BIOS version
HP Kayak XM600	S1	S3	S4	S5	RPO for APM for ACPI check BIOS version
HP e-pc c10 HP e-pc s10 HP e-vecetra	S1	S3	S4	S5	for ACPI check BIOS version
HP Brio BA410	S1	S3	S4	S5	RPO for APM only

\* To support RPO from S5 the BIOS version and Driver version must *both* support RPO in S5 mode. See table below.

Remote Power On from S5 Mode

HP PC Model	3com LAN	HP LAN	OS supporting RPO*		1st BIOS version to support RPO	1st 3com LAN driver to support RPO	1st HP LAN driver to support RPO
			W2K	W98			
HP Vectra VLi8	bundled	-	support	preload	<b>HZ.01.10</b>	ED 5.20	-
HP Vectra VL400	onboard	-	preload	preload	<b>IP.01.05</b>	ED 5.20**	-
HP Vectra VL600	bundled	-	preload	preload	<b>WHY.01.07</b>	ED 5.20	-
HP Vectra VL800	bundled	-	preload	support	<b>[release early 2001]</b>	ED 5.20	-
HP Kayak XM600	option	bundle	preload	support	<b>IC.11.09</b>	ED 5.20	ACC 1035
HP e-pc c10 HP e-pc s10 HP e-vecetra	onboard onboard onboard	- - -	preload	preload	<b>IN.02.00</b>	ED 5.20	- - -

The HP BIOS versions listed here are current or soon to be released. Check the HP website for your model of HP PC to find details.

\* In all cases RPO is supported from the Shutdown mode (not from First Boot or Failure states)

\*\*Also identified as "3C520HP" or by the 3COM version No.1.80.0000

## The Power Button and Unexpected Wakeup

The operating systems Windows 2000 and Windows 98 SE both enable software-configuration of the PC's power-on button. Depending on the chosen configuration, the push-switch may not behave like a hard-wired on/off switch, and the user should no longer expect it simply to turn off the PC's power supply. The PC could instead go into a power saving mode such as Hibernate, where it is still under tension.

Furthermore the PC can automatically power on, for example for scheduled maintenance or remote management. Users should realize that the PC can "turn itself on" and that this is normal behavior.

PCs with a network card supporting RWU (Remote Wake Up) can be woken up by the network in this way.

Most non-ACPI PC models equipped with a network card that supports Remote Wake Up or RPO (Remote Power On) can also be woken up or restarted by the network.

It may be difficult to discover if the PC is in a low power state or is turned off (electrically isolated from the power source).

Considering these points, before any maintenance action you should wake the PC and carry out a shut down (S5) to ensure it is correctly powered off. Always remove the PC power cable from the socket before any maintenance actions. This ensures that the PC is 'off' and disconnected from the power source. Please read current HP documentation on "Servicing the PC" before starting an intervention.

For the reasons described in “Desktop Management”, it is recommended that you configure the power button to **Hibernate** when running Windows 2000, or to Standby if it is available on your PC model, running either Windows 2000 or Windows 98 SE. This ensures that you can perform remote management. In addition these options provide a more rapid restart than the system cold boot.

Your PCs can safely remain in one of these two states when not in use, and need to be turned off only when maintenance or physical relocation of the PC is necessary.

## Using the Mouse

The mouse cannot be used to wake up the PC from Standby or Hibernate. To wake up the PC from Standby, the user can press any key on the keyboard (from S1 only, on some HP PC models), the keyboard space bar (on some HP PC models), or the PC power button.

The mouse is considered too unstable to be an effective wake-up agent, as it is subject to accidental movement or may even pick up vibration from the environment, causing unwanted wake up.

To wake up from Hibernate mode, the user must press the PC power button or the space bar on models that support this feature.

On some older non-ACPI HP PCs, the mouse could be used to wake the PC from a custom sleep state similar to Standby. This sleep state is no longer used since power management states are now standardized.

## For System Administrators

### Recommended Operating Systems

To make use of the ACPI features provided by new HP PCs, you need Windows 98 SE or Windows 2000. In fact, on new HP PCs, one of these operating systems will be provided preloaded on the hard disk or on the CD that comes with the PC.

For the fullest set of ACPI features with HP PCs, Windows 2000 is recommended. For example, Hibernate mode is only available on new HP PCs when using Windows 2000.

For manageability, Windows 2000 is recommended rather than Windows 98 SE.

### Desktop Management

New and recent HP PCs running Windows NT or Windows 95 can be powered on from the off state using RPO (Remote Power On).

However, for HP PCs running Windows 98 SE, or running Windows 2000 with ACPI, you require the new HP BIOS versions which support RPO from S5

under Windows 2000 and ACPI. These BIOS versions will be announced as they become available in 2000 and early 2001.

If you are planning to use remote desktop management on ACPI-based PCs, with current HP BIOS versions you should not make use of the off state (S5). Instead, Hibernate is recommended, since you can then wake up the PCs remotely using RWU (remote wake up). To ensure that Soft Off is not used, you must reconfigure the power button.

Also, it is possible to remove the **ShutDown** option from the Windows **Start > ShutDown** menu. To learn how to do this, refer to Microsoft’s hardware white paper “Windows Power Management Configuration Tools Design Notes and Reference”, available at

[www.microsoft.com/hwdev/desinit/wpmtools.htm](http://www.microsoft.com/hwdev/desinit/wpmtools.htm)

### Enable RPO

To enable Remote Power On, several settings may be necessary:

- In the driver (e.g. under Windows 98). Power settings are accessed in **Start > Settings > Control Panel > Power**
- In the BIOS (options vary depending on the BIOS). At boot, press **F2** to open the BIOS settings and select **Power Management**.

For networked PCs the BIOS settings may also be altered remotely using HP Tootools. See the HP Tootools documentation or website for more information.

### HP Utilities

HP Utilities that provided power management features in non-ACPI based systems are to be phased out and are not available for Windows 98 SE or Windows 2000. The features provided by these utilities are now provided by Microsoft’s ACPI-based operating systems.

HP Utility	Non-ACPI Systems		ACPI Systems	
	Win 95	Win NT4	Win 98 SE	Win 2000
HP Safe Off	✓	n.a.	Feature provided by operating system	
HP NT Lock	n.a.	✓		
HP Soft PowerDown	n.a.	✓		

### Servicing the PC

Before upgrading or servicing the PC, it is very important to ensure that the PC is off (in S5 mode) and not in Hibernation mode (S4).

If the PC is in Standby mode, there will be a flashing or yellow indicator light on the PC’s front panel.

There is no way of telling if the PC is in Hibernate mode. The best way to ensure that the PC is not in Hibernate mode is to restart the PC then shut it down. To do this, select **Shut Down** from the **Start** menu then under the heading '**What do you want the computer to do?**' select the option '**Shut Down**' from the drop-down list.

### If the Shut Down Option Has Been Removed

If the '**Shut Down**' has been removed from the list of options, the following procedure is recommended to ensure the PC is not serviced while in S4 mode.

Procedure:

- 1 Restart the PC by selecting **Start > Shut Down** and then choosing '**Restart**' from the drop-down menu.
- 2 When the PC has fully shut down and is just beginning to restart (you will see the initial Brio, Vectra, Kayak or HP logo), press the power switch to shut down the PC.
- 3 Remove the power cable to isolate the PC.

Alternatively, you can log on to the PC as Administrator and then activate the **Shut Down** option in **Start > Settings > Control Panel > Power Options**. The choice '**Shut Down**' will then be available in the dropdown menu headed '**What do you want the computer to do?**'. Use this to choice to shut down the computer and then remove the power cable.

Once servicing or upgrading has been completed, the PC will perform the full startup procedure, taking into account any changes to the PCs configuration.

Note that if the PC is serviced (power off) while in the Hibernate mode, the power up sequence may easily cause an OS crash with unpredictable and undesirable effects.

This is particularly the case when the hardware configuration has been altered in the serviced PC. Hibernate will assume there has been no power interruption and will attempt to reload the previous OS state from the hard disk without verifying the state of any hardware present (which may require initialization after a power out).

The full boot from S5 checks all hardware and carries out all initialization required.

### Power Loss in the Different Power Management States

If the PC loses power in S1 or S3 Standby mode (through a power failure in the building or by pulling out the PC's power cord), you will lose any unsaved data. In this case it is just as if the PC lost power while it was on.

If the PC loses power in Hibernate (S4) or soft off (S5) mode however, there will be no data loss. In fact, it is as if the PC was already powered off.

## RPO 'out of the box'

New HP PC are delivered preloaded and ready to function 'out of the box' as soon as they are powered up.

However, the Remote Power On (RPO) function requires a continued power supply to operate correctly. When your HP PC comes 'out of the box' it is in a state equivalent to a power interruption.

To set up RPO, you should connect up all peripherals and switch on the PC. Enable the **Hibernate** option then put the PC into Hibernation mode by selecting **Start > Shutdown > Hibernation**. The computer is now able to respond to any RPO request.

From the box:

- 1 Connect all PC peripherals and power cable
- 2 Press the Power Switch to power-up the PC
- 3 After the OS is running, enable Hibernate in **Start > Settings > Control Panel > Power Options**.
- 4 Put the computer into the Hibernate mode by selecting **Start > Shut Down > Hibernate**.

Alternatively, If your PC fully supports RPO from S5 and you have enabled the option in the BIOS, you can put the PC into Hibernate mode simply by pressing the Power Switch a second time.

The PC is now in Hibernate mode and 'set' for RPO.

Note: it is possible that at the next use of the PC following this initialization a glitch will be noticed (once only) when the PC restarts. This is normal, and is dealt with by the PC during the course of the restart. Your HP PC is now operative.

## For More Information

- The ACPI web site  
[www.teleport.com/~acpi](http://www.teleport.com/~acpi)
- The ACPI Specification  
[www.teleport.com/~acpi/spec.htm](http://www.teleport.com/~acpi/spec.htm)
- Microsoft's web site on power management, ACPI, APM, and Windows operating systems  
[www.microsoft.com/hwdev/onnow](http://www.microsoft.com/hwdev/onnow)
- Microsoft's hardware white paper "Windows Power Management Configuration Tools Design Notes and Reference" is available at  
[www.microsoft.com/hwdev/desinit/wpmttools.htm](http://www.microsoft.com/hwdev/desinit/wpmttools.htm)
- Intel's web site on 'Instantly Available' and ACPI technology  
[developer.intel.com/technology/iapc](http://developer.intel.com/technology/iapc).
- HP's white paper "HP Windows 2000" discusses the support offered for Windows 2000 (including its power management features) on HP Desktop PCs. It is available at  
[www.hp.com/desktops/vectra/library.html](http://www.hp.com/desktops/vectra/library.html)