



Windows[®] 98 Power Management on ThinkPad Notebooks

Information Brief

Introduction

The introduction of Microsoft Windows 98 brings with it a new power and system management method called Advanced Configuration and Power Interface or ACPI. This information brief introduces power management concepts and discusses the differences between ACPI and its predecessor, Advanced Power Management (APM). High level descriptions of APM and ACPI are given. If you desire more detail, please refer to the World Wide Web references listed at the end of the brief. The objective of this brief is to provide enough knowledge so that you can make an informed decision about which power management method best suits your needs now and in the future.

In addition to the information contained in this paper about power management on Windows 98, the Web site contains additional information about Windows 98 in general and how to install it on existing ThinkPad notebooks.

What is power management?

Notebook designers employ power management features to provide users with the longest possible battery life, smallest notebook size and lightest weight. Power management is based on one key fact: a computers' resources are seldom fully utilized. In other words, the printer port, serial port, PCMCIA cards, and even the processor are not all used all the time, and even when they are used, they are often not used at 100% of their capacity. As a result, there is an opportunity to save battery power by turning these devices off in much the same way as you save electricity by turning the lights off when you leave a room.

Power management implementations vary from system to system. Some power management operations are easily noticed. These include turning the LCD backlight, the hard disk, or the system fan on or off. Other power management actions are designed to be transparent to the user. These include turning on or off parts of the computer like the ports, CD-ROM drive, modem and PC Cards when they are not being used. The trick is to keep these devices off as much as possible but not interfere with the operation of the system. A perfect power management implementation would be totally transparent to the user and would not provide power to anything that wasn't in use.

Power management and your ThinkPad notebook

The ThinkPad product line has long been known for its excellent power management. In addition to making the computers easy to use and providing them with long battery life, power management has enabled ThinkPad notebooks to be smaller and lighter than many competitors' models.

The following features are just a few power management-related features that have been available on ThinkPad computers:

- The power-saving modes (Standby, Suspend, and Hibernation) stop all tasks when the computer is not used for a specified time.
- 'Suspend' and 'Resume' allow you to interrupt and return to your work without shutting down.
- 'Suspend' allows you to treat your computer just like a notebook – simply close it and put it away when you finish working.
- 'Resume on Ring' answers the phone and receive faxes even when the system is "off."
- 'Standby' stops the hard drive and turns the display off.
- 'Hibernate' and 'RediSafe' save the state of the computer on the hard disk to help ensure that you can resume operation where you left off, even if the system is powered off for an extended period of time.

These features as well as many more have been provided by ThinkPad notebooks using APM, and most of these will also be available when ThinkPad notebooks begin using ACPI.

Power management implementation--under the covers

Implementing power management is a very complex task. It requires finding the right balance of power conservation, system performance and usability. Up until now, the task of implementing the power management algorithms has been given to system designers to put in a system's hardware, BIOS, and system unique device drivers. This makes the task especially difficult because although the system can tell what resources have been and are being used, it has no way of knowing what resources are about to be used. This means that the system needs to try to predict what the application is going to do and ensure that any required resources are powered on when needed. If they are not powered on, the power management code must turn them on in a manner that doesn't disrupt the application and do so quickly enough that the computer's performance is not impacted.

The ThinkPad development team has done an outstanding job of implementing power management. This has enabled ThinkPad computers to have excellent battery life without sacrificing performance or requiring large batteries.

APM

Advanced Power Management or APM was introduced to provide a standard application programming interface (API) for power management. As described before, the majority of the power management decisions have been made by the system's hardware, BIOS and system specific applications or device drivers. APM's role was to enable some cooperation between the system and its operating system for power management operations. For example, APM provides the interface that allows the operating system to report the remaining battery capacity.

It also provides the communication mechanism between the system and the operating system to determine if the computer is ready to go into Standby or Suspend mode.

The actual power management code is largely implemented in BIOS or special code specific to a given system and thus, implementations varied greatly. This caused a large disparity in the level of function and the user interfaces between various computer manufacturers. The IBM ThinkPad notebook has one of the most advanced power management implementations and makes power management as transparent to the user as possible. There are also manual controls for advanced users. These controls enable users to do things like setting the speed of the system's processor, so that it can be set to a slower speed for longer battery life when away from the office and sped up for maximum performance while on AC power.

ACPI

ACPI stands for Advanced Configuration and Power Interface. ACPI is initially being introduced on Windows 98 and will also be featured on Windows NT 5.0. Its major improvement over APM is that it moves the bulk of power management decisions from the computer to the operating system and applications. The operating system and the applications know more about the system's current and future activity and are thus better able to manage the power state of the system. For example, in the future, applications supporting ACPI will tell the operating system when they need a lot of processor performance and when they are just waiting for input. The operating system will use this information to regulate the speed of the processor and thus its power consumption. In order for ACPI to realize its full promise and operate in this mode, a significant number of applications need to be rewritten as ACPI-aware applications. When this happens, ACPI should provide an improvement in power management over APM without requiring any decisions on the part of the user.

In the meantime, ACPI provides a similar level of performance to APM, but it does not allow some of the more "hands on" controls, such as the ability to set the microprocessor speed to a slower speed while on battery power to extend the battery life.

What's not in ACPI?

Along with the consistency and improved operation without user intervention that ACPI provides, comes the disadvantage of losing manual control of a number of features that were introduced by the ThinkPad team with APM. Some of the features not supported in the initial release of ACPI include:

Function	Description
Microprocessor speed control	Under Windows 95 and Windows 98 with APM, you can manually adjust the microprocessor speed. This allows you to slow the system down to conserve power when away from the office.
Power control using the power switch	Under Windows 95 and Windows 98 with APM, the power switch can be programmed to behave as a power switch or to put the system into Suspend or Hibernate modes. Under Windows 98 with ACPI, the power switch can be programmed only to Shutdown or Standby.
RediSafe	Under Windows 95 and Windows 98 with APM, this function combines the safety of Hibernating (saving the computer state to the hard disk) with the speed and convenience of Suspend. During RediSafe operation, the computer's state is retained in memory as well as on the hard disk. Doing this provides extra protection for user data and ensures that the computer's state can be recovered even if the system is left for an extended period of time.
Hot or warm bay device swapping	ThinkPad 770 and 600 series products running under Windows 95 or Windows 98 with APM have IBM-developed code that allows the bay devices to be swapped without restarting the system. This does not work under Windows 98 with ACPI.
Function keys to control power states	Under Windows 95 and Windows 98 with APM, ThinkPad computers provide hot keys to allow the fuel level to be queried, the display to be turned off and the system power mode to be changed. These keys do not function under Windows 98 with ACPI. Additionally under APM, separate keys are provided for Suspend and Hibernation. Under ACPI only one function can be programmed to either Suspend or Hibernate.

Status and where to find more information

The latest Windows 98 and ACPI status for ThinkPad computers will be posted on <http://www.pc.ibm.com/us/accessories/thinkpad/windows98.html>

This brief is being written as Microsoft prepares to release the retail version of Windows 98. At this time, while ACPI shows a great deal of promise for the future, there are still numerous problems affecting operation of ACPI on ThinkPad and other systems. Therefore, new ThinkPad notebooks come with Windows 98 running in APM mode.

Many ThinkPad notebooks, including the 770 series and the new 600 series, have been, and are being announced, as being "ACPI ready." ACPI ready means that even though current ThinkPad notebooks do not come with ACPI installed, the system's hardware and BIOS support it. When the remaining issues with ACPI are resolved, an upgrade package will be made available on the IBM Web site. That upgrade package will contain operating system updates, device driver updates, and BIOS updates as necessary to make ACPI work reliably.

Specifications and more technical information on ACPI can be found on the Web at <http://www.teleport.com/~acpi/>. Similar APM information is available at <http://pentium.intel.com/ial/powermgm/apmovr.htm>.

In summary, the ThinkPad team is committed to providing its customers with the very best power management and usability. Ultimately this will be provided with ACPI, but at this time, APM is more stable and provides more utility.

For more information

For information via the World Wide Web	www.pc.ibm.com
For product and dealer location information	1 800 426-2968
To access the IBM PC Company Bulletin Board	1 919 517-0001
For product information sent directly to your fax machine	1 800 IBM-3395 (1 800 426-3395)
ThinkPad Catalog	Doc #11078
PC Desktop Catalog	Doc #11079
Servers Catalog	Doc #11080

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