Runtime Power Management

v1.0

Introduction

Computer processor manufacturers are incorporating the ability to manage power use directly into their newer processors. Processors recently released by both Intel and AMD include features that work with the BIOS and operating system to lower power consumption. Along with being more environmentally friendly, reduced power consumption results in reduced heat production. Less heat means lower fan speed requirements, thereby providing quieter, more efficient computers.

What is EIST?

Enhanced Intel SpeedStep Technology (EIST) is the term Intel uses for its processor power management technology. This processor feature allows the system to dynamically adjust processor voltage and core frequency as often as is required to decrease power consumption and decrease heat production. The processor alters performance by changing bus-to-core frequency ratio and voltage. Only the internal core frequency is altered - the front side bus (FSB) is not affected. To run at reduced power consumption, the voltage is changed in step with the bus ratio.

What is Cool'n'Quiet

Cool'n'Quiet is the term AMD uses for its processor power management technology. This processor feature dynamically adjusts the operating frequency and voltage of a processor up to 30 times per second depending on the CPU load. When full processor performance is not needed, the processor slows its frequency, resulting in significant power savings, which results in cooler and quieter performance.

While Cool'n'Quiet technology is new to desktop processors, a similar technology from AMD has been used in mobile processors for several years. This mobile processor technology is known as PowerNow!

Why are EIST and Cool'n'Quiet needed?

EIST and Cool'n'Quiet were created to lower power consumption when software activity does not require the full capabilities of the processor. Reduced power consumption means reduced operating costs and reduced heat production. Reduced heat production means reduced fan speed requirements. Reduced fan speed requirements also mean reduced system noise.

This technology is also especially useful for portable computers, as reduced power consumption leads to increased battery life.

What are the required components for EIST and Cool'n'Quiet to function?

For a system to take advantage of EIST or Cool'n'Quiet, the following system components must support the feature:

- Processor
- Chipset
- System BIOS
- Operating system
- Processor driver

Processor

Intel's 600 and 800 series processors support EIST. AMD's Athlon 64 line of processors support Cool'n'Quiet. Both technologies may become a standard feature for future processors.

Chipset

EIST requires the Intel 915 or later chipset. Current HP business desktop systems with qualifying chipsets include:

Intel 915:

- dc5100
- dc7100
- dx6100 (not available in North America)

Intel 945:

- dc7600
- dx7200 (not available in North America)

Cool'n'Quiet requires the ATI RS480/SB400 (Radeon Xpress) chipset. Current HP business desktop systems with qualifying chipsets include:

ATI RS480/SB400:

- dx5150

System BIOS

You can enable or disable the Runtime Power Management (RTPM) option in the BIOS of Intel 915 and 945-based systems. This option is located in F10 Setup in the **Power/OS Power Management** section. The default EIST BIOS support setting depends on several factors:

EIST Support	TM2 Support	Default Runtime Power Management (RTPM) Setting
Yes	Yes	RTPM Option Shown in F10 Setup - Enabled
No	Yes	RTPM Option Shown in F10 Setup - Disabled
No	No	RTPM Option Not Shown in F10 Setup

Thermal Monitor 2 (TM2) is an older Intel processor feature that allows CPU throttling to slow down the processor. EIST will replace TM2. Some older processors support TM2, but do not support EIST, while even older processors do not support either TM2 or EIST. All processors shipped with HP i915 and i945 systems support both EIST and TM2.

You can enable Runtime Power Management (RTPM) on systems that only support TM2. This setup allows the BIOS to control processor throttling. EIST uses the operating system to control throttling.

For processors that support both EIST and TM2, CPU throttling is controlled by EIST and the operating system. The HP BIOS controls CPU throttling on TM2-only processors, resulting in support for RTPM. See "Known Issues" on page 9 for possible compatibility issues. There is no RTPM capability for processors that do not support EIST or TM2.

You can enable or disable the AMD Cool'n'Quiet option in the BIOS of the HP dx5150. This option is located in F10 Setup in the **Power Management Options** section. The default Cool'n'Quiet support for HP dx5150 systems is set to **Auto (enabled).**

Operating System

Microsoft implemented EIST support in Windows XP Service Pack 2. All future Microsoft operating systems will include EIST support.

Several Microsoft operating systems support Cool'n'Quiet, including Windows XP, Windows 2000, and Windows ME. All future Microsoft operating systems will include Cool'n'Quiet support.

Processor Driver

Microsoft Windows controls the performance of a processor with the kernel power policy manager, a processor driver, and the system BIOS. The kernel power policy manager sets the rules for using the correct performance state at a given time. Once the performance state is determined, Windows uses the processor driver or system BIOS to make the changes. The processor driver changes the performance state if the processor is not Hyper-Threaded (HT). The system BIOS changes the performance state if the processor is HT-enabled.

The use of a processor driver, such as the generic *processr.sys*, allows Windows to interact and control different processors - for example, Intel, AMD, and Transmeta. Vendor-specific processor drivers are also available, such as *intelppm.sys* for Intel processors in Windows XP Service Pack 2. You can add support for future processors, if needed.

The processor performance control policy is linked to the power management scheme. See the table in the Power Management Scheme section for detailed information about the relationship between power management scheme and control policy.

There are four control policies:

- Constant - Always runs at lowest performance state.
- Adaptive - CPU usage determines performance state.
- Degrade - Starts at lowest performance state and slowly reduces performance as battery discharges (notebooks only).
- None - Always runs at highest performance state.

Power Management Scheme

EIST will function only if the operating system is using an adaptive power management scheme. The following table shows the relationship between power scheme and the control policy used.

Power Scheme	AC Power	DC Power
Home/Office Desk	None	Adaptive
Portable/Laptop	Adaptive	Adaptive
Presentation	Adaptive	Degrade
Always On	None	None
Minimal Power Management	Adaptive	Adaptive
Max Battery	Adaptive	Degrade

For more information about processor performance control, go to:

http://www.microsoft.com/whdc/system/pnppwr/powermgmt/ProcPerfCtrl.mspx

Power Scheme - Adaptive or Not

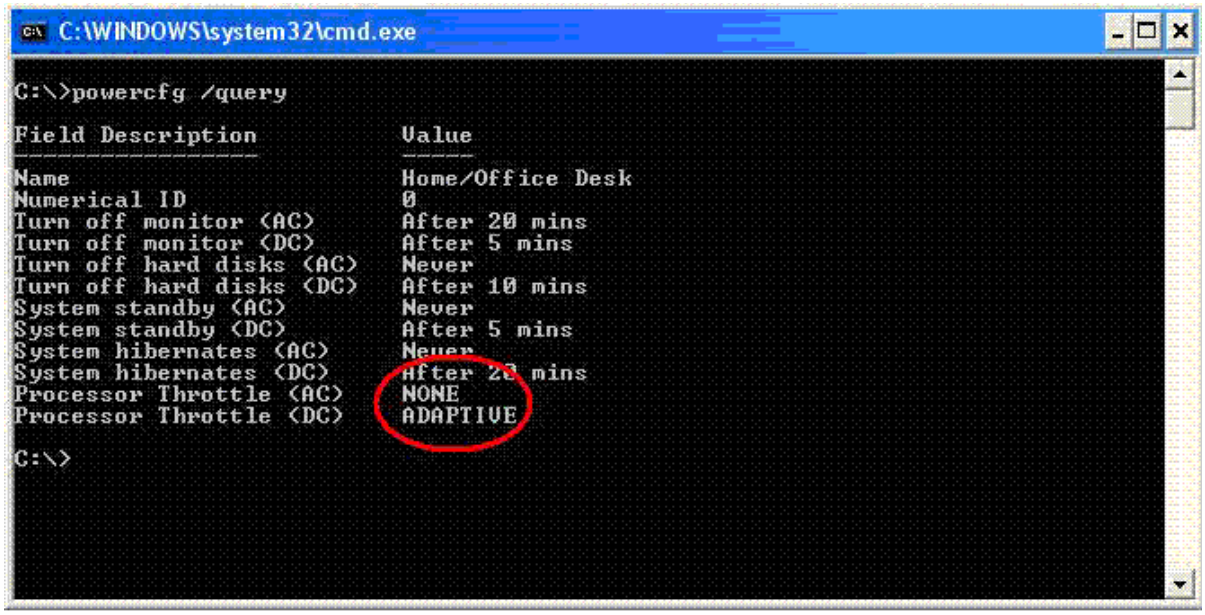
An adaptive power scheme allows the operating system to dynamically adjust performance of a processor (frequency and voltage) according to the amount of processor usage. You can determine whether a power management scheme is adaptive. If a power management scheme has not been modified, it will have the default processor performance control policy. However, a modified power scheme will not provide external notification regarding its current control policy.

To verify processor performance control policy, perform the following steps:

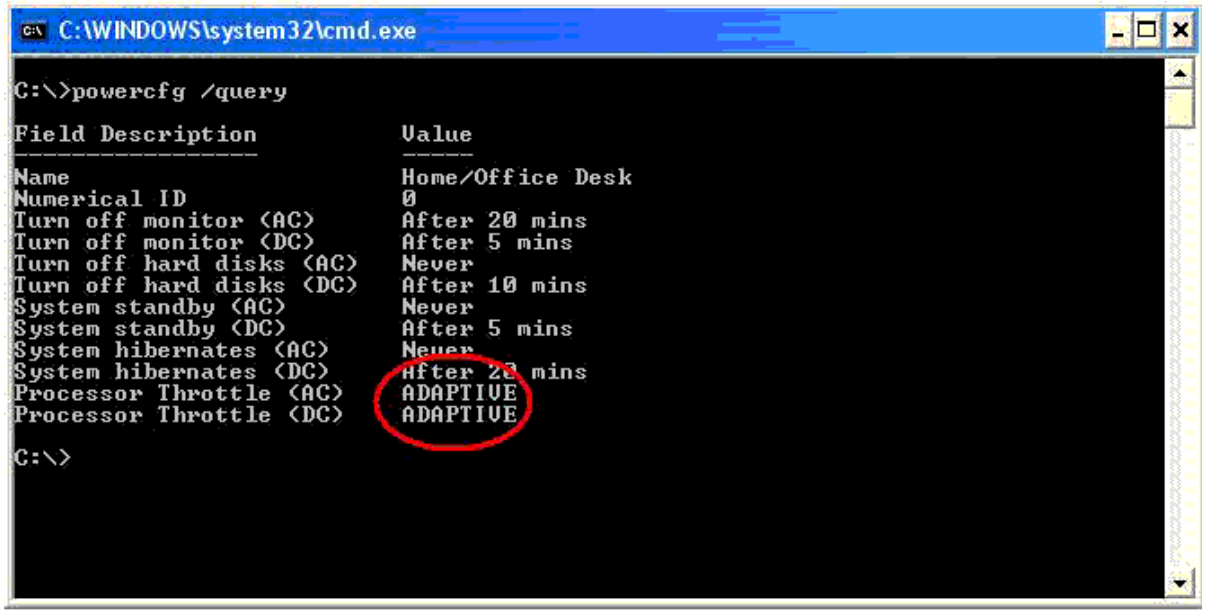
1. Click **Start** > **Run**.
2. Type `CMD`.
3. Type `powercfg /query`.

The system displays the current power configuration. **Processor Throttle <AC>** and **Processor Throttle <DC>** indicate which control policy is implemented when the system is using AC power or battery power.

Home/Office Desk in default state

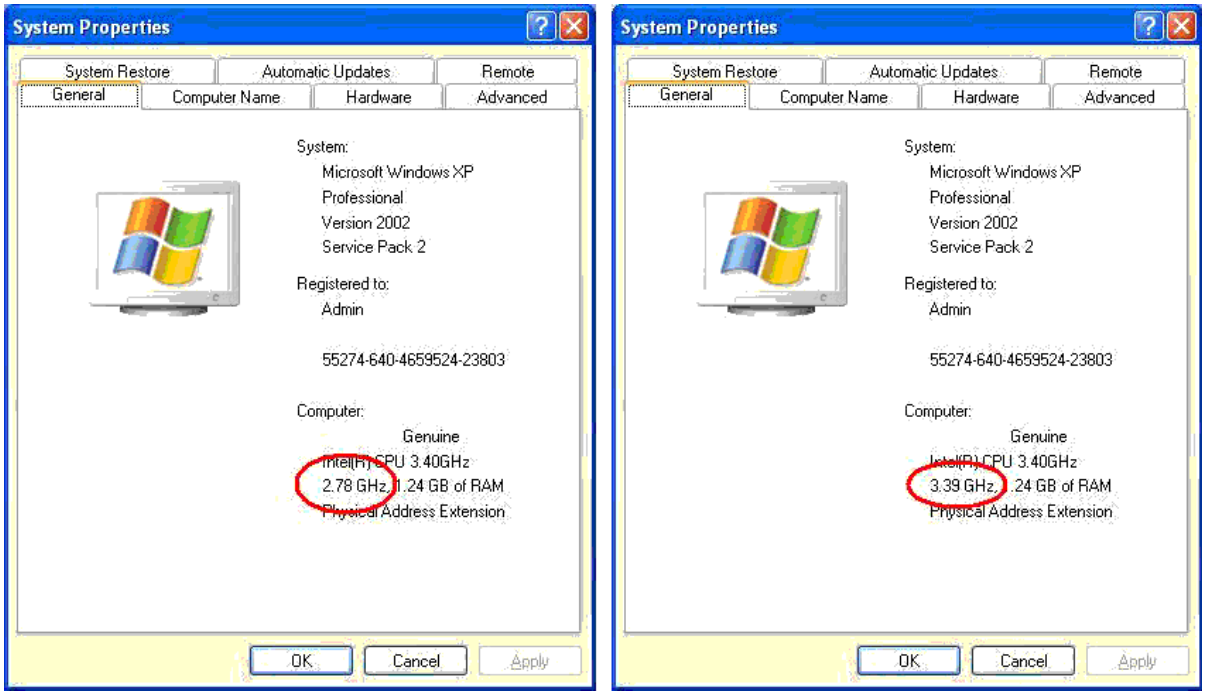


Home/Office Desk in adaptive state



System Properties - EIST

The System Properties window displays current processor speed on computers installed with an EIST-capable processor and Windows XP Service Pack 2 that are using an adaptive power scheme. The following images illustrate a drop in processor speed for an Intel Pentium 4 system (3.4 GHz) under throttled conditions with EIST both enabled and disabled.



Maximum Processor Speed

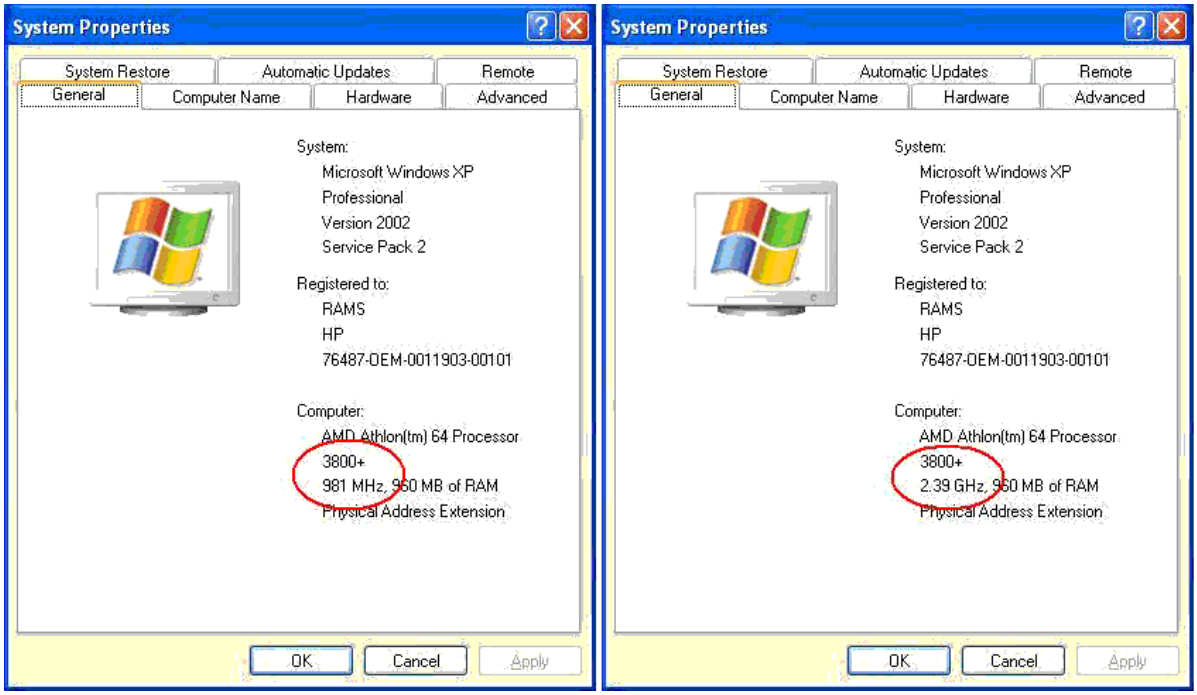
You can check the maximum speed setting for systems with EIST or Cool'n'Quiet enabled by performing the following steps:

1. Click **Start** > **All Programs** > **Accessories** > **System Tools** > **System Information**.
2. Locate the **Processor** listing.

   The maximum speed of the processor (listed in MHz) displays in the right pane next to **Processor**. The System Information screen reports only the maximum speed of the processor.

System Properties - Cool'n'Quiet

The System Properties window displays current processor speed on computers installed with a Cool'n'Quiet-capable processor and Windows XP Service Pack 2 that are using an adaptive power scheme. The following images illustrate a drop in processor speed for an AMD Athlon 64 3800+ system (2.4-GHz) under throttled conditions with Cool'n'Quiet enabled and disabled.



How will EIST and Cool'n'Quiet impact HP Customers?

HP tests its images and deliverables for EIST and Cool'n'Quiet compatibility. These tests include:

- Applications bundled with HP bPC computers
- Operating system images bundled with HP bPC computers
- Peripheral drivers bundled with HP bPC computers
- Samples of popular applications and games

By default, the **Home/Office Desk** power scheme that is shipped with the HP image is non-adaptive. This means that under normal circumstances, a system will not see any power saving benefits with an EIST or Cool'n'Quiet capable processor. HP resolves this issue by making the Home/Office Desk power scheme adaptive using the Microsoft supplied *powercfg.exe* utility. During unbundling, if the system contains an EIST or Cool'n'Quiet- capable processor, the **Home/Office Desk** power scheme is modified.

Advantages of using EIST/Cool'n'Quiet

Enabling EIST/Cool'n'Quiet provides the following benefits:

- Increased power savings.
- Lower operating costs.
- Less heat production.
- Potential for less noise from slow fan speeds.

Disadvantages of using EIST/Cool'n'Quiet

There are no known disadvantages to using EIST/Cool'n'Quiet if you use the latest HP BIOS and/or the latest service packs for Microsoft operating systems.

Known Issues

- There are known EIST compatibility issues for i915/i945 systems using older Intel processors, older HP BIOS, and older Windows XP service packs. These problems may include both Windows blue screens and operating system hangs/delays. These issues have been fixed in the following:
  - HP BIOS for DDR i915 systems - 786C1 v2.14 or later
  - HP BIOS for DDR2 i915 systems - 786C2 v1.06 or later
  - Windows XP Service Pack 2
  - Windows Server 2003 Service Pack 1

  Systems running Windows XP Service Pack 2 with older Intel processors that only support TM2 do not provide RTPM capability. Windows XP Service Pack 2 supports RTPM for only EIST processors.
- Windows XP may report inaccurate processor speed. For more information about this issue, as well as information about determining processor speed, see the following Microsoft Knowledge Base articles:

  http://support.microsoft.com/default.aspx?scid=kb;en-us;316965&Product=winxp

  http://support.microsoft.com/default.aspx?scid=kb;en-us;888282
- Windows XP on portable computers may display the following message: STOP 0x000000D1. For more information about this error message, see the following Microsoft Knowledge Base article:

  http://support.microsoft.com/default.aspx?scid=kb;en-us;888399

Resources for EIST and Cool'n'Quiet

The following web sites provide additional information about EIST and Cool'n'Quiet.

http://www.intel.com/cd/channel/reseller/asmo-na/eng/products/box_processors/desktop/proc_dsk_p4/technical_reference/203838.htm

http://www.amd.com/us-en/Processors/ProductInformation/0,,30_118_9485_9487%5E10272,00.html

http://www.amd.com/us-en/Processors/TechnicalResources/0,,30_182_871_9706,00.html

Frequently Asked Questions

Q: How can I verify if my electricity bill is actually lower?

A: To perform an isolated test, you can hook the system up to a power meter to see how much power a computer uses when EIST is on or off.

Q: Does the "speedstep" or "Cool'n'Quiet" feature cost more?

A: These features are incorporated into newer processors and have minimal affect on processor pricing.

Q: What will the lower power do to the performance of my system?

A: The lower power consumption has no affect on perceived system performance. While the system does operate at a reduced speed, it only does so for applications that require lesser speeds, so the actual performance of these applications is not affected. You will not see a performance drop since the processor only throttles down when the extra speed would have been wasted anyway.

Q: If an application requires more performance, how long will it take the system to return to full performance state?

A: When the processor determines that greater performance is required, it can return to full performance state immediately. The user will perceive no loss in performance.

Q: Does the constant variation in processor speed reduce the quality of the product?

A: No. In actuality, the added functionality provided by the ability to vary processor speed increases the quality of the product.

Q: Does the integration of this functionality imply that the processor speeds available are really too great for standard needs?

A: No. This functionality simply provides more flexibility when you use applications that require less processor performance. Today's world constantly offers more applications that require greater processor performance. And while you may use these resource-intensive applications, you will likely also use applications, such as email, that do not require full processor capability.

Q: If I have a system that supports this – can I turn it off in the BIOS without disrupting the system configuration or the software image?

A: Yes, you can turn off EIST/Cool'n'Quiet support in the BIOS at any time with no software impact. Doing so simply means you will not conserve power.

Q: If after the feature is turned on and runs for a while, if the system performance worsens, should I turn the feature off before calling support?

A: Turning off the feature can be a good debug step before calling support. However, if performance worsens after a significant amount of time, the chances of a relation to EIST is low. Testing has indicated no noticeable performance degradation.

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