Athlon Powersaving HOWTO

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2007−06−06

Revision History

Revision 1.2.3	2007−06−06	Revised by: dn
corrected the correction from 1.2.3 (thx to Rajeev V. Pillai)		
Revision 1.2.2	2007−05−30	Revised by: dn
corrected a typo in the nforce disable command		
Revision 1.2.1	2007−05−13	Revised by: dn
corrections to the new copyright statement, corrections to the disclaimer		
Revision 1.2	2007−05−10	Revised by: dn
coolrun added, new URL for (brazilian) Portuguese Version, License Change (GNU FDL to GNU GPL), some minor accessibility related changes		
Revision 1.1.12	2006−04−06	Revised by: dn
typos corrected		

How to enable the power−saving functionality of the Athlon/Duron/AthlonXP processor on some motherboards/chipsets. This is usefull for saving Power and lowering the Temperature of the CPU and the System. (It also will reduce noise if you use temperature controlled fans in your case/on your cpu heatsink).

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1. Introduction

1.1. Basics on the Athlon Power Saving Mode

The HLT signal which is used by the normal idle−loop of the Linux kernel doesn't normaly bring any significant power−saving on processors of the Athlon/Duron family (hereafter referred to as Athlon processors). To get real power−saving on an Athlon processor, you have to put the processor in the STPGNT−Mode (Stop Grant Mode). In this mode, the processor is disconnected from the front−side bus (FSB), and can turn off parts of the CPU as well as reduce the clock to save power.

Some modern Motherboards/Chipsets also support a Function to make a STPGNT when a HLT signal is detected.

1.2. Copyright and License

1.3. Disclaimer

1.4. Feedback/Questions/Support

Feedback is most essential for this document. New solutions for new chipsets are especially needed, as are comments, whether the provided solutions work or don't work. Also please report spelling errors if you find them, cause i am no native english speaker. Send your additions, comments, criticisms and questions to the following email address: `<daniel@nofftz.net.NOSPAM>`. *You can email me in German or English!*

If you want to support me, you could donate through Paypal (to the same email−adress) or send me some new Hardware to play with. ;)

1.5. New Versions of this Document

The newest version of this HOWTO will always first be made available at: http://www.daniel.nofftz.net/linux/

The sourcecode of this HOWTO is hosted at the Linux Documentation Project or can be requested from me.

2. The Different Approaches

In the following section I present different approaches to achieve the same goal: power−saving on your Athlon/Athlon−XP based system. My recommended approach at the moment is to use the "command−line hack" or the athcool programm (the kernel patch is outdated and will not be developed any further, and the LVCool patch supports only one chipset family.)

Nearly all of these approaches will set the " Disconnect enable when STPGNT detected" bit in the north bridge of the chipset. All other work is done by the ACPI subsystem of the kernel which sends a STPGNT signal to the processor, when it enters the acpi−c2 idle mode.

If you haven't already got a kernel with ACPI support, you have to enable it in the kernel setup and then recompile the new kernel. You'll find the ACPI−options under General Setup+Power Management Setup−>ACPI. You must have at least the following options: ACPI Bus Manager, System and Processor.

Or for the new 2.4.22 Kernel: General Setup+ACPI Support. You must have at least the following option: Processor.

2.6.x Kernel: Powermanagment options+ACPI. You must have at least the option Processor enabled. You shouldn't enable Thermal Zone !!

Some Chipsets also support a STPGNT if a HLT signal is detected. This Motherboards/Chipsets don't need ACPI to be enabled! At the moment i look for feedback which Chipsets work without ACPI and which need ACPI. Maybee you could test it on your Motherboard and send me a mail. (see Section 3.1)

2.1. The Command−line Hack (recommended)

To use the command−line hack you normaly have to enable ACPI in the kernel, otherwise it is mentioned. No reboot is needed to enable the Powersaving. You could enable/disable it from the command line with this commands:

on KT133/133A, KX133, KL/KLE133, KM/KN133, ...: (needs definitively acpi enabled)

enable: **setpci −v −H1 −s 0:0.0 52=$(printf %x $((0x$(setpci −H1 −s 0:0.0 52) | 0x80)))**

disable: **setpci −v −H1 −s 0:0.0 52=$(printf %x $((0x$(setpci −H1 −s 0:0.0 52) & 0x7f)))**

on KT266/266A/333,KM266/266A/333, ...:

enable:

setpci −v −H1 −s 0:0.0 92=$(printf %x $((0x$(setpci −H1 −s 0:0.0 92) | 0x80)))

setpci −v −H1 −s 0:0.0 95=$(printf %x $((0x$(setpci −H1 −s 0:0.0 95) | 0x02)))

disable:

setpci −v −H1 −s 0:0.0 92=$(printf %x $((0x$(setpci −H1 −s 0:0.0 92) & 0x7f)))

setpci −v −H1 −s 0:0.0 95=$(printf %x $((0x$(setpci −H1 −s 0:0.0 95) & 0xfd)))

on KT333CF/KT400/KT400A/KM400/KM400A/KT600:

enable:

setpci −v −H1 −s 0:0.0 D2=$(printf %x $((0x$(setpci −H1 −s 0:0.0 D2) | 0x80)))

setpci −v −H1 −s 0:0.0 D5=$(printf %x $((0x$(setpci −H1 −s 0:0.0 D5) | 0x02)))

disable:

setpci −v −H1 −s 0:0.0 D2=$(printf %x $((0x$(setpci −H1 −s 0:0.0 D2) & 0x7f)))

setpci −v −H1 −s 0:0.0 D5=$(printf %x $((0x$(setpci −H1 −s 0:0.0 D5) & 0xfd)))

on KT880:

enable:

setpci −v −H1 −s 0:0.0 82=$(printf %x $((0x$(setpci −H1 −s 0:0.0 82) | 0x80)))

setpci −v −H1 −s 0:0.0 85=$(printf %x $((0x$(setpci −H1 −s 0:0.0 85) | 0x02)))

disable:

setpci −v −H1 −s 0:0.0 82=$(printf %x $((0x$(setpci −H1 −s 0:0.0 82) & 0x7f)))

setpci −v −H1 −s 0:0.0 85=$(printf %x $((0x$(setpci −H1 −s 0:0.0 85) & 0xfd)))

on SIS730/733:

enable: **setpci −v −H1 −s 0:0.0 6B=$(printf %x $((0x$(setpci −H1 −s 0:0.0 6B) | 0x01)))**

disable: **setpci −v −H1 −s 0:0.0 6B=$(printf %x $((0x$(setpci −H1 −s 0:0.0 6B) & 0xfe)))**

on SIS735/740/745/755:

enable: **setpci −v −H1 −s 0:0.0 6A=$(printf %x $((0x$(setpci −H1 −s 0:0.0 6A) | 0x0003)))**

disable: **setpci −v −H1 −s 0:0.0 6A=$(printf %x $((0x$(setpci −H1 −s 0:0.0 6A) & 0xfffc)))**

on SIS741/741GX/746/748:

setpci −v −H1 −s 0:0.0 6C=$(printf %x $((0x$(setpci −H1 −s 0:0.0 6C) | 0x0003)))

disable:

setpci −v −H1 −s 0:0.0 6C=$(printf %x $((0x$(setpci −H1 −s 0:0.0 6C) & 0xfffc)))

on Nforce:

enable:

setpci −v −H1 −s 0:0.0 E7=$(printf %x $((0x$(setpci −H1 −s 0:0.0 E7) | 0x06)))

disable:

setpci −v −H1 −s 0:0.0 E7=$(printf %x $((0x$(setpci −H1 −s 0:0.0 E7) & 0xf9)))

on Nforce2: (works without acpi enabled)

enable: **setpci −v −H1 −s 0:0.0 6F=$(printf %x $((0x$(setpci −H1 −s 0:0.0 6F) | 0x10)))**

disable: **setpci −v −H1 −s 0:0.0 6F=$(printf %x $((0x$(setpci −H1 −s 0:0.0 6F) & 0xef)))**

on AMD751 and AMD760/761:(not for the 760MP!!!)(works without acpi enabled)

enable: **setpci −v −s 0:0.0 0x62=$(printf %x $((0x$(setpci −H1 −s 0:0.0 62) | 0x06)))**

disable: **setpci −v −s 0:0.0 0x62=$(printf %x $((0x$(setpci −H1 −s 0:0.0 62) & 0xf9)))**

2.2. The coolrun shellscript (recommended)

coolrun is a small shellscript which uses the command line hacks and does all the work for you. It is developed/maintened by Grozdan Nikolov and based on this HOWTO.

You can read more about it (and download it) here: https://sourceforge.net/projects/coolrun/

2.3. The Athcool Program (recommended)

Athcool is a small program which performs the same task as the **setpci** commands above. It supports the same chipsets and detects what chipset you have, issuing the right settings in the chipset to get the power−saving to work.

You can read more about it (and download it) here:
http://members.jcom.home.ne.jp/jacobi/linux/softwares.html *I am not the Author of this program!*

2.4. BIOS updates

On some newer boards the manufacturer provides a BIOS update which sets the needed bit/bits in the chipset of the board (or let you choose in the BIOS−setup whether it should be enabled). Refer to the homepage of your motherboard manufacturer to see if such a BIOS−update is available.

2.5. Kernel Patches

The patch is based on another patch (from Jan Niehusmann) I found on the Newsnet. I modified the patch to also support the KT266/266A chipset. By the way, my patch does the same as the command−line hack, except that the Patch does it from within the kernel. This is why I recommend using the command−line hack, which is really simple to use and you don't have to modify your kernel.

Ok... now step by step, here's how to apply the patch:

1. First you have to download the patch:

   Kernel Patch for 2.4.17

   Kernel Patch for 2.4.21 (thx to Thomas Reinhardt for porting it to 2.4.21)

   Kernel Patch for 2.6.5 which supports all Via Chipsets up to the KT600 (thx to Sebastian Droege for porting it to 2.6.5 and adding the other Chipsets)

   Kernel Patch for 2.6.9 which supports all Via Chipsets up to the KT600 (thx to Alexander Hug for porting it from 2.6.5 to 2.6.9)
2. Login as root
3. **cd /usr/src**
4. Apply the patch: **cat $path−to−patch/amd_cool.diff | patch −p0** (The new 2.6.5 Patch: cd to linux and patch −p1)
5. **cd linux**

6. Make the new kernel
7. Reboot, and at the kernel boot−prompt, enter the statement **`amd_disconnect=yes`** . This is because there are known bugs within the Athlon processor, which could cause problems on several boards. You should test the patch, and if it works, you can append the statement **`amd_disconnect=yes`** to the file `/etc/lilo.conf`.

2.6. The LVCool Solution

LVCool is a small port of the Windows programm VCool. It only supports the KT133/133A and KX133 chipset and I can't provide support for it. You can download it here. This solutions needs no ACPI compiled in the kernel.

2.7. The FVCool Program

Here is another Powersaving program which supports several chipsets. I didn't test it by myself but i heared it works. Check it out ... There is also a program provided with which you could use the onboard monitoring chips on some motherboards (like the lm−sensors package).

2.8. AMD 760MP Powersaving

There is a kernel module which enables powersaving on the 760MP multiprocessor chipset. You could find it here. I don't know how good it works, but i got at least one mail from someone who said it works for him. So check it out.

3. What Else?

3.1. How to test whether it works

Ok ... you use one of the described powersaving possibilitys and you want to verify, whether it works. Here are two ways to check it:

If you have temperature controlled Fan on your CPU−Heatsink, you could check for the noise level of the Fan to see whether it works or not. After a few idle minutes you give the CPU somthing to do.

I normaly do it like this:

1. get superuser (root)
2. **cd /usr/src/linux**
3. and give the computer something to do: **while true; do make clean; make bzImage; done**

After about 20 or 30 seconds you should notice that the noise of the fan is getting louder while the fan is getting faster. Don't forget to end the while−loop after some time (a few minutes) with STRG−C.

The same procedure as above works also with a monitoring program for the cpu−temperature (like lm−sensors, xmbmon and rtsensors).

3.2. Known Bugs/Problems

There are two known bugs in the Athlon/Duron processor. This is number 11 and number 14 in the *AMD Athlon Processor Revision Guide*. It looks like the Athlon XP is significantly less often affected by these bugs. So if you have an Athlon XP you are on the lucky side (like me).

There could be following problems (caused by the bugs):

- skips during sound playback
- skips and slowdown during video playback
- slowdown of the ultra−DMA harddisk transfers
- system hangs
- USB problems
- someone reported a high cheeping noise

Sometimes a BIOS−update will help (it exists as a workaround for bug 11, which could be done by the BIOS). But as far as I know there are only a few boards out there which have this workaround in the BIOS.

For the Asus A7V133−C, it is known that the BIOS−option `PCI master read caching` will solve most problems when it is enabled. So look at your BIOS to see whether it has such functionality.

It is also known that on some boards, the BIOS option `Delayed Transaction` solves some of the problems. You may want to give this option a try too.

WARNING: On boards with KT133A, this could enable the famous VIA−Southbridge bug!

From a Newsnet post, regarding Asus A7V:

* without delayed transaction: sound−skips and TV−skips
* with delayed transaction: no sound skips and only slight TV problems
* with delayed transcation and master read caching: nearly no TV problems and no sound skips at all

There are other causes for problems:

* the PSU is not strong enough to handle the fluctuations in the power consumption of the processor/motherboard
* some motherboard voltage−regulators could have the same problems like the PSU ;)
* you have a K7S5A (as far as I know, this board could be really wierd when power−saving is enabled)

If you have minor problems with power−saving enabled, and nevertheless want to use power−saving, you can enable the power−saving by default, and turn it off if you want to playback music, watch TV, ...

3.3. Fix for sound skips and other problems

Thank you to Michael Hamilton for submitting me the idea how it works.

The working of this Fix was confirmed by two People, so it looks like it works, but it may not work for everyone. Please feel free to submit further experiences!

Lets go: It looks like at least the sound skips are curable by maximizing the pci latency timer of the device.

First you have to find the "pci−address" of your Soundcard. This could be done with **lspci**. You have to look for something like "Multimedia audio controller" or "AudioPCI". Take the "pci−address" of the device (looks like something like that: 01:06.0 −> it stands for: bus:slot.function) and maximize the latency timer for it. This is done by setpci:

setpci −v −s "pci−address" latency_timer=ff

For additional Information on the Latency Timer you could look here.

Maybe this works also for other problems like USB−Problems and Harddisk−Transfer−Slowdowns, but this hasn't been tested for now. Feel free to test it (but don't blame me, if it doesn't work or makes everything worse) and report whether it works. The problem is, that i have none of this problems and so can't test this by myself.

If it works, you have to perform this setpci command at every startup/reboot of the Computer. So it would be wise to put it in one of the init−scripts (after the driver module is loaded!).

3.4. Another Fix for sound skips and other problems (on some Via−Chipsets)

Thank you to Wijatmoko Prayitno for submitting this!

The working of this Fix was confirmed for KT266, KT/KM333 and KT/KM400 Chipsets. It may also work for other Via−Chipsets. Please report if it works on other Via−Chipsets !

This is quite easy and works like the Commandline−Hack for enabling the Powersaving:

Soundfix on KT/KM333 and KT/KM400 Chipsets:

enable: **setpci −v −H1 −s 0:0.0 70=$(printf %x $((0x$(setpci −H1 −s 0:0.0 70) | 0x08)))**

disable: **setpci −v −H1 −s 0:0.0 70=$(printf %x $((0x$(setpci −H1 −s 0:0.0 70) & 0xf7)))**

If it works, you have to perform this setpci command at every startup/reboot of the Computer. So it would be wise to put it in one of the init−scripts (after the driver module is loaded!).

3.5. ToDo

Adding more chipsets and more informations to this document.

Adding some Informations on the Powersaving System of the Athlon64 and Opteron CPUs.

Adding some Informations on Notebooks and Power−Saving.

3.6. Translations

Translations into different languages also exist. At the moment, some of them are not up to date.

Hungarianby Zsolt Mocza

Spanish by Carlos Mayo (very out−dated)

brasilian Portuguese/Portuguese by Bruno Buys

French by Mathieu Pillard (very out−dated)

Italian by Maurizio Fantino (very out−dated)

German (only parts) by Fabian Mohren

Japanese by Seiji Kaneko