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TLP Settings

Contents

Introduction

All [TLP](#) settings are stored in the config file /etc/default/tlp. The [default configuration](#) provides optimized power saving out of the box. Some advanced features like turning off the optical drive and battery thresholds need to be activated explicitly.

The config file can be changed with any text editor (root privilege is needed). For example:

gksudo gedit /etc/default/tlp

Changes to the settings take effect after a reboot, a change of the power source or directly by

sudo tlp start

Hint: when installing updates of TLP, the package manager asks for confirmation before overwriting a changed config file with an updated version. Please refer to the [TLP FAQ](#).

Parameters

Power Saving

General hints:

- Parameters ending on _AC are effective with the power supply connected
- Parameters ending on _BAT are effective when running on battery
- Parameters containing blanks must be enclosed in double quotes ("")
- Some parameters are inactive by default; remove the leading '#' to activate

General

TLP_ENABLE=1

Set to 0 to disable TLP (Reboot needed).

TLP_DEFAULT_MODE=AC

Defines TLP's default operation mode (AC / BAT) in case a power source cannot be detected. Concerns some desktop and embedded hardware only.

TLP_PERSISTENT_DEFAULT=0

Select TLP's operation mode:

- 0 – apply settings acccording to actual power source (default mode)
- 1 – always use settings for TLP_DEFAULT_MODE

Hint: TLP_DEFAULT_MODE=BAT, TLP_PERSISTENT_DEFAULT=1 forces BAT settings while AC powered.

File System

DISK_IDLE_SECS_ON_AC=0
DISK_IDLE_SECS_ON_BAT=2

Values > 0 activate kernel laptop mode. Do not change this setting.

MAX_LOST_WORK_SECS_ON_AC=15
MAX_LOST_WORK_SECS_ON_BAT=60

Timeout (in seconds) for writing unsaved data in file systems buffers to disk.

Processor and Frequency Scaling

CPU_SCALING_GOVERNOR_ON_AC=powersave
CPU_SCALING_GOVERNOR_ON_BAT=powersave

Selects the CPU scaling governor for automatic frequency scaling. Configuration depends on the active driver:

intel_pstate

For Intel Core i 2nd gen. ("Sandy Bridge") or newer hardware. Supported governors are:

- powersave (recommended; kernel default)
- performance

acpi-cpufreq

For older hardware. Supported governors are:

- ondemand (recommended; default for most distributions)
- schedutil – new with kernel 4.7
- powersave
- performance
- conservative

Hints:

- To determine the active scaling driver and available governors, refer to the output of tlp-stat -p.
- powersave for intel_pstate and ondemand for acpi-cpufreq are power efficient for *almost all* workloads and therefore kernel and most distributions have chosen them as defaults. If you still want to change the scaling governor, you should know what you're doing!

- To use this setting you *must* disable your distribution's governor settings or conflicts will occur. See the [TLP FAQ](#).

CPU_SCALING_MIN_FREQ_ON_AC=0
CPU_SCALING_MAX_FREQ_ON_AC=9999999
CPU_SCALING_MIN_FREQ_ON_BAT=0
CPU_SCALING_MAX_FREQ_ON_BAT=9999999

Set the min/max frequency available for the scaling governor. Possible values depend on your CPU. For available frequencies consult the output of tlp-stat -p.

Hints:

- Do not use this setting with the [intel_pstate](#) scaling driver, use CPU_MIN/MAX_PERF instead (see below).
- Min/max frequencies have to be specified for battery *and* AC modes.
- To enable processor defaults comment all four settings and reboot.
- Lowering the max frequency on battery power does not conserve power. The best results are achieved by the ondemand governor without frequency limits.

CPU_HWP_ON_AC=balance_performance
CPU_HWP_ON_BAT=balance_power

Set energy performance hints (HWP) for the [intel_pstate](#) scaling driver. Possible values are (in order of increasing power saving):

- performance
- balance_performance
- default
- balance_power
- power

Hints:

- Requires Linux 4.10 and above
- Needs Intel Skylake or newer CPU

CPU_MIN_PERF_ON_AC=0
CPU_MAX_PERF_ON_AC=100
CPU_MIN_PERF_ON_BAT=0
CPU_MAX_PERF_ON_BAT=30

Define the min/max P-state for Intel Core processors. Values are stated as a percentage (0..100%) of the total available processor performance.

Hints:

- Requires the intel_pstate scaling driver, see above
- The driver imposes a limit > 0 on the min P-state, see min_perf_pct in the output of tlp-stat -p
- This setting is intended to limit the power dissipation of the CPU

CPU_BOOST_ON_AC=1
CPU_BOOST_ON_BAT=0

Disable CPU "turbo boost" (Intel) or "turbo core" (AMD) feature (0 = disable / 1 = allow).

Hints:

- A value of 1 does *not* activate boosting, it just allows it
- This may conflict with your distribution's governor settings

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SCHED_POWERSAVE_ON_AC=0
SCHED_POWERSAVE_ON_BAT=1

Minimize number of used CPU cores/hyper-threads under light load conditions (1 = enabled, 0 = disabled). Depends on processor model.

ENERGY_PERF_POLICY_ON_AC=performance
ENERGY_PERF_POLICY_ON_BAT=powersave

Define the general performance versus energy savings policy for the CPU. Possible values are (in order of increasing power saving):

- performance
- balance-performance
- default (deprecated: normal)
- balance-power
- power (deprecated: powersave)

Important: this setting requires the kernel module msr and the tool x86_energy_perf_policy matching your kernel version.

Kernel

NMI_WATCHDOG=0

Activate kernel NMI watchdog timer (0 = disabled/save power, 1=enabled). A value of 1 is relevant for kernel debugging and the watchdog daemon.

Undervolting

Hint: advanced Linux skills are necessary to use this feature.

PHC_CONTROLS="F:V F:V F:V F:V"

Frequency/voltage ID pairs for the undervolting of Intel processors. Assumes that a kernel with [PHC patches](#) is installed. For more information see the [PHC wiki](#).

Disks and Controllers

Note: TLP's default settings work well with SSDs, there is no immediate need to tune them.

Device Assignment

DISK_DEVICES="sda sdb"

Defines the disk devices the following parameters are effective for. Multiple devices are separated with blanks.

When using a 2nd disk in a swappable drive slot or the Ultrabay, the assignment of device names by the kernel (sda/sdb) can change possibly. In this case it is advisable to do the device assignment using IDs:

DISK_DEVICES="ata-INTEL_SSDSA2M160G2GC_XZY123456890 ata-HITACHI_HTS541612J9SA00_XZY123456890"

The command

tlp diskid

shows the IDs of all attached disks.

Advanced Power Management (APM)

DISK_APM_LEVEL_ON_AC="254 254"
DISK_APM_LEVEL_ON_BAT="128 128"

Set the "Advanced Power Management Level". Possible values range between 1 and 255.

Some selected values are:

- 1 – max power saving / minimum performance – **Important:** this setting may lead to increased disk drive wear and tear because of excessive read-write head unloading (recognizable from the clicking noises)
- 128 – compromise between power saving and wear (TLP standard setting on battery)
- 192 – prevents excessive head unloading of some HDDs
- 254 – minimum power saving / max performance (TLP standard setting on ac)
- 255 – disable APM (not supported by some disk models)
- keep – special value to skip this setting for the particular disk (synonym: _)

Values for multiple disks are separated with blanks.

Spin Down

DISK_SPINDOWN_TIMEOUT_ON_AC="0 0"
DISK_SPINDOWN_TIMEOUT_ON_BAT="0 0"

Timeout value until the spindle motor stops when the disk is idle. Valid settings:

- 0 – disabled
- 1..240 – timeouts from 5 seconds to 20 minutes (in increments of 5 seconds)
- 241..251 – timeouts from 30 minutes to 5.5 hours (in increments of 30 minutes)
- keep – special value to skip this setting for the particular disk (synonym: _)

Values for multiple disks are separated with blanks.

SSDs don't have moving parts, therefore this setting is "don't care" for them and can remain disabled.

Hint: stopping the system disk for extended periods of time is unlikely to work, because applications and system daemons wake up the disk frequently. However for a 2nd disk in a swappable drive slot or the Ultrabay that is not accessed permanently, this setting may be quite useful.

Disk I/O Scheduler

DISK_IOSCHED="deadline cfq"

Sets the I/O scheduler per disk. Possible values:

- cfq – Linux default, works well with both conventional HDDs and SSDs
- deadline – Linux default (newer kernels), works well with both conventional HDDs and SSDs
- noop
- bfq – recently proposed scheduler (needs custom kernel)

- keep – special value to use the kernel default scheduler for the particular disk (synonym: _)

Values for multiple disks are separated with blanks.

AHCI Link Power Management (ALPM)

SATA_LINKPWR_ON_AC=max_performance
SATA_LINKPWR_ON_BAT=min_power

Sets the power management mode for the SATA links connecting disk and optical drives. Possible values (in order of increasing power saving):

- max_performance – minimum power saving / max performance
- medium_power – medium power saving and performance
- med_power_with_dipm – best balance between power saving and performance (Kernel >= 4.15 required, then recommended)
- min_power – max power saving / minimum performance

Hint: to disable this setting completely, insert a '#' in the first column.

TLP 1.1 and higher determine automatically when med_power_with_dipm is available. For that a second value is provided in the default configuration as a fallback for older kernels:

SATA_LINKPWR_ON_AC="med_power_with_dipm max_performance"
SATA_LINKPWR_ON_BAT="med_power_with_dipm min_power"

Multiple values separated with spaces are tried sequentially until success.

SATA_LINKPWR_BLACKLIST="host1"

Exclude listed SATA host devices from link power management. Look into the output of tlp-stat -d, section "SATA Aggressive Link Power Management", to determine valid host identifiers (format: "hostX"). This is intended as a workaround for SATA host devices not bearing power management.

Separate multiple hosts with spaces.

PCI Express Bus

Active State Power Management

PCIE_ASPM_ON_AC=performance
PCIE_ASPM_ON_BAT=powersave

Sets [PCIe ASPM](#) power saving mode. Possible values:

- default
- performance
- powersave

Graphics Cards

Radeon (old)

RADEON_POWER_PROFILE_ON_AC=high
RADEON_POWER_PROFILE_ON_BAT=low

Controls the graphics card's clock. Supported by the radeon driver only, not fglrx. Possible values:

- low
- mid
- high
- auto – mid on battery, high on ac
- default – uses hardware defaults, clock control disabled

Hint: this setting makes the display flicker briefly upon changing the power source.

Radeon DPM (new)

Since kernel 3.11 the new radeon dynamic power management (DPM) is available. Supported by the radeon driver only, not fglrx.

Hint: needs the kernel boot option radeon.dpm=1.

RADEON_DPM_STATE_ON_AC=performance
RADEON_DPM_STATE_ON_BAT=battery

Controls the power management method. Possible values:

- battery – default on battery power
- performance – default on ac power

RADEON_DPM_PERF_LEVEL_ON_AC=auto
RADEON_DPM_PERF_LEVEL_ON_BAT=auto

Controls the performance level. Possible values:

- auto – recommended!
- low
- high

Networking

Wifi Power Management

WIFI_PWR_ON_AC=off
WIFI_PWR_ON_BAT=on

Sets wifi power saving mode. Adapter support depends on kernel and driver. Possible values:

- off – disabled
- on – enabled

Note: deprecated config values 1=off/5=on are supported for backwards compatibility.

Hint: power save can cause an unstable wifi link.

Wake On LAN

WOL_DISABLE=Y

- Y – Wake on LAN disabled
- N – Wake on LAN enabled

Hint: after enabling a restart is required to ensure that the new setting takes.

Audio

SOUND_POWER_SAVE_ON_AC=0
SOUND_POWER_SAVE_ON_BAT=1

Timeout (in seconds) for the audio power saving mode (supports Intel HDA, AC97). A value of 0 disables power save.

Hint: this setting can cause slight clicks in sound output.

SOUND_POWER_SAVE_CONTROLLER=Y

- Y – powers off the controller together with the sound chip
- N – controller active permanently

Drive Slot / **Ultrabay**

BAY_POWEROFF_ON_AC=0
BAY_POWEROFF_ON_BAT=0

- 1 – power off the optical drive
- 0 – optical drive remains on

BAY_DEVICE=sr0

Device file for the optical drive (default: /dev/sr0).

Hints:

- Re-power the drive by releasing and reinserting the drive slot/Ultrabay eject lever; on newer models push the media eject button
- Devices other than optical drives – in particular hard disk drives – are *not affected* by this setting

Runtime Power Management

RUNTIME_PM_ON_AC=on
RUNTIME_PM_ON_BAT=auto

Controls runtime power management for PCI(e) devices. Possible values:

- auto – enabled (power down idle devices)
- on – disabled (devices powered on permanently)

Hint: to disable this setting completely, insert a '#' in the first column.

RUNTIME_PM_BLACKLIST="00:12.3 00:45.6"

Exclude listed PCI(e) device addresses from runtime power management. Use lspci to lookup the addresses (first column).

RUNTIME_PM_DRIVER_BLACKLIST="amdgpu nouveau nvidia radeon"

Exclude PCI(e) devices assigned to listed drivers from runtime power management. Use tlp-stat -e to lookup the drivers (in parentheses at end of line). Separate multiple drivers with spaces.

The default (even when commented via '#') is "amdgpu nouveau nvidia radeon" to prevent accidental power on of hybrid graphics' discrete part. Use an empty list ("") to disable the feature completely (not recommended).

USB

USB_AUTOSUSPEND=1

Set autosuspend mode for all USB devices upon system start or a change of power source. Input devices like mice and keyboards are exluded by default (see USB_DRIVER_BLACKLIST below). Possible values:

- 1 – enable
- 0 – disable

Note: TLP activates USB autosuspend independent of the power source, i.e. on battery *and* AC.

USB_BLACKLIST="1111:2222 3333:4444"

Exclude USB device IDs from autosuspend mode. Useful for devices having difficulties in waking up from autosuspend. Use tlp-stat -u to determine IDs. Multiple IDs are separated with blanks.

Hint: all input devices (driver "usbhid") get excluded by default. It's therefore unnecessary to put them on the USB_BLACKLIST. To circumvent the default for certain devices enter the IDs into USB_WHITELIST.

Note: because of conflicts with udevd v221 (and higher) the parameter USB_DRIVER_BLACKLIST had to be removed with TLP version 0.8. Enter the device IDs to be excluded into USB_BLACKLIST instead.

USB_BLACKLIST_BTUSB=1

Exclude bluetooth devices from autosuspend mode:

- 0 – do not exclude
- 1 – exclude

Note: this feature is intended to solve stability issues with bluetooth connections.

USB_BLACKLIST_PHONE=1

Exclude smartphones from autosuspend mode to enable charging:

- 0 – do not exclude
- 1 – exclude

USB_BLACKLIST_PRINTER=1

Exclude printers from autosuspend mode:

- 0 – do not exclude
- 1 – exclude

USB_BLACKLIST_WWAN=1

Exclude *builtin* WWAN devices from autosuspend mode:

- 0 – do not exclude
- 1 – exclude

Note: this feature is implemented by an internal blacklist currently matching cards from Qualcomm, Ericsson and Sierra. To re-enable autosuspend mode for WWAN, enter the ID into USB_WHITELIST.

USB_WHITELIST="5555:6666 7777:8888"

Re-enable autosuspend mode for USB device IDs already excluded by any of the lists above (whitelist always wins). Use tlp-stat -u to determine IDs. Multiple IDs are separated with blanks.

USB_AUTOSUSPEND_DISABLE_ON_SHUTDOWN=1

Disables USB autosuspend mode upon system shutdown. This is intended as a workaround if suspended USB devices disturb the shutdown process.

Radio Device Switching

On System Start and Shutdown

RESTORE_DEVICE_STATE_ON_STARTUP=0

Restores radio device state (*builtin* bluetooth, wifi, wwan) from previous shutdown on system startup:

- 0 – disable
- 1 – enable

Hints:

- Debian and Ubuntu packages mask systemd-rfkill.service because it implements identical functionality. To mimic the systemd default behavior, set RESTORE_DEVICE_STATE_ON_STARTUP=1.
- The parameters DEVICES_TO_DISABLE_ON_STARTUP/SHUTDOWN below are ignored when this feature is enabled

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DEVICES_TO_DISABLE_ON_STARTUP="bluetooth wifi wwan"

Disables *builtin* radio devices upon system start:

- bluetooth
- wifi – Wireless LAN
- wwan – Wireless Wide Area Network (UMTS)

Multiple devices are separated with blanks.

DEVICES_TO_ENABLE_ON_STARTUP="bluetooth wifi wwan"

Linux enables all builtin radio devices by default. In case of exception you can use this setting to enable the missing devices upon system startup. Possible values are as above.

DEVICES_TO_DISABLE_ON_SHUTDOWN="bluetooth wifi wwan"

Disables builtin radio devices upon system shutdown. May be used as a workaround when enabled radio devices block the shutdown process. Possible values are as above.

DEVICES_TO_ENABLE_ON_SHUTDOWN="bluetooth wifi wwan"

Enables builtin radio devices upon system shutdown. May be used as a workaround to prevent other operating systems from missing disabled devices. Possible values are as above.

Upon Change of Power Source

Note: the following settings apply only at the moment where the power source actually changes (from AC to battery or vice versa).

DEVICES_TO_ENABLE_ON_AC="bluetooth wifi wwan"

Enables builtin radio devices when AC power is plugged in. Possible values are as above.

DEVICES_TO_DISABLE_ON_BAT="bluetooth wifi wwan"

Disables builtin radio devices when changing to battery power regardless of their connection state. Possible values are as above.

DEVICES_TO_DISABLE_ON_BAT_NOT_IN_USE="bluetooth wifi wwan"

Disables builtin radio devices that are not connected when changing to battery power. Possible values are as above.

Hint: do not use both DEVICES_TO_DISABLE_ON_BAT and DEVICES_TO_DISABLE_ON_BAT_NOT_IN_USE for the same radio device because DEVICES_TO_DISABLE_ON_BAT always has precendence.

ThinkPad Battery Charge Thresholds

ThinkPads only

START_CHARGE_THRESH_BAT0=75
STOP_CHARGE_THRESH_BAT0=80

START_CHARGE_THRESH_BAT1=75
STOP_CHARGE_THRESH_BAT1=80

Set ThinkPad battery charge thresholds for main battery (BAT0) and auxiliary/Ultrabay battery (BAT1). Values are given as a percentage of the full capacity. A value of 0 is translated to the hardware defaults 96 / 100%.

Charging starts upon connecting AC power, but only if the remaining capacity is below the value of START_CHARGE_TRESH (start threshold). Charging stops when reaching the STOP_CHARGE_TRESH (stop threshold) value. If, however when you connect the AC adapter, charge is above the start threshold, then it will not charge.

Note: the charge threshold settings are disabled by default and must be enabled explicitly by removing the leading '#'.

ThinkPad T420(s)/T520/W520/X220 (and all newer models): check erratic battery behavior (FAQ).

For further questions concerning charge thresholds please visit the [TLP FAQ](#).

RESTORE_THRESHOLDS_ON_BAT=1

Restore configured charge thresholds when AC is unplugged:

- 0 – disable
- 1 – enable

Hint: after a command like tlp setcharge/discharge/recalibrate the charge thresholds will stay at the hardware defaults 96 / 100% until the next reboot. Use this feature to restore them prematurely.

Radio Device Wizard

The radio device wizard provides the capability to enable or disable *builtin* radio devices triggered by certain events. In Ubuntu and Debian it is implemented in the (optional) package tlp-rdw.

Hint: the radio device wizard needs Network Manager as a prerequisite.

Disable on Network Connect

DEVICES_TO_DISABLE_ON_LAN_CONNECT="wifi wwan"
DEVICES_TO_DISABLE_ON_WIFI_CONNECT="wwan"
DEVICES_TO_DISABLE_ON_WWAN_CONNECT="wifi"

Upon a lan, wifi or wwan connect the stated radio devices are disabled:

- bluetooth
- wifi – Wireless LAN
- wwan – Wireless Wide Area Network (UMTS)

Multiple devices are separated with blanks.

Enable on Network Disconnect

DEVICES_TO_ENABLE_ON_LAN_DISCONNECT="wifi wwan"
DEVICES_TO_ENABLE_ON_WIFI_DISCONNECT=""
DEVICES_TO_ENABLE_ON_WWAN_DISCONNECT=""

Upon a lan, wifi or wwan disconnect the stated radio devices are enabled.

Enable/Disable on Dock

DEVICES_TO_ENABLE_ON_DOCK=""
DEVICES_TO_DISABLE_ON_DOCK=""

After docking the stated radio devices are enabled/disabled.

Enable/Disable on Undock

DEVICES_TO_ENABLE_ON_UNDOCK="wifi"
DEVICES_TO_DISABLE_ON_UNDOCK=""

After undocking the stated radio devices are enabled/disabled.

Trace Mode

For support purposes TLP provides a trace mode. To enable it add the following line to the configuration file:

TLP_DEBUG="bat disk lock nm path pm rf run sysfs udev usb"

Default Configuration

For reference see /etc/default/tlp as contained in the installation package.

Links

TLP

- TLP Linux Advanced Power Management – Installation instructions and user documentation
- TLP FAQ
- TLP Troubleshooting
- TLP Developer Documentation – Packaging instructions

Background

- [I/O scheduling](#) – Wikipedia article
- [Intel P-state](#) – intel_pstate driver documentation
- [Improvements in CPU frequency management](#) – LWN article covering the schedutil governor
- [Making sense of PCIe ASPM](#) – PCI Express Active State Power Management
- [med_power_with_dipm](#) – explanation from Hans de Goede
- [Radeon driver documentation](#) – see "KMS Power Management Options"
- [rfkill](#) – Kernel framework for switching radio devices
- [Runtime power management](#) – Kernel documentation
- [tp-smapi](#) – tp-smapi documentation at thinkwiki.org
- [tpacpi-bat](#) – Tool for extended battery functions on Sandy Bridge ThinkPads (X220 / T420) and later models
- [USB Auto Suspend](#) – Kernel documentation