

# **libATA Developer's Guide**

**Jeff Garzik**

# **libATA Developer's Guide**

by Jeff Garzik

Copyright © 2003-2006 Jeff Garzik

The contents of this file are subject to the Open Software License version 1.1 that can be found at <http://www.opensource.org/licenses/osl-1.1.txt> and is included herein by reference.

Alternatively, the contents of this file may be used under the terms of the GNU General Public License version 2 (the "GPL") as distributed in the kernel source COPYING file, in which case the provisions of the GPL are applicable instead of the above. If you wish to allow the use of your version of this file only under the terms of the GPL and not to allow others to use your version of this file under the OSL, indicate your decision by deleting the provisions above and replace them with the notice and other provisions required by the GPL. If you do not delete the provisions above, a recipient may use your version of this file under either the OSL or the GPL.

# Table of Contents

<b>1. Introduction.....</b>	<b>1</b>
<b>2. libata Driver API.....</b>	<b>3</b>
2.1. struct ata_port_operations .....	3
2.1.1. Disable ATA port .....	3
2.1.2. Post-IDENTIFY device configuration .....	3
2.1.3. Set PIO/DMA mode.....	3
2.1.4. Taskfile read/write.....	4
2.1.5. PIO data read/write .....	4
2.1.6. ATA command execute .....	4
2.1.7. Per-cmd ATAPI DMA capabilities filter .....	5
2.1.8. Read specific ATA shadow registers .....	5
2.1.9. Select ATA device on bus.....	5
2.1.10. Private tuning method .....	6
2.1.11. Control PCI IDE BMDMA engine .....	6
2.1.12. High-level taskfile hooks .....	7
2.1.13. Exception and probe handling (EH) .....	7
2.1.14. Hardware interrupt handling .....	8
2.1.15. SATA phy read/write.....	9
2.1.16. Init and shutdown.....	9
<b>3. Error handling .....</b>	<b>11</b>
3.1. Origins of commands.....	11
3.2. How commands are issued.....	11
3.3. How commands are processed.....	12
3.4. How commands are completed .....	12
3.5. ata_scsi_error() .....	13
3.6. Problems with the current EH.....	14
<b>4. libata Library .....</b>	<b>17</b>
atapi_cmd_type .....	17
ata_tf_to_fis.....	18
ata_tf_from_fis.....	19
ata_pack_xfermask .....	20
ata_unpack_xfermask .....	21
ata_xfer_mask2mode .....	22
ata_xfer_mode2mask .....	23
ata_xfer_mode2shift .....	24
ata_mode_string .....	25
ata_dev_classify .....	26
ata_id_string.....	27
ata_id_c_string.....	28
ata_id_xfermask.....	29

ata_pio_need_iordy.....	30
ata_do_dev_read_id .....	31
ata_cable_40wire .....	32
ata_cable_80wire .....	33
ata_cable_unknown.....	34
ata_cable_ignore .....	35
ata_cable_sata .....	36
ata_port_probe .....	36
ata_dev_pair .....	37
ata_port_disable .....	38
sata_set_spd .....	39
ata_timing_cycle2mode .....	40
ata_do_set_mode.....	41
ata_wait_after_reset .....	42
sata_link_debounce.....	44
sata_link_resume.....	45
ata_std_prereset.....	46
sata_link_hardreset .....	47
sata_std_hardreset.....	49
ata_std_postreset.....	50
ata_std_qc_defer .....	51
ata_sg_init.....	52
ata_qc_complete .....	53
ata_qc_complete_multiple .....	54
sata_scr_valid.....	55
sata_scr_read.....	56
sata_scr_write .....	57
sata_scr_write_flush.....	59
ata_link_online.....	60
ata_link_offline .....	61
ata_host_suspend .....	62
ata_host_resume.....	63
ata_port_start.....	64
ata_host_alloc .....	65
ata_host_alloc_pinfo .....	66
ata_slave_link_init .....	68
ata_host_start .....	69
ata_host_init.....	70
ata_host_register .....	71
ata_host_activate.....	72
ata_host_detach.....	74
ata_pci_remove_one .....	75
ata_wait_register .....	76

<b>5. libata Core Internals.....</b>	<b>79</b>
ata_dev_phys_link .....	79
ata_force_cbl.....	80
ata_force_link_limits .....	81
ata_force_xfermask.....	82
ata_force_horkage.....	83
ata_rwcmd_protocol .....	83
ata_tf_read_block.....	84
ata_build_rw_tf.....	85
ata_dev_enable_pm.....	87
ata_dev_disable_pm.....	88
ata_read_native_max_address .....	89
ata_set_max_sectors .....	90
ata_hpa_resize.....	91
ata_dump_id.....	92
ata_pio_queue_task.....	93
ata_port_flush_task .....	94
ata_exec_internal_sg.....	95
ata_exec_internal .....	97
ata_do_simple_cmd .....	98
ata_pio_mask_no_iordy .....	99
ata_dev_read_id .....	100
ata_dev_configure .....	102
ata_bus_probe .....	103
sata_print_link_status .....	104
sata_down_spd_limit .....	105
sata_set_spd_needed.....	105
ata_down_xfermask_limit.....	107
ata_wait_ready .....	108
ata_dev_same_device.....	109
ata_dev_reread_id.....	110
ata_dev_revalidate.....	111
ata_is_40wire .....	113
cable_is_40wire .....	113
ata_dev_xfermask .....	114
ata_dev_set_xfermode .....	115
ata_dev_set_feature.....	116
ata_dev_init_params .....	117
ata_sg_clean.....	119
atapi_check_dma.....	119
ata_sg_setup.....	120
swap_buf_le16 .....	121
ata_qc_new .....	122

ata_qc_new_init .....	123
ata_qc_free .....	124
ata_qc_issue .....	125
ata_phys_link_online .....	126
ata_phys_link_offline .....	127
ata_dev_init .....	128
ata_link_init .....	129
sata_link_init_spd .....	130
ata_port_alloc .....	131
ata_finalize_port_ops .....	132
ata_port_detach .....	133
<b>6. libata SCSI translation/emulation .....</b>	<b>135</b>
ata_std_bios_param .....	135
ata_scsi_slave_config .....	136
ata_scsi_slave_destroy .....	137
ata_scsi_change_queue_depth .....	138
ata_scsi_queuecmd .....	139
ata_scsi_simulate .....	140
ata_sas_port_alloc .....	141
ata_sas_port_start .....	142
ata_sas_port_stop .....	143
ata_sas_port_init .....	144
ata_sas_port_destroy .....	145
ata_sas_slave_configure .....	146
ata_sas_queuecmd .....	147
ata_get_identity .....	147
ata_cmd_ioctl .....	148
ata_task_ioctl .....	149
ata_scsi_qc_new .....	150
ata_dump_status .....	152
ata_to_sense_error .....	153
ata_gen_ata_sense .....	154
atapi_drain_needed .....	155
ata_scsi_start_stop_xlat .....	156
ata_scsi_flush_xlat .....	157
scsi_6_lba_len .....	158
scsi_10_lba_len .....	159
scsi_16_lba_len .....	160
ata_scsi_verify_xlat .....	161
ata_scsi_rw_xlat .....	163
ata_scsi_translate .....	164
ata_scsi_rbuf_get .....	165
ata_scsi_rbuf_put .....	166

ata_scsi_rbuf_fill.....	167
ata_scsiop_inq_std.....	168
ata_scsiop_inq_00.....	169
ata_scsiop_inq_80.....	170
ata_scsiop_inq_83.....	171
ata_scsiop_inq_89.....	173
ata_scsiop_noop.....	174
ata_msense_caching.....	174
ata_msense_ctl_mode.....	175
ata_msense_rw_recovery.....	176
ata_scsiop_mode_sense.....	177
ata_scsiop_read_cap.....	178
ata_scsiop_report_luns.....	179
ataapi_xlat.....	180
ata_scsi_find_dev.....	181
ata_scsi_pass_thru.....	182
ata_get_xlat_func.....	183
ata_scsi_dump_cdb.....	184
ata_scsi_offline_dev.....	185
ata_scsi_remove_dev.....	186
ata_scsi_media_change_notify.....	187
ata_scsi_hotplug.....	188
ata_scsi_user_scan.....	189
ata_scsi_dev_rescan.....	190
<b>7. ATA errors and exceptions.....</b>	<b>193</b>
7.1. Exception categories.....	193
7.1.1. HSM violation.....	193
7.1.2. ATA/ATAPI device error (non-NCQ / non-CHECK CONDITION)	194
7.1.3. ATAPI device CHECK CONDITION.....	195
7.1.4. ATA device error (NCQ).....	196
7.1.5. ATA bus error.....	196
7.1.6. PCI bus error.....	197
7.1.7. Late completion.....	197
7.1.8. Unknown error (timeout).....	197
7.1.9. Hotplug and power management exceptions.....	197
7.2. EH recovery actions.....	198
7.2.1. Clearing error condition.....	198
7.2.2. Reset.....	198
7.2.3. Reconfigure transport.....	200

<b>8. ata_piix Internals .....</b>	<b>201</b>
ich_pata_cable_detect .....	201
piix_pata_prereset .....	201
piix_set_piomode .....	202
do_pata_set_dmamode .....	203
piix_set_dmamode .....	204
ich_set_dmamode .....	205
piix_check_450nx_errata .....	206
piix_init_one .....	207
<b>9. sata_sil Internals .....</b>	<b>209</b>
sil_set_mode .....	209
sil_dev_config .....	209
<b>10. Thanks.....</b>	<b>213</b>



# Chapter 1. Introduction

libATA is a library used inside the Linux kernel to support ATA host controllers and devices. libATA provides an ATA driver API, class transports for ATA and ATAPI devices, and SCSI<->ATA translation for ATA devices according to the T10 SAT specification.

This Guide documents the libATA driver API, library functions, library internals, and a couple sample ATA low-level drivers.



# Chapter 2. libata Driver API

struct ata\_port\_operations is defined for every low-level libata hardware driver, and it controls how the low-level driver interfaces with the ATA and SCSI layers.

FIS-based drivers will hook into the system with ->qc\_prep() and ->qc\_issue() high-level hooks. Hardware which behaves in a manner similar to PCI IDE hardware may utilize several generic helpers, defining at a bare minimum the bus I/O addresses of the ATA shadow register blocks.

## 2.1. struct ata\_port\_operations

### 2.1.1. Disable ATA port

```
void (*port_disable) (struct ata_port *);
```

Called from ata\_bus\_probe() and ata\_bus\_reset() error paths, as well as when unregistering from the SCSI module (rmmod, hot unplug). This function should do whatever needs to be done to take the port out of use. In most cases, ata\_port\_disable() can be used as this hook.

Called from ata\_bus\_probe() on a failed probe. Called from ata\_bus\_reset() on a failed bus reset. Called from ata\_scsi\_release().

### 2.1.2. Post-IDENTIFY device configuration

```
void (*dev_config) (struct ata_port *, struct ata_device *);
```

Called after IDENTIFY [PACKET] DEVICE is issued to each device found. Typically used to apply device-specific fixups prior to issue of SET FEATURES - XFER MODE, and prior to operation.

Called by ata\_device\_add() after ata\_dev\_identify() determines a device is present.

This entry may be specified as NULL in ata\_port\_operations.

### 2.1.3. Set PIO/DMA mode

```
void (*set_piomode) (struct ata_port *, struct ata_device *);
```

```
void (*set_dmamode) (struct ata_port *, struct ata_device *);  
void (*post_set_mode) (struct ata_port *);  
unsigned int (*mode_filter) (struct ata_port *, struct ata_device *, unsigned int);
```

Hooks called prior to the issue of SET FEATURES - XFER MODE command. The optional `->mode_filter()` hook is called when libata has built a mask of the possible modes. This is passed to the `->mode_filter()` function which should return a mask of valid modes after filtering those unsuitable due to hardware limits. It is not valid to use this interface to add modes.

`dev->pio_mode` and `dev->dma_mode` are guaranteed to be valid when `->set_piomode()` and when `->set_dmamode()` is called. The timings for any other drive sharing the cable will also be valid at this point. That is the library records the decisions for the modes of each drive on a channel before it attempts to set any of them.

`->post_set_mode()` is called unconditionally, after the SET FEATURES - XFER MODE command completes successfully.

`->set_piomode()` is always called (if present), but `->set_dma_mode()` is only called if DMA is possible.

## **2.1.4. Taskfile read/write**

```
void (*tf_load) (struct ata_port *ap, struct ata_taskfile *tf);  
void (*tf_read) (struct ata_port *ap, struct ata_taskfile *tf);
```

`->tf_load()` is called to load the given taskfile into hardware registers / DMA buffers. `->tf_read()` is called to read the hardware registers / DMA buffers, to obtain the current set of taskfile register values. Most drivers for taskfile-based hardware (PIO or MMIO) use `ata_tf_load()` and `ata_tf_read()` for these hooks.

## **2.1.5. PIO data read/write**

```
void (*data_xfer) (struct ata_device *, unsigned char *, unsigned int, int);
```

All bmdma-style drivers must implement this hook. This is the low-level operation that actually copies the data bytes during a PIO data transfer. Typically the driver will choose one of `ata_pio_data_xfer_noirq()`, `ata_pio_data_xfer()`, or `ata_mmio_data_xfer()`.

## 2.1.6. ATA command execute

```
void (*exec_command)(struct ata_port *ap, struct ata_taskfile *tf);
```

causes an ATA command, previously loaded with `->tf_load()`, to be initiated in hardware. Most drivers for taskfile-based hardware use `ata_exec_command()` for this hook.

## 2.1.7. Per-cmd ATAPI DMA capabilities filter

```
int (*check_atapi_dma)(struct ata_queued_cmd *qc);
```

Allow low-level driver to filter ATA PACKET commands, returning a status indicating whether or not it is OK to use DMA for the supplied PACKET command.

This hook may be specified as NULL, in which case libata will assume that atapi dma can be supported.

## 2.1.8. Read specific ATA shadow registers

```
u8 (*check_status)(struct ata_port *ap);  
u8 (*check_altstatus)(struct ata_port *ap);
```

Reads the Status/AltStatus ATA shadow register from hardware. On some hardware, reading the Status register has the side effect of clearing the interrupt condition. Most drivers for taskfile-based hardware use `ata_check_status()` for this hook.

Note that because this is called from `ata_device_add()`, at least a dummy function that clears device interrupts must be provided for all drivers, even if the controller doesn't actually have a taskfile status register.

## 2.1.9. Select ATA device on bus

```
void (*dev_select)(struct ata_port *ap, unsigned int device);
```

Issues the low-level hardware command(s) that causes one of N hardware devices to be considered 'selected' (active and available for use) on the ATA bus. This generally has no meaning on FIS-based devices.

Most drivers for taskfile-based hardware use `ata_std_dev_select()` for this hook. Controllers which do not support second drives on a port (such as SATA controllers) will use `ata_noop_dev_select()`.

## 2.1.10. Private tuning method

```
void (*set_mode) (struct ata_port *ap);
```

By default libata performs drive and controller tuning in accordance with the ATA timing rules and also applies blacklists and cable limits. Some controllers need special handling and have custom tuning rules, typically raid controllers that use ATA commands but do not actually do drive timing.

### Warning

This hook should not be used to replace the standard controller tuning logic when a controller has quirks. Replacing the default tuning logic in that case would bypass handling for drive and bridge quirks that may be important to data reliability. If a controller needs to filter the mode selection it should use the `mode_filter` hook instead.

## 2.1.11. Control PCI IDE BMDMA engine

```
void (*bmdma_setup) (struct ata_queued_cmd *qc);  
void (*bmdma_start) (struct ata_queued_cmd *qc);  
void (*bmdma_stop) (struct ata_port *ap);  
u8 (*bmdma_status) (struct ata_port *ap);
```

When setting up an IDE BMDMA transaction, these hooks arm (`->bmdma_setup`), fire (`->bmdma_start`), and halt (`->bmdma_stop`) the hardware's DMA engine. `->bmdma_status` is used to read the standard PCI IDE DMA Status register.

These hooks are typically either no-ops, or simply not implemented, in FIS-based drivers.

Most legacy IDE drivers use `ata_bmdma_setup()` for the `bmdma_setup()` hook. `ata_bmdma_setup()` will write the pointer to the PRD table to the IDE PRD Table Address register, enable DMA in the DMA Command register, and call `exec_command()` to begin the transfer.

Most legacy IDE drivers use `ata_bmdma_start()` for the `bmdma_start()` hook. `ata_bmdma_start()` will write the `ATA_DMA_START` flag to the DMA Command register.

Many legacy IDE drivers use `ata_bmdma_stop()` for the `bmdma_stop()` hook. `ata_bmdma_stop()` clears the `ATA_DMA_START` flag in the DMA command register.

Many legacy IDE drivers use `ata_bmdma_status()` as the `bmdma_status()` hook.

## 2.1.12. High-level taskfile hooks

```
void (*qc_prep) (struct ata_queued_cmd *qc);  
int (*qc_issue) (struct ata_queued_cmd *qc);
```

Higher-level hooks, these two hooks can potentially supercede several of the above taskfile/DMA engine hooks. `->qc_prep` is called after the buffers have been DMA-mapped, and is typically used to populate the hardware's DMA scatter-gather table. Most drivers use the standard `ata_qc_prep()` helper function, but more advanced drivers roll their own.

`->qc_issue` is used to make a command active, once the hardware and S/G tables have been prepared. IDE BMDMA drivers use the helper function `ata_qc_issue_prot()` for taskfile protocol-based dispatch. More advanced drivers implement their own `->qc_issue`.

`ata_qc_issue_prot()` calls `->tf_load()`, `->bmdma_setup()`, and `->bmdma_start()` as necessary to initiate a transfer.

## 2.1.13. Exception and probe handling (EH)

```
void (*eng_timeout) (struct ata_port *ap);  
void (*phy_reset) (struct ata_port *ap);
```

Deprecated. Use `->error_handler()` instead.

```
void (*freeze) (struct ata_port *ap);  
void (*thaw) (struct ata_port *ap);
```

`ata_port_freeze()` is called when HSM violations or some other condition disrupts normal operation of the port. A frozen port is not allowed to perform any operation until the port is thawed, which usually follows a successful reset.

The optional `->freeze()` callback can be used for freezing the port hardware-wise (e.g. mask interrupt and stop DMA engine). If a port cannot be frozen hardware-wise, the interrupt handler must ack and clear interrupts unconditionally while the port is frozen.

The optional `->thaw()` callback is called to perform the opposite of `->freeze()`: prepare the port for normal operation once again. Unmask interrupts, start DMA engine, etc.

```
void (*error_handler) (struct ata_port *ap);
```

`->error_handler()` is a driver's hook into probe, hotplug, and recovery and other exceptional conditions. The primary responsibility of an implementation is to call `ata_do_eh()` or `ata_bmdma_drive_eh()` with a set of EH hooks as arguments:

'prereset' hook (may be NULL) is called during an EH reset, before any other actions are taken.

'postreset' hook (may be NULL) is called after the EH reset is performed. Based on existing conditions, severity of the problem, and hardware capabilities,

Either 'softreset' (may be NULL) or 'hardreset' (may be NULL) will be called to perform the low-level EH reset.

```
void (*post_internal_cmd) (struct ata_queued_cmd *qc);
```

Perform any hardware-specific actions necessary to finish processing after executing a probe-time or EH-time command via `ata_exec_internal()`.

## 2.1.14. Hardware interrupt handling

```
irqreturn_t (*irq_handler)(int, void *, struct pt_regs *);  
void (*irq_clear) (struct ata_port *);
```

`->irq_handler` is the interrupt handling routine registered with the system, by libata. `->irq_clear` is called during probe just before the interrupt handler is registered, to be sure hardware is quiet.

The second argument, `dev_instance`, should be cast to a pointer to struct `ata_host_set`.

Most legacy IDE drivers use `ata_interrupt()` for the `irq_handler` hook, which scans all ports in the `host_set`, determines which queued command was active (if any), and calls `ata_host_intr(ap,qc)`.



Most legacy IDE drivers use `ata_bmdma_irq_clear()` for the `irq_clear()` hook, which simply clears the interrupt and error flags in the DMA status register.

### 2.1.15. SATA phy read/write

```
int (*scr_read) (struct ata_port *ap, unsigned int sc_reg,
                u32 *val);
int (*scr_write) (struct ata_port *ap, unsigned int sc_reg,
                 u32 val);
```

Read and write standard SATA phy registers. Currently only used if `->phy_reset` hook called the `sata_phy_reset()` helper function. `sc_reg` is one of `SCR_STATUS`, `SCR_CONTROL`, `SCR_ERROR`, or `SCR_ACTIVE`.

### 2.1.16. Init and shutdown

```
int (*port_start) (struct ata_port *ap);
void (*port_stop) (struct ata_port *ap);
void (*host_stop) (struct ata_host_set *host_set);
```

`->port_start()` is called just after the data structures for each port are initialized. Typically this is used to alloc per-port DMA buffers / tables / rings, enable DMA engines, and similar tasks. Some drivers also use this entry point as a chance to allocate driver-private memory for `ap->private_data`.

Many drivers use `ata_port_start()` as this hook or call it from their own `port_start()` hooks. `ata_port_start()` allocates space for a legacy IDE PRD table and returns.

`->port_stop()` is called after `->host_stop()`. It's sole function is to release DMA/memory resources, now that they are no longer actively being used. Many drivers also free driver-private data from port at this time.

Many drivers use `ata_port_stop()` as this hook, which frees the PRD table.

`->host_stop()` is called after all `->port_stop()` calls have completed. The hook must finalize hardware shutdown, release DMA and other resources, etc. This hook may be specified as `NULL`, in which case it is not called.



# Chapter 3. Error handling

This chapter describes how errors are handled under libata. Readers are advised to read SCSI EH (Documentation/scsi/scsi\_eh.txt) and ATA exceptions doc first.

## 3.1. Origins of commands

In libata, a command is represented with struct `ata_queued_cmd` or `qc`. `qc`'s are preallocated during port initialization and repetitively used for command executions. Currently only one `qc` is allocated per port but yet-to-be-merged NCQ branch allocates one for each tag and maps each `qc` to NCQ tag 1-to-1.

libata commands can originate from two sources - libata itself and SCSI midlayer. libata internal commands are used for initialization and error handling. All normal blk requests and commands for SCSI emulation are passed as SCSI commands through `queuecommand` callback of SCSI host template.

## 3.2. How commands are issued

### Internal commands

First, `qc` is allocated and initialized using `ata_qc_new_init()`. Although `ata_qc_new_init()` doesn't implement any wait or retry mechanism when `qc` is not available, internal commands are currently issued only during initialization and error recovery, so no other command is active and allocation is guaranteed to succeed.

Once allocated `qc`'s taskfile is initialized for the command to be executed. `qc` currently has two mechanisms to notify completion. One is via `qc->complete_fn()` callback and the other is completion `qc->waiting`. `qc->complete_fn()` callback is the asynchronous path used by normal SCSI translated commands and `qc->waiting` is the synchronous (issuer sleeps in process context) path used by internal commands.

Once initialization is complete, `host_set` lock is acquired and the `qc` is issued.

### SCSI commands

All libata drivers use `ata_scsi_queuecmd()` as `hostt->queuecommand` callback. `scmds` can either be simulated or translated. No `qc` is involved in processing a simulated `scmd`. The result is computed right away and the `scmd` is completed.

For a translated scmd, `ata_qc_new_init()` is invoked to allocate a qc and the scmd is translated into the qc. SCSI midlayer's completion notification function pointer is stored into `qc->scsidone`.

`qc->complete_fn()` callback is used for completion notification. ATA commands use `ata_scsi_qc_complete()` while ATAPI commands use `atapi_qc_complete()`. Both functions end up calling `qc->scsidone` to notify upper layer when the qc is finished. After translation is completed, the qc is issued with `ata_qc_issue()`.

Note that SCSI midlayer invokes `hostt->queuecommand` while holding `host_set` lock, so all above occur while holding `host_set` lock.

### 3.3. How commands are processed

Depending on which protocol and which controller are used, commands are processed differently. For the purpose of discussion, a controller which uses taskfile interface and all standard callbacks is assumed.

Currently 6 ATA command protocols are used. They can be sorted into the following four categories according to how they are processed.

#### ATA NO DATA or DMA

`ATA_PROT_NODATA` and `ATA_PROT_DMA` fall into this category. These types of commands don't require any software intervention once issued. Device will raise interrupt on completion.

#### ATA PIO

`ATA_PROT_PIO` is in this category. `libata` currently implements PIO with polling. `ATA_NIEN` bit is set to turn off interrupt and `pio_task` on `ata_wq` performs polling and IO.

#### ATAPI NODATA or DMA

`ATA_PROT_ATAPI_NODATA` and `ATA_PROT_ATAPI_DMA` are in this category. `packet_task` is used to poll BSY bit after issuing `PACKET` command. Once BSY is turned off by the device, `packet_task` transfers CDB and hands off processing to interrupt handler.

#### ATAPI PIO

`ATA_PROT_ATAPI` is in this category. `ATA_NIEN` bit is set and, as in ATAPI NODATA or DMA, `packet_task` submits cdb. However, after submitting cdb, further processing (data transfer) is handed off to `pio_task`.

## 3.4. How commands are completed

Once issued, all qc's are either completed with `ata_qc_complete()` or time out. For commands which are handled by interrupts, `ata_host_intr()` invokes `ata_qc_complete()`, and, for PIO tasks, `pio_task` invokes `ata_qc_complete()`. In error cases, `packet_task` may also complete commands.

`ata_qc_complete()` does the following.

1. DMA memory is unmapped.
2. `ATA_QCFLAG_ACTIVE` is cleared from `qc->flags`.
3. `qc->complete_fn()` callback is invoked. If the return value of the callback is not zero. Completion is short circuited and `ata_qc_complete()` returns.
4. `__ata_qc_complete()` is called, which does
  - a. `qc->flags` is cleared to zero.
  - b. `ap->active_tag` and `qc->tag` are poisoned.
  - c. `qc->waiting` is cleared & completed (in that order).
  - d. qc is deallocated by clearing appropriate bit in `ap->qactive`.

So, it basically notifies upper layer and deallocates qc. One exception is short-circuit path in #3 which is used by `ataapi_qc_complete()`.

For all non-ATAPI commands, whether it fails or not, almost the same code path is taken and very little error handling takes place. A qc is completed with success status if it succeeded, with failed status otherwise.

However, failed ATAPI commands require more handling as REQUEST SENSE is needed to acquire sense data. If an ATAPI command fails, `ata_qc_complete()` is invoked with error status, which in turn invokes `ataapi_qc_complete()` via `qc->complete_fn()` callback.

This makes `ataapi_qc_complete()` set `scmd->result` to `SAM_STAT_CHECK_CONDITION`, complete the `scmd` and return 1. As the sense data is empty but `scmd->result` is `CHECK_CONDITION`, SCSI midlayer will invoke EH for the `scmd`, and returning 1 makes `ata_qc_complete()` to return without deallocating the qc. This leads us to `ata_scsi_error()` with partially completed qc.

## 3.5. ata\_scsi\_error()

`ata_scsi_error()` is the current `transport->eh_strategy_handler()` for libata. As discussed above, this will be entered in two cases - timeout and ATAPI error

completion. This function calls low level libata driver's `eng_timeout()` callback, the standard callback for which is `ata_eng_timeout()`. It checks if a qc is active and calls `ata_qc_timeout()` on the qc if so. Actual error handling occurs in `ata_qc_timeout()`.

If EH is invoked for timeout, `ata_qc_timeout()` stops BMDMA and completes the qc. Note that as we're currently in EH, we cannot call `scsi_done`. As described in SCSI EH doc, a recovered scmd should be either retried with `scsi_queue_insert()` or finished with `scsi_finish_command()`. Here, we override `qc->scsidone` with `scsi_finish_command()` and calls `ata_qc_complete()`.

If EH is invoked due to a failed ATAPI qc, the qc here is completed but not deallocated. The purpose of this half-completion is to use the qc as place holder to make EH code reach this place. This is a bit hackish, but it works.

Once control reaches here, the qc is deallocated by invoking `__ata_qc_complete()` explicitly. Then, internal qc for REQUEST SENSE is issued. Once sense data is acquired, scmd is finished by directly invoking `scsi_finish_command()` on the scmd. Note that as we already have completed and deallocated the qc which was associated with the scmd, we don't need to/cannot call `ata_qc_complete()` again.

## 3.6. Problems with the current EH

- Error representation is too crude. Currently any and all error conditions are represented with ATA STATUS and ERROR registers. Errors which aren't ATA device errors are treated as ATA device errors by setting ATA\_ERR bit. Better error descriptor which can properly represent ATA and other errors/exceptions is needed.
- When handling timeouts, no action is taken to make device forget about the timed out command and ready for new commands.
- EH handling via `ata_scsi_error()` is not properly protected from usual command processing. On EH entrance, the device is not in quiescent state. Timed out commands may succeed or fail any time. `pio_task` and `atapi_task` may still be running.
- Too weak error recovery. Devices / controllers causing HSM mismatch errors and other errors quite often require reset to return to known state. Also, advanced error handling is necessary to support features like NCQ and hotplug.
- ATA errors are directly handled in the interrupt handler and PIO errors in `pio_task`. This is problematic for advanced error handling for the following reasons.

First, advanced error handling often requires context and internal qc execution.

Second, even a simple failure (say, CRC error) needs information gathering and could trigger complex error handling (say, resetting & reconfiguring). Having multiple code paths to gather information, enter EH and trigger actions makes life painful.

Third, scattered EH code makes implementing low level drivers difficult. Low level drivers override libata callbacks. If EH is scattered over several places, each affected callbacks should perform its part of error handling. This can be error prone and painful.





# Chapter 4. libata Library

## atapi\_cmd\_type

### LINUX

Kernel Hackers Manual February 2010

### Name

`atapi_cmd_type` — Determine ATAPI command type from SCSI opcode

### Synopsis

```
int atapi_cmd_type (u8 opcode);
```

### Arguments

*opcode*

SCSI opcode

### Description

Determine ATAPI command type from *opcode*.

### LOCKING

None.

### RETURNS

`ATAPI_{READ|WRITE|READ_CD|PASS_THRU|MISC}`

## ata\_tf\_to\_fis

### LINUX

Kernel Hackers Manual February 2010

### Name

`ata_tf_to_fis` — Convert ATA taskfile to SATA FIS structure

### Synopsis

```
void ata_tf_to_fis (const struct ata_taskfile * tf, u8 pmp,  
int is_cmd, u8 * fis);
```

### Arguments

*tf*

Taskfile to convert

*pmp*

Port multiplier port

*is\_cmd*

This FIS is for command

*fis*

Buffer into which data will output

## Description

Converts a standard ATA taskfile to a Serial ATA FIS structure (Register - Host to Device).

## LOCKING

Inherited from caller.

# ata\_tf\_from\_fis

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_tf_from_fis` — Convert SATA FIS to ATA taskfile

## Synopsis

```
void ata_tf_from_fis (const u8 * fis, struct ata_taskfile *  
tf);
```

## Arguments

*fis*

Buffer from which data will be input

*tf*

Taskfile to output

## Description

Converts a serial ATA FIS structure to a standard ATA taskfile.

## LOCKING

Inherited from caller.

# ata\_pack\_xfermask

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_pack_xfermask` — Pack pio, mwdma and udma masks into xfer\_mask

## Synopsis

```
unsigned long ata_pack_xfermask (unsigned long pio_mask,  
unsigned long mwdma_mask, unsigned long udma_mask);
```

## Arguments

*pio\_mask*

pio\_mask

*mwdma\_mask*

mwdma\_mask

*udma\_mask*

udma\_mask

## Description

Pack *pio\_mask*, *mwdma\_mask* and *udma\_mask* into a single unsigned int *xfer\_mask*.

## LOCKING

None.

## RETURNS

Packed *xfer\_mask*.

# ata\_unpack\_xfermask

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_unpack_xfermask` — Unpack *xfer\_mask* into *pio*, *mwdma* and *udma* masks

## Synopsis

```
void ata_unpack_xfermask (unsigned long xfer_mask, unsigned  
long * pio_mask, unsigned long * mwdma_mask, unsigned long *  
udma_mask);
```

## Arguments

*xfer\_mask*

*xfer\_mask* to unpack

*pio\_mask*

resulting *pio\_mask*

*mwdma\_mask*

resulting *mwdma\_mask*

*udma\_mask*

resulting *udma\_mask*

## Description

Unpack *xfer\_mask* into *pio\_mask*, *mwdma\_mask* and *udma\_mask*. Any NULL destination masks will be ignored.

# ata\_xfer\_mask2mode

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_xfer_mask2mode` — Find matching XFER\_\* for the given *xfer\_mask*

## Synopsis

```
u8 ata_xfer_mask2mode (unsigned long xfer_mask);
```

## Arguments

*xfer\_mask*

*xfer\_mask* of interest

## Description

Return matching XFER\_\* value for *xfer\_mask*. Only the highest bit of *xfer\_mask* is considered.

## LOCKING

None.

## RETURNS

Matching XFER\_\* value, 0xff if no match found.

# ata\_xfer\_mode2mask

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_xfer_mode2mask` — Find matching *xfer\_mask* for XFER\_\*

## Synopsis

```
unsigned long ata_xfer_mode2mask (u8 xfer_mode);
```

## Arguments

*xfer\_mode*

XFER\_\* of interest

## Description

Return matching xfer\_mask for *xfer\_mode*.

## LOCKING

None.

## RETURNS

Matching xfer\_mask, 0 if no match found.

# ata\_xfer\_mode2shift

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_xfer_mode2shift` — Find matching xfer\_shift for XFER\_\*

## Synopsis

```
int ata_xfer_mode2shift (unsigned long xfer_mode);
```



## Arguments

*xfer\_mode*

XFER\_\* of interest

## Description

Return matching xfer\_shift for *xfer\_mode*.

## LOCKING

None.

## RETURNS

Matching xfer\_shift, -1 if no match found.

# ata\_mode\_string

## LINUX

Kernel Hackers Manual February 2010

## Name

ata\_mode\_string — convert xfer\_mask to string

## Synopsis

```
const char * ata_mode_string (unsigned long xfer_mask);
```

## Arguments

*xfer\_mask*

mask of bits supported; only highest bit counts.

## Description

Determine string which represents the highest speed (highest bit in *modemask*).

## LOCKING

None.

## RETURNS

Constant C string representing highest speed listed in *mode\_mask*, or the constant C string “<n/a>”.

# ata\_dev\_classify

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_dev_classify` — determine device type based on ATA-spec signature

## Synopsis

```
unsigned int ata_dev_classify (const struct ata_taskfile *  
tf);
```

## Arguments

*tf*

ATA taskfile register set for device to be identified

## Description

Determine from taskfile register contents whether a device is ATA or ATAPI, as per “Signature and persistence” section of ATA/PI spec (volume 1, sect 5.14).

## LOCKING

None.

## RETURNS

Device type, `ATA_DEV_ATA`, `ATA_DEV_ATAPI`, `ATA_DEV_PMP` or `ATA_DEV_UNKNOWN` the event of failure.

# ata\_id\_string

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_id_string` — Convert IDENTIFY DEVICE page into string

## Synopsis

```
void ata_id_string (const u16 * id, unsigned char * s,
unsigned int ofs, unsigned int len);
```

## Arguments

*id*

IDENTIFY DEVICE results we will examine

*s*

string into which data is output

*ofs*

offset into identify device page

*len*

length of string to return. must be an even number.

## Description

The strings in the IDENTIFY DEVICE page are broken up into 16-bit chunks. Run through the string, and output each 8-bit chunk linearly, regardless of platform.

## LOCKING

caller.

## ata\_id\_c\_string

### LINUX

Kernel Hackers Manual February 2010

## Name

`ata_id_c_string` — Convert IDENTIFY DEVICE page into C string

## Synopsis

```
void ata_id_c_string (const ul6 * id, unsigned char * s,
unsigned int ofs, unsigned int len);
```

## Arguments

*id*

IDENTIFY DEVICE results we will examine

*s*

string into which data is output

*ofs*

offset into identify device page

*len*

length of string to return. must be an odd number.

## Description

This function is identical to `ata_id_string` except that it trims trailing spaces and terminates the resulting string with null. *len* must be actual maximum length (even number) + 1.

## LOCKING

caller.

## ata\_id\_xfermask

**LINUX**

## Name

`ata_id_xfermask` — Compute xfermask from the given IDENTIFY data

## Synopsis

```
unsigned long ata_id_xfermask (const u16 * id);
```

## Arguments

*id*

IDENTIFY data to compute xfer mask from

## Description

Compute the xfermask for this device. This is not as trivial as it seems if we must consider early devices correctly.

## FIXME

pre IDE drive timing (do we care ?).

## LOCKING

None.

## RETURNS

Computed xfermask

# ata\_pio\_need\_iordy

## LINUX

Kernel Hackers Manual February 2010

### Name

`ata_pio_need_iordy` — check if iordy needed

### Synopsis

```
unsigned int ata_pio_need_iordy (const struct ata_device *  
adev);
```

### Arguments

*adev*

ATA device

### Description

Check if the current speed of the device requires IORDY. Used by various controllers for chip configuration.

# ata\_do\_dev\_read\_id

## LINUX

## Name

`ata_do_dev_read_id` — default ID read method

## Synopsis

```
unsigned int ata_do_dev_read_id (struct ata_device * dev,  
struct ata_taskfile * tf, u16 * id);
```

## Arguments

*dev*

device

*tf*

proposed taskfile

*id*

data buffer

## Description

Issue the identify taskfile and hand back the buffer containing identify data. For some RAID controllers and for pre ATA devices this function is wrapped or replaced by the driver

## `ata_cable_40wire`

**LINUX**



## Name

`ata_cable_40wire` — return 40 wire cable type

## Synopsis

```
int ata_cable_40wire (struct ata_port * ap);
```

## Arguments

*ap*

port

## Description

Helper method for drivers which want to hardwire 40 wire cable detection.

# ata\_cable\_80wire

## LINUX

## Name

`ata_cable_80wire` — return 80 wire cable type

## Synopsis

```
int ata_cable_80wire (struct ata_port * ap);
```

## Arguments

*ap*

port

## Description

Helper method for drivers which want to hardwire 80 wire cable detection.

## ata\_cable\_unknown

### LINUX

Kernel Hackers Manual February 2010

## Name

`ata_cable_unknown` — return unknown PATA cable.

## Synopsis

```
int ata_cable_unknown (struct ata_port * ap);
```

## Arguments

*ap*  
port

## Description

Helper method for drivers which have no PATA cable detection.

# ata\_cable\_ignore

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_cable_ignore` — return ignored PATA cable.

## Synopsis

```
int ata_cable_ignore (struct ata_port * ap);
```

## Arguments

*ap*  
port

## Description

Helper method for drivers which don't use cable type to limit transfer mode.

## ata\_cable\_sata

### LINUX

Kernel Hackers Manual February 2010

### Name

`ata_cable_sata` — return SATA cable type

### Synopsis

```
int ata_cable_sata (struct ata_port * ap);
```

### Arguments

*ap*  
port

### Description

Helper method for drivers which have SATA cables

## ata\_port\_probe

### LINUX

## Name

`ata_port_probe` — Mark port as enabled

## Synopsis

```
void ata_port_probe (struct ata_port * ap);
```

## Arguments

*ap*

Port for which we indicate enablement

## Description

Modify *ap* data structure such that the system thinks that the entire port is enabled.

## LOCKING

host lock, or some other form of serialization.

## `ata_dev_pair`

## LINUX

## Name

`ata_dev_pair` — return other device on cable

## Synopsis

```
struct ata_device * ata_dev_pair (struct ata_device * adev);
```

## Arguments

*adev*

device

## Description

Obtain the other device on the same cable, or if none is present NULL is returned

# ata\_port\_disable

## LINUX

## Name

`ata_port_disable` — Disable port.

## Synopsis

```
void ata_port_disable (struct ata_port * ap);
```

## Arguments

*ap*

Port to be disabled.

## Description

Modify *ap* data structure such that the system thinks that the entire port is disabled, and should never attempt to probe or communicate with devices on this port.

## LOCKING

host lock, or some other form of serialization.

# sata\_set\_spd

## LINUX

Kernel Hackers Manual February 2010

## Name

sata\_set\_spd — set SATA spd according to spd limit

## Synopsis

```
int sata_set_spd (struct ata_link * link);
```

## Arguments

*link*

Link to set SATA spd for

## Description

Set SATA spd of *link* according to `sata_spd_limit`.

## LOCKING

Inherited from caller.

## RETURNS

0 if spd doesn't need to be changed, 1 if spd has been changed. Negative `errno` if SCR registers are inaccessible.

# ata\_timing\_cycle2mode

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_timing_cycle2mode` — find xfer mode for the specified cycle duration



## Synopsis

```
u8 ata_timing_cycle2mode (unsigned int xfer_shift, int cycle);
```

## Arguments

*xfer\_shift*

ATA\_SHIFT\_\* value for transfer type to examine.

*cycle*

cycle duration in ns

## Description

Return matching xfer mode for *cycle*. The returned mode is of the transfer type specified by *xfer\_shift*. If *cycle* is too slow for *xfer\_shift*, 0xff is returned. If *cycle* is faster than the fastest known mode, the fastest mode is returned.

## LOCKING

None.

## RETURNS

Matching xfer\_mode, 0xff if no match found.

## ata\_do\_set\_mode

**LINUX**

## Name

`ata_do_set_mode` — Program timings and issue SET FEATURES - XFER

## Synopsis

```
int ata_do_set_mode (struct ata_link * link, struct ata_device  
** r_failed_dev);
```

## Arguments

*link*

link on which timings will be programmed

*r\_failed\_dev*

out parameter for failed device

## Description

Standard implementation of the function used to tune and set ATA device disk transfer mode (PIO3, UDMA6, etc.). If `ata_dev_set_mode` fails, pointer to the failing device is returned in *r\_failed\_dev*.

## LOCKING

PCI/etc. bus probe sem.

## RETURNS

0 on success, negative errno otherwise

# ata\_wait\_after\_reset

## LINUX

Kernel Hackers Manual February 2010

### Name

`ata_wait_after_reset` — wait for link to become ready after reset

### Synopsis

```
int ata_wait_after_reset (struct ata_link * link, unsigned  
long deadline, int (*check_ready) (struct ata_link *link));
```

### Arguments

*link*

link to be waited on

*deadline*

deadline jiffies for the operation

*check\_ready*

callback to check link readiness

### Description

Wait for *link* to become ready after reset.

### LOCKING

EH context.

## RETURNS

0 if *link* is ready before *deadline*; otherwise, -errno.

# sata\_link\_debounce

## LINUX

Kernel Hackers Manual February 2010

## Name

sata\_link\_debounce — debounce SATA phy status

## Synopsis

```
int sata_link_debounce (struct ata_link * link, const unsigned  
long * params, unsigned long deadline);
```

## Arguments

*link*

ATA link to debounce SATA phy status for

*params*

timing parameters { interval, duration, timeout } in msec

*deadline*

deadline jiffies for the operation

## Description

Make sure SStatus of *link* reaches stable state, determined by holding the same value where DET is not 1 for *duration* polled every *interval*, before *timeout*. Timeout constraints the beginning of the stable state. Because DET gets stuck at 1 on some controllers after hot unplugging, this functions waits until timeout then returns 0 if DET is stable at 1.

*timeout* is further limited by *deadline*. The sooner of the two is used.

## LOCKING

Kernel thread context (may sleep)

## RETURNS

0 on success, -errno on failure.

# sata\_link\_resume

## LINUX

Kernel Hackers Manual February 2010

## Name

sata\_link\_resume — resume SATA link

## Synopsis

```
int sata_link_resume (struct ata_link * link, const unsigned
long * params, unsigned long deadline);
```

## Arguments

*link*

ATA link to resume SATA

*params*

timing parameters { interval, duration, timeout } in msec

*deadline*

deadline jiffies for the operation

## Description

Resume SATA phy *link* and debounce it.

## LOCKING

Kernel thread context (may sleep)

## RETURNS

0 on success, -errno on failure.

# ata\_std\_prereset

## LINUX

Kernel Hackers Manual February 2010

## Name

ata\_std\_prereset — prepare for reset

## Synopsis

```
int ata_std_prereset (struct ata_link * link, unsigned long
deadline);
```

## Arguments

*link*

ATA link to be reset

*deadline*

deadline jiffies for the operation

## Description

*link* is about to be reset. Initialize it. Failure from prereset makes libata abort whole reset sequence and give up that port, so prereset should be best-effort. It does its best to prepare for reset sequence but if things go wrong, it should just whine, not fail.

## LOCKING

Kernel thread context (may sleep)

## RETURNS

0 on success, -errno otherwise.

## sata\_link\_hardreset

**LINUX**

## Name

`sata_link_hardreset` — reset link via SATA phy reset

## Synopsis

```
int sata_link_hardreset (struct ata_link * link, const
unsigned long * timing, unsigned long deadline, bool * online,
int (*check_ready) (struct ata_link *));
```

## Arguments

*link*

link to reset

*timing*

timing parameters { interval, duration, timeout } in msec

*deadline*

deadline jiffies for the operation

*online*

optional out parameter indicating link onlineness

*check\_ready*

optional callback to check link readiness

## Description

SATA phy-reset *link* using DET bits of SControl register. After hardreset, link readiness is waited upon using `ata_wait_ready` if *check\_ready* is specified. LLDs are allowed to not specify *check\_ready* and wait itself after this function returns. Device classification is LLD's responsibility.

\**online* is set to one iff reset succeeded and *link* is online after reset.



## LOCKING

Kernel thread context (may sleep)

## RETURNS

0 on success, -errno otherwise.

# sata\_std\_hardreset

## LINUX

Kernel Hackers Manual February 2010

## Name

sata\_std\_hardreset — COMRESET w/o waiting or classification

## Synopsis

```
int sata_std_hardreset (struct ata_link * link, unsigned int *  
class, unsigned long deadline);
```

## Arguments

*link*

link to reset

*class*

resulting class of attached device

*deadline*

deadline jiffies for the operation

## Description

Standard SATA COMRESET w/o waiting or classification.

## LOCKING

Kernel thread context (may sleep)

## RETURNS

0 if link offline, -EAGAIN if link online, -errno on errors.

# ata\_std\_postreset

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_std_postreset` — standard postreset callback

## Synopsis

```
void ata_std_postreset (struct ata_link * link, unsigned int *  
classes);
```

## Arguments

*link*

the target `ata_link`

*classes*

classes of attached devices

## Description

This function is invoked after a successful reset. Note that the device might have been reset more than once using different reset methods before `postreset` is invoked.

## LOCKING

Kernel thread context (may sleep)

# ata\_std\_qc\_defer

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_std_qc_defer` — Check whether a qc needs to be deferred

## Synopsis

```
int ata_std_qc_defer (struct ata_queued_cmd * qc);
```

## Arguments

*qc*

ATA command in question

## Description

Non-NCQ commands cannot run with any other command, NCQ or not. As upper layer only knows the queue depth, we are responsible for maintaining exclusion. This function checks whether a new command *qc* can be issued.

## LOCKING

`spin_lock_irqsave(host lock)`

## RETURNS

`ATA_DEFER_*` if deferring is needed, 0 otherwise.

# ata\_sg\_init

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_sg_init` — Associate command with scatter-gather table.

## Synopsis

```
void ata_sg_init (struct ata_queued_cmd * qc, struct  
scatterlist * sg, unsigned int n_elem);
```

## Arguments

*qc*

Command to be associated

*sg*

Scatter-gather table.

*n\_elem*

Number of elements in s/g table.

## Description

Initialize the data-related elements of `queued_cmd` *qc* to point to a scatter-gather table *sg*, containing *n\_elem* elements.

## LOCKING

`spin_lock_irqsave(host lock)`

# ata\_qc\_complete

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_qc_complete` — Complete an active ATA command

## Synopsis

```
void ata_qc_complete (struct ata_queued_cmd * qc);
```

## Arguments

*qc*

Command to complete

## Description

Indicate to the mid and upper layers that an ATA command has completed, with either an ok or not-ok status.

## LOCKING

spin\_lock\_irqsave(host lock)

# ata\_qc\_complete\_multiple

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_qc_complete_multiple` — Complete multiple qcs successfully

## Synopsis

```
int ata_qc_complete_multiple (struct ata_port * ap, u32  
qc_active);
```

## Arguments

*ap*

port in question

*qc\_active*

new qc\_active mask

## Description

Complete in-flight commands. This functions is meant to be called from low-level driver's interrupt routine to complete requests normally. *ap->qc\_active* and *qc\_active* is compared and commands are completed accordingly.

## LOCKING

spin\_lock\_irqsave(host lock)

## RETURNS

Number of completed commands on success, -errno otherwise.

## sata\_scr\_valid

### LINUX

Kernel Hackers Manual February 2010

### Name

`sata_scr_valid` — test whether SCRs are accessible

## Synopsis

```
int sata_scr_valid (struct ata_link * link);
```

## Arguments

*link*

ATA link to test SCR accessibility for

## Description

Test whether SCRs are accessible for *link*.

## LOCKING

None.

## RETURNS

1 if SCRs are accessible, 0 otherwise.

## sata\_scr\_read

### LINUX

Kernel Hackers Manual February 2010

## Name

`sata_scr_read` — read SCR register of the specified port



## Synopsis

```
int sata_scr_read (struct ata_link * link, int reg, u32 *  
val);
```

## Arguments

*link*

ATA link to read SCR for

*reg*

SCR to read

*val*

Place to store read value

## Description

Read SCR register *reg* of *link* into *\*val*. This function is guaranteed to succeed if *link* is *ap->link*, the cable type of the port is SATA and the port implements *->scr\_read*.

## LOCKING

None if *link* is *ap->link*. Kernel thread context otherwise.

## RETURNS

0 on success, negative *errno* on failure.

# sata\_scr\_write

## LINUX

Kernel Hackers Manual February 2010

### Name

`sata_scr_write` — write SCR register of the specified port

### Synopsis

```
int sata_scr_write (struct ata_link * link, int reg, u32 val);
```

### Arguments

*link*

ATA link to write SCR for

*reg*

SCR to write

*val*

value to write

### Description

Write *val* to SCR register *reg* of *link*. This function is guaranteed to succeed if *link* is ap->link, the cable type of the port is SATA and the port implements ->scr\_read.

### LOCKING

None if *link* is ap->link. Kernel thread context otherwise.

## RETURNS

0 on success, negative errno on failure.

# sata\_scr\_write\_flush

## LINUX

Kernel Hackers Manual February 2010

## Name

`sata_scr_write_flush` — write SCR register of the specified port and flush

## Synopsis

```
int sata_scr_write_flush (struct ata_link * link, int reg, u32  
val);
```

## Arguments

*link*

ATA link to write SCR for

*reg*

SCR to write

*val*

value to write

## Description

This function is identical to `sata_scr_write` except that this function performs flush after writing to the register.

## LOCKING

None if `link` is `ap->link`. Kernel thread context otherwise.

## RETURNS

0 on success, negative `errno` on failure.

# ata\_link\_online

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_link_online` — test whether the given link is online

## Synopsis

```
bool ata_link_online (struct ata_link * link);
```

## Arguments

*link*

ATA link to test

## Description

Test whether *link* is online. This is identical to `ata_phys_link_online` when there's no slave link. When there's a slave link, this function should only be called on the master link and will return true if any of M/S links is online.

## LOCKING

None.

## RETURNS

True if the port online status is available and online.

# ata\_link\_offline

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_link_offline` — test whether the given link is offline

## Synopsis

```
bool ata_link_offline (struct ata_link * link);
```

## Arguments

*link*

ATA link to test

## Description

Test whether *link* is offline. This is identical to `ata_phys_link_offline` when there's no slave link. When there's a slave link, this function should only be called on the master link and will return true if both M/S links are offline.

## LOCKING

None.

## RETURNS

True if the port offline status is available and offline.

# ata\_host\_suspend

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_host_suspend` — suspend host

## Synopsis

```
int ata_host_suspend (struct ata_host * host, pm_message_t  
mesg);
```

## Arguments

*host*

host to suspend

*msg*

PM message

## Description

Suspend *host*. Actual operation is performed by EH. This function requests EH to perform PM operations and waits for EH to finish.

## LOCKING

Kernel thread context (may sleep).

## RETURNS

0 on success, -errno on failure.

# ata\_host\_resume

## LINUX

Kernel Hackers Manual February 2010

## Name

ata\_host\_resume — resume host

## Synopsis

```
void ata_host_resume (struct ata_host * host);
```

## Arguments

*host*

host to resume

## Description

Resume *host*. Actual operation is performed by EH. This function requests EH to perform PM operations and returns. Note that all resume operations are performed parallelly.

## LOCKING

Kernel thread context (may sleep).

## ata\_port\_start

### LINUX

Kernel Hackers Manual February 2010

## Name

`ata_port_start` — Set port up for dma.



## Synopsis

```
int ata_port_start (struct ata_port * ap);
```

## Arguments

*ap*

Port to initialize

## Description

Called just after data structures for each port are initialized. Allocates space for PRD table.

May be used as the `port_start` entry in `ata_port_operations`.

## LOCKING

Inherited from caller.

## ata\_host\_alloc

### LINUX

Kernel Hackers Manual February 2010

## Name

`ata_host_alloc` — allocate and init basic ATA host resources

## Synopsis

```
struct ata_host * ata_host_alloc (struct device * dev, int  
max_ports);
```

## Arguments

*dev*

generic device this host is associated with

*max\_ports*

maximum number of ATA ports associated with this host

## Description

Allocate and initialize basic ATA host resources. LLD calls this function to allocate a host, initializes it fully and attaches it using `ata_host_register`.

*max\_ports* ports are allocated and `host->n_ports` is initialized to *max\_ports*. The caller is allowed to decrease `host->n_ports` before calling `ata_host_register`. The unused ports will be automatically freed on registration.

## RETURNS

Allocate ATA host on success, NULL on failure.

## LOCKING

Inherited from calling layer (may sleep).

# ata\_host\_alloc\_pinfo

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_host_alloc_pinfo` — alloc host and init with `port_info` array

## Synopsis

```
struct ata_host * ata_host_alloc_pinfo (struct device * dev,
const struct ata_port_info * const * ppi, int n_ports);
```

## Arguments

*dev*

generic device this host is associated with

*ppi*

array of ATA `port_info` to initialize host with

*n\_ports*

number of ATA ports attached to this host

## Description

Allocate ATA host and initialize with info from *ppi*. If NULL terminated, *ppi* may contain fewer entries than *n\_ports*. The last entry will be used for the remaining ports.

## RETURNS

Allocate ATA host on success, NULL on failure.

## LOCKING

Inherited from calling layer (may sleep).

# ata\_slave\_link\_init

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_slave_link_init` — initialize slave link

## Synopsis

```
int ata_slave_link_init (struct ata_port * ap);
```

## Arguments

*ap*

port to initialize slave link for

## Description

Create and initialize slave link for *ap*. This enables slave link handling on the port.

In libata, a port contains links and a link contains devices. There is single host link but if a PMP is attached to it, there can be multiple fan-out links. On SATA, there's usually a single device connected to a link but PATA and SATA controllers emulating TF based interface can have two - master and slave.

However, there are a few controllers which don't fit into this abstraction too well - SATA controllers which emulate TF interface with both master and slave devices

but also have separate SCR register sets for each device. These controllers need separate links for physical link handling (e.g. onlineness, link speed) but should be treated like a traditional M/S controller for everything else (e.g. command issue, softreset).

slave\_link is libata's way of handling this class of controllers without impacting core layer too much. For anything other than physical link handling, the default host link is used for both master and slave. For physical link handling, separate *ap->slave\_link* is used. All dirty details are implemented inside libata core layer. From LLD's POV, the only difference is that prereset, hardreset and postreset are called once more for the slave link, so the reset sequence looks like the following.

```
prereset(M) -> prereset(S) -> hardreset(M) -> hardreset(S) -> softreset(M) ->
postreset(M) -> postreset(S)
```

Note that softreset is called only for the master. Softreset resets both M/S by definition, so SRST on master should handle both (the standard method will work just fine).

## LOCKING

Should be called before host is registered.

## RETURNS

0 on success, -errno on failure.

# ata\_host\_start

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_host_start` — start and freeze ports of an ATA host

## Synopsis

```
int ata_host_start (struct ata_host * host);
```

## Arguments

*host*

ATA host to start ports for

## Description

Start and then freeze ports of *host*. Started status is recorded in *host->flags*, so this function can be called multiple times. Ports are guaranteed to get started only once. If *host->ops* isn't initialized yet, its set to the first non-dummy port ops.

## LOCKING

Inherited from calling layer (may sleep).

## RETURNS

0 if all ports are started successfully, -errno otherwise.

## ata\_host\_init

### LINUX

Kernel Hackers Manual February 2010

## Name

`ata_host_init` — Initialize a host struct

## Synopsis

```
void ata_host_init (struct ata_host * host, struct device *
dev, unsigned long flags, struct ata_port_operations * ops);
```

## Arguments

*host*

host to initialize

*dev*

device host is attached to

*flags*

host flags

*ops*

port\_ops

## LOCKING

PCI/etc. bus probe sem.

## ata\_host\_register

### LINUX

Kernel Hackers Manual February 2010

## Name

`ata_host_register` — register initialized ATA host

## Synopsis

```
int ata_host_register (struct ata_host * host, struct  
scsi_host_template * sht);
```

## Arguments

*host*

ATA host to register

*sht*

template for SCSI host

## Description

Register initialized ATA host. *host* is allocated using `ata_host_alloc` and fully initialized by LLD. This function starts ports, registers *host* with ATA and SCSI layers and probe registered devices.

## LOCKING

Inherited from calling layer (may sleep).

## RETURNS

0 on success, -errno otherwise.

## ata\_host\_activate

**LINUX**



## Name

`ata_host_activate` — start host, request IRQ and register it

## Synopsis

```
int ata_host_activate (struct ata_host * host, int irq,  
irq_handler_t irq_handler, unsigned long irq_flags, struct  
scsi_host_template * sht);
```

## Arguments

*host*

target ATA host

*irq*

IRQ to request

*irq\_handler*

irq\_handler used when requesting IRQ

*irq\_flags*

irq\_flags used when requesting IRQ

*sht*

scsi\_host\_template to use when registering the host

## Description

After allocating an ATA host and initializing it, most libata LLDs perform three steps to activate the host - start host, request IRQ and register it. This helper takes necessary arguments and performs the three steps in one go.

An invalid IRQ skips the IRQ registration and expects the host to have set polling mode on the port. In this case, *irq\_handler* should be NULL.

## LOCKING

Inherited from calling layer (may sleep).

## RETURNS

0 on success, -errno otherwise.

# ata\_host\_detach

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_host_detach` — Detach all ports of an ATA host

## Synopsis

```
void ata_host_detach (struct ata_host * host);
```

## Arguments

*host*

Host to detach

## Description

Detach all ports of *host*.

## LOCKING

Kernel thread context (may sleep).

# ata\_pci\_remove\_one

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_pci_remove_one` — PCI layer callback for device removal

## Synopsis

```
void ata_pci_remove_one (struct pci_dev * pdev);
```

## Arguments

*pdev*

PCI device that was removed

## Description

PCI layer indicates to libata via this hook that hot-unplug or module unload event has occurred. Detach all ports. Resource release is handled via devres.

## LOCKING

Inherited from PCI layer (may sleep).

# ata\_wait\_register

## LINUX

Kernel Hackers Manual February 2010

### Name

`ata_wait_register` — wait until register value changes

### Synopsis

```
u32 ata_wait_register (void __iomem * reg, u32 mask, u32 val,  
unsigned long interval, unsigned long timeout);
```

### Arguments

*reg*

IO-mapped register

*mask*

Mask to apply to read register value

*val*

Wait condition

*interval*

polling interval in milliseconds

*timeout*

timeout in milliseconds

## Description

Waiting for some bits of register to change is a common operation for ATA controllers. This function reads 32bit LE IO-mapped register *reg* and tests for the following condition.

`(*reg & mask) != val`

If the condition is met, it returns; otherwise, the process is repeated after *interval\_msec* until timeout.

## LOCKING

Kernel thread context (may sleep)

## RETURNS

The final register value.



# Chapter 5. libata Core Internals

## ata\_dev\_phys\_link

### LINUX

Kernel Hackers Manual February 2010

### Name

`ata_dev_phys_link` — find physical link for a device

### Synopsis

```
struct ata_link * ata_dev_phys_link (struct ata_device * dev);
```

### Arguments

*dev*

ATA device to look up physical link for

### Description

Look up physical link which *dev* is attached to. Note that this is different from *dev->link* only when *dev* is on slave link. For all other cases, it's the same as *dev->link*.

### LOCKING

Don't care.

## RETURNS

Pointer to the found physical link.

## ata\_force\_cbl

### LINUX

Kernel Hackers Manual February 2010

### Name

`ata_force_cbl` — force cable type according to `libata.force`

### Synopsis

```
void ata_force_cbl (struct ata_port * ap);
```

### Arguments

*ap*

ATA port of interest

### Description

Force cable type according to `libata.force` and whine about it. The last entry which has matching port number is used, so it can be specified as part of device force parameters. For example, both “a:40c,1.00:udma4” and “1.00:40c,udma4” have the same effect.



## LOCKING

EH context.

## ata\_force\_link\_limits

### LINUX

Kernel Hackers Manual February 2010

### Name

`ata_force_link_limits` — force link limits according to `libata.force`

### Synopsis

```
void ata_force_link_limits (struct ata_link * link);
```

### Arguments

*link*

ATA link of interest

### Description

Force link flags and SATA spd limit according to `libata.force` and whine about it. When only the port part is specified (e.g. 1:), the limit applies to all links connected to both the host link and all fan-out ports connected via PMP. If the device part is specified as 0 (e.g. 1.00:), it specifies the first fan-out link not the host link. Device number 15 always points to the host link whether PMP is attached or not. If the controller has slave link, device number 16 points to it.

## LOCKING

EH context.

# ata\_force\_xfermask

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_force_xfermask` — force xfermask according to `libata.force`

## Synopsis

```
void ata_force_xfermask (struct ata_device * dev);
```

## Arguments

*dev*

ATA device of interest

## Description

Force `xfer_mask` according to `libata.force` and whine about it. For consistency with link selection, device number 15 selects the first device connected to the host link.

## LOCKING

EH context.

# ata\_force\_horkage

## LINUX

Kernel Hackers Manual February 2010

### Name

`ata_force_horkage` — force horkage according to `libata.force`

### Synopsis

```
void ata_force_horkage (struct ata_device * dev);
```

### Arguments

*dev*

ATA device of interest

### Description

Force horkage according to `libata.force` and whine about it. For consistency with link selection, device number 15 selects the first device connected to the host link.

### LOCKING

EH context.

# ata\_rwcmd\_protocol

## LINUX

Kernel Hackers Manual February 2010

### Name

`ata_rwcmd_protocol` — set taskfile r/w commands and protocol

### Synopsis

```
int ata_rwcmd_protocol (struct ata_taskfile * tf, struct
ata_device * dev);
```

### Arguments

*tf*

command to examine and configure

*dev*

device *tf* belongs to

### Description

Examine the device configuration and *tf->flags* to calculate the proper read/write commands and protocol to use.

### LOCKING

caller.

# ata\_tf\_read\_block

## LINUX

Kernel Hackers Manual February 2010

### Name

`ata_tf_read_block` — Read block address from ATA taskfile

### Synopsis

```
u64 ata_tf_read_block (struct ata_taskfile * tf, struct
ata_device * dev);
```

### Arguments

*tf*

ATA taskfile of interest

*dev*

ATA device *tf* belongs to

### LOCKING

None.

Read block address from *tf*. This function can handle all three address formats - LBA, LBA48 and CHS. *tf*->protocol and flags select the address format to use.

### RETURNS

Block address read from *tf*.

# ata\_build\_rw\_tf

## LINUX

Kernel Hackers Manual February 2010

### Name

`ata_build_rw_tf` — Build ATA taskfile for given read/write request

### Synopsis

```
int ata_build_rw_tf (struct ata_taskfile * tf, struct
ata_device * dev, u64 block, u32 n_block, unsigned int
tf_flags, unsigned int tag);
```

### Arguments

*tf*

Target ATA taskfile

*dev*

ATA device *tf* belongs to

*block*

Block address

*n\_block*

Number of blocks

*tf\_flags*

RW/FUA etc...

*tag*

tag

## LOCKING

None.

Build ATA taskfile *tf* for read/write request described by *block*, *n\_block*, *tf\_flags* and *tag* on *dev*.

## RETURNS

0 on success, -ERANGE if the request is too large for *dev*, -EINVAL if the request is invalid.

# ata\_dev\_enable\_pm

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_dev_enable_pm` — enable SATA interface power management

## Synopsis

```
void ata_dev_enable_pm (struct ata_device * dev, enum link_pm  
policy);
```

## Arguments

*dev*

device to enable power management

*policy*

the link power management policy

## Description

Enable SATA Interface power management. This will enable Device Interface Power Management (DIPM) for min\_power policy, and then call driver specific callbacks for enabling Host Initiated Power management.

## Locking

Caller.

## Returns

-EINVAL if IPM is not supported, 0 otherwise.

# ata\_dev\_disable\_pm

## LINUX

Kernel Hackers Manual February 2010

## Name

ata\_dev\_disable\_pm — disable SATA interface power management

## Synopsis

```
void ata_dev_disable_pm (struct ata_device * dev);
```



## Arguments

*dev*

device to disable power management

## Description

Disable SATA Interface power management. This will disable Device Interface Power Management (DIPM) without changing policy, call driver specific callbacks for disabling Host Initiated Power management.

## Locking

Caller.

## Returns

void

# ata\_read\_native\_max\_address

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_read_native_max_address` — Read native max address

## Synopsis

```
int ata_read_native_max_address (struct ata_device * dev, u64
* max_sectors);
```

## Arguments

*dev*

target device

*max\_sectors*

out parameter for the result native max address

## Description

Perform an LBA48 or LBA28 native size query upon the device in question.

## RETURNS

0 on success, -EACCES if command is aborted by the drive. -EIO on other errors.

# ata\_set\_max\_sectors

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_set_max_sectors` — Set max sectors

## Synopsis

```
int ata_set_max_sectors (struct ata_device * dev, u64  
new_sectors);
```

## Arguments

*dev*

target device

*new\_sectors*

new max sectors value to set for the device

## Description

Set max sectors of *dev* to *new\_sectors*.

## RETURNS

0 on success, -EACCES if command is aborted or denied (due to previous non-volatile SET\_MAX) by the drive. -EIO on other errors.

# ata\_hpa\_resize

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_hpa_resize` — Resize a device with an HPA set

## Synopsis

```
int ata_hpa_resize (struct ata_device * dev);
```

## Arguments

*dev*

Device to resize

## Description

Read the size of an LBA28 or LBA48 disk with HPA features and resize it if required to the full size of the media. The caller must check the drive has the HPA feature set enabled.

## RETURNS

0 on success, -errno on failure.

## ata\_dump\_id

### LINUX

Kernel Hackers Manual February 2010

## Name

`ata_dump_id` — IDENTIFY DEVICE info debugging output

## Synopsis

```
void ata_dump_id (const u16 * id);
```

## Arguments

*id*

IDENTIFY DEVICE page to dump

## Description

Dump selected 16-bit words from the given IDENTIFY DEVICE page.

## LOCKING

caller.

# ata\_pio\_queue\_task

## LINUX

Kernel Hackers Manual February 2010

## Name

ata\_pio\_queue\_task — Queue port\_task

## Synopsis

```
void ata_pio_queue_task (struct ata_port * ap, void * data,  
unsigned long delay);
```

## Arguments

*ap*

The ata\_port to queue port\_task for

*data*

data for *fn* to use

*delay*

delay time in msec for workqueue function

## Description

Schedule *fn(data)* for execution after *delay* jiffies using port\_task. There is one port\_task per port and it's the user(low level driver)'s responsibility to make sure that only one task is active at any given time.

libata core layer takes care of synchronization between port\_task and EH.

ata\_pio\_queue\_task may be ignored for EH synchronization.

## LOCKING

Inherited from caller.

# ata\_port\_flush\_task

## LINUX

Kernel Hackers Manual February 2010

## Name

ata\_port\_flush\_task — Flush port\_task

## Synopsis

```
void ata_port_flush_task (struct ata_port * ap);
```

## Arguments

*ap*

The `ata_port` to flush `port_task` for

## Description

After this function completes, `port_task` is guranteed not to be running or scheduled.

## LOCKING

Kernel thread context (may sleep)

# ata\_exec\_internal\_sg

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_exec_internal_sg` — execute libata internal command

## Synopsis

```
unsigned ata_exec_internal_sg (struct ata_device * dev, struct  
ata_taskfile * tf, const u8 * cdb, int dma_dir, struct
```

```
scatterlist * sgl, unsigned int n_elem, unsigned long
timeout);
```

## Arguments

*dev*

Device to which the command is sent

*tf*

Taskfile registers for the command and the result

*cdb*

CDB for packet command

*dma\_dir*

Data tranfer direction of the command

*sgl*

sg list for the data buffer of the command

*n\_elem*

Number of sg entries

*timeout*

Timeout in msec (0 for default)

## Description

Executes libata internal command with timeout. *tf* contains command on entry and result on return. Timeout and error conditions are reported via return value. No recovery action is taken after a command times out. It's caller's duty to clean up after timeout.

## LOCKING

None. Should be called with kernel context, might sleep.



## RETURNS

Zero on success, AC\_ERR\_\* mask on failure

# ata\_exec\_internal

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_exec_internal` — execute libata internal command

## Synopsis

```
unsigned ata_exec_internal (struct ata_device * dev, struct  
ata_taskfile * tf, const u8 * cdb, int dma_dir, void * buf,  
unsigned int buflen, unsigned long timeout);
```

## Arguments

*dev*

Device to which the command is sent

*tf*

Taskfile registers for the command and the result

*cdb*

CDB for packet command

*dma\_dir*

Data transfer direction of the command

*buf*

Data buffer of the command

*buflen*

Length of data buffer

*timeout*

Timeout in msec (0 for default)

## Description

Wrapper around `ata_exec_internal_sg` which takes simple buffer instead of sg list.

## LOCKING

None. Should be called with kernel context, might sleep.

## RETURNS

Zero on success, `AC_ERR_*` mask on failure

# ata\_do\_simple\_cmd

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_do_simple_cmd` — execute simple internal command

## Synopsis

```
unsigned int ata_do_simple_cmd (struct ata_device * dev, u8  
cmd);
```

## Arguments

*dev*

Device to which the command is sent

*cmd*

Opcode to execute

## Description

Execute a 'simple' command, that only consists of the opcode 'cmd' itself, without filling any other registers

## LOCKING

Kernel thread context (may sleep).

## RETURNS

Zero on success, AC\_ERR\_\* mask on failure

# ata\_pio\_mask\_no\_iordy

**LINUX**

## Name

`ata_pio_mask_no_iordy` — Return the non IORDY mask

## Synopsis

```
u32 ata_pio_mask_no_iordy (const struct ata_device * adev);
```

## Arguments

*adev*

ATA device

## Description

Compute the highest mode possible if we are not using iordy. Return -1 if no iordy mode is available.

# ata\_dev\_read\_id

## LINUX

## Name

`ata_dev_read_id` — Read ID data from the specified device

## Synopsis

```
int ata_dev_read_id (struct ata_device * dev, unsigned int *
p_class, unsigned int flags, u16 * id);
```

## Arguments

*dev*

target device

*p\_class*

pointer to class of the target device (may be changed)

*flags*

ATA\_READID\_\* flags

*id*

buffer to read IDENTIFY data into

## Description

Read ID data from the specified device. ATA\_CMD\_ID\_ATA is performed on ATA devices and ATA\_CMD\_ID\_ATAPI on ATAPI devices. This function also issues ATA\_CMD\_INIT\_DEV\_PARAMS for pre-ATA4 drives.

## FIXME

ATA\_CMD\_ID\_ATA is optional for early drives and right now we abort if we hit that case.

## LOCKING

Kernel thread context (may sleep)

## RETURNS

0 on success, -errno otherwise.

# ata\_dev\_configure

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_dev_configure` — Configure the specified ATA/ATAPI device

## Synopsis

```
int ata_dev_configure (struct ata_device * dev);
```

## Arguments

*dev*

Target device to configure

## Description

Configure *dev* according to *dev->id*. Generic and low-level driver specific fixups are also applied.

## LOCKING

Kernel thread context (may sleep)

## RETURNS

0 on success, -errno otherwise

# ata\_bus\_probe

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_bus_probe` — Reset and probe ATA bus

## Synopsis

```
int ata_bus_probe (struct ata_port * ap);
```

## Arguments

*ap*

Bus to probe

## Description

Master ATA bus probing function. Initiates a hardware-dependent bus reset, then attempts to identify any devices found on the bus.

## LOCKING

PCI/etc. bus probe sem.

## RETURNS

Zero on success, negative errno otherwise.

# sata\_print\_link\_status

## LINUX

Kernel Hackers Manual February 2010

## Name

`sata_print_link_status` — Print SATA link status

## Synopsis

```
void sata_print_link_status (struct ata_link * link);
```

## Arguments

*link*

SATA link to print link status about

## Description

This function prints link speed and status of a SATA link.

## LOCKING

None.



# sata\_down\_spd\_limit

## LINUX

Kernel Hackers Manual February 2010

### Name

`sata_down_spd_limit` — adjust SATA spd limit downward

### Synopsis

```
int sata_down_spd_limit (struct ata_link * link);
```

### Arguments

*link*

Link to adjust SATA spd limit for

### Description

Adjust SATA spd limit of *link* downward. Note that this function only adjusts the limit. The change must be applied using `sata_set_spd`.

### LOCKING

Inherited from caller.

### RETURNS

0 on success, negative errno on failure

# sata\_set\_spd\_needed

## LINUX

Kernel Hackers Manual February 2010

### Name

`sata_set_spd_needed` — is SATA spd configuration needed

### Synopsis

```
int sata_set_spd_needed (struct ata_link * link);
```

### Arguments

*link*

Link in question

### Description

Test whether the spd limit in SControl matches *link*->sata\_spd\_limit. This function is used to determine whether hardreset is necessary to apply SATA spd configuration.

### LOCKING

Inherited from caller.

### RETURNS

1 if SATA spd configuration is needed, 0 otherwise.

# ata\_down\_xfermask\_limit

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_down_xfermask_limit` — adjust dev xfer masks downward

## Synopsis

```
int ata_down_xfermask_limit (struct ata_device * dev, unsigned
int sel);
```

## Arguments

*dev*

Device to adjust xfer masks

*sel*

ATA\_DNXFER\_\* selector

## Description

Adjust xfer masks of *dev* downward. Note that this function does not apply the change. Invoking `ata_set_mode` afterwards will apply the limit.

## LOCKING

Inherited from caller.

## RETURNS

0 on success, negative errno on failure

## ata\_wait\_ready

### LINUX

Kernel Hackers Manual February 2010

### Name

`ata_wait_ready` — wait for link to become ready

### Synopsis

```
int ata_wait_ready (struct ata_link * link, unsigned long
deadline, int (*check_ready) (struct ata_link *link));
```

### Arguments

*link*

link to be waited on

*deadline*

deadline jiffies for the operation

*check\_ready*

callback to check link readiness

## Description

Wait for *link* to become ready. *check\_ready* should return positive number if *link* is ready, 0 if it isn't, -ENODEV if link doesn't seem to be occupied, other errno for other error conditions.

Transient -ENODEV conditions are allowed for ATA\_TMOUT\_FF\_WAIT.

## LOCKING

EH context.

## RETURNS

0 if *linke* is ready before *deadline*; otherwise, -errno.

# ata\_dev\_same\_device

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_dev_same_device` — Determine whether new ID matches configured device

## Synopsis

```
int ata_dev_same_device (struct ata_device * dev, unsigned int
new_class, const ul6 * new_id);
```

## Arguments

*dev*

device to compare against

*new\_class*

class of the new device

*new\_id*

IDENTIFY page of the new device

## Description

Compare *new\_class* and *new\_id* against *dev* and determine whether *dev* is the device indicated by *new\_class* and *new\_id*.

## LOCKING

None.

## RETURNS

1 if *dev* matches *new\_class* and *new\_id*, 0 otherwise.

# ata\_dev\_reread\_id

## LINUX

Kernel Hackers Manual February 2010

## Name

ata\_dev\_reread\_id — Re-read IDENTIFY data

## Synopsis

```
int ata_dev_reread_id (struct ata_device * dev, unsigned int  
readid_flags);
```

## Arguments

*dev*

target ATA device

*readid\_flags*

read ID flags

## Description

Re-read IDENTIFY page and make sure *dev* is still attached to the port.

## LOCKING

Kernel thread context (may sleep)

## RETURNS

0 on success, negative errno otherwise

## ata\_dev\_revalidate

**LINUX**

## Name

`ata_dev_revalidate` — Revalidate ATA device

## Synopsis

```
int ata_dev_revalidate (struct ata_device * dev, unsigned int
new_class, unsigned int readid_flags);
```

## Arguments

*dev*

device to revalidate

*new\_class*

new class code

*readid\_flags*

read ID flags

## Description

Re-read IDENTIFY page, make sure *dev* is still attached to the port and reconfigure it according to the new IDENTIFY page.

## LOCKING

Kernel thread context (may sleep)

## RETURNS

0 on success, negative errno otherwise



## ata\_is\_40wire

### LINUX

Kernel Hackers Manual February 2010

### Name

`ata_is_40wire` — check drive side detection

### Synopsis

```
int ata_is_40wire (struct ata_device * dev);
```

### Arguments

*dev*

device

### Description

Perform drive side detection decoding, allowing for device vendors who can't follow the documentation.

## cable\_is\_40wire

### LINUX

## Name

`cable_is_40wire` — 40/80/SATA decider

## Synopsis

```
int cable_is_40wire (struct ata_port * ap);
```

## Arguments

*ap*

port to consider

## Description

This function encapsulates the policy for speed management in one place. At the moment we don't cache the result but there is a good case for setting `ap->cbl` to the result when we are called with unknown cables (and figuring out if it impacts hotplug at all).

Return 1 if the cable appears to be 40 wire.

# ata\_dev\_xfermask

## LINUX

## Name

`ata_dev_xfermask` — Compute supported xfermask of the given device

## Synopsis

```
void ata_dev_xfermask (struct ata_device * dev);
```

## Arguments

*dev*

Device to compute xfermask for

## Description

Compute supported xfermask of *dev* and store it in *dev->\*\_mask*. This function is responsible for applying all known limits including host controller limits, device blacklist, etc...

## LOCKING

None.

## ata\_dev\_set\_xfermode

### LINUX

Kernel Hackers Manual February 2010

## Name

`ata_dev_set_xfermode` — Issue SET FEATURES - XFER MODE command

## Synopsis

```
unsigned int ata_dev_set_xfermode (struct ata_device * dev);
```

## Arguments

*dev*

Device to which command will be sent

## Description

Issue SET FEATURES - XFER MODE command to device *dev* on port *ap*.

## LOCKING

PCI/etc. bus probe sem.

## RETURNS

0 on success, AC\_ERR\_\* mask otherwise.

## ata\_dev\_set\_feature

### LINUX

Kernel Hackers Manual February 2010

## Name

`ata_dev_set_feature` — Issue SET FEATURES - SATA FEATURES

## Synopsis

```
unsigned int ata_dev_set_feature (struct ata_device * dev, u8
enable, u8 feature);
```

## Arguments

*dev*

Device to which command will be sent

*enable*

Whether to enable or disable the feature

*feature*

The sector count represents the feature to set

## Description

Issue SET FEATURES - SATA FEATURES command to device *dev* on port *ap* with sector count

## LOCKING

PCI/etc. bus probe sem.

## RETURNS

0 on success, AC\_ERR\_\* mask otherwise.

# ata\_dev\_init\_params

## LINUX

Kernel Hackers Manual February 2010

### Name

`ata_dev_init_params` — Issue INIT DEV PARAMS command

### Synopsis

```
unsigned int ata_dev_init_params (struct ata_device * dev, u16  
heads, u16 sectors);
```

### Arguments

*dev*

Device to which command will be sent

*heads*

Number of heads (taskfile parameter)

*sectors*

Number of sectors (taskfile parameter)

### LOCKING

Kernel thread context (may sleep)

### RETURNS

0 on success, `AC_ERR_*` mask otherwise.

# ata\_sg\_clean

## LINUX

Kernel Hackers Manual February 2010

### Name

`ata_sg_clean` — Unmap DMA memory associated with command

### Synopsis

```
void ata_sg_clean (struct ata_queued_cmd * qc);
```

### Arguments

*qc*

Command containing DMA memory to be released

### Description

Unmap all mapped DMA memory associated with this command.

### LOCKING

`spin_lock_irqsave(host lock)`

# atapi\_check\_dma

## LINUX

## Name

`ataapi_check_dma` — Check whether ATAPI DMA can be supported

## Synopsis

```
int ataapi_check_dma (struct ata_queued_cmd * qc);
```

## Arguments

*qc*

Metadata associated with taskfile to check

## Description

Allow low-level driver to filter ATA PACKET commands, returning a status indicating whether or not it is OK to use DMA for the supplied PACKET command.

## LOCKING

`spin_lock_irqsave(host lock)`

## RETURNS

0 when ATAPI DMA can be used nonzero otherwise



# ata\_sg\_setup

## LINUX

Kernel Hackers Manual February 2010

### Name

`ata_sg_setup` — DMA-map the scatter-gather table associated with a command.

### Synopsis

```
int ata_sg_setup (struct ata_queued_cmd * qc);
```

### Arguments

*qc*

Command with scatter-gather table to be mapped.

### Description

DMA-map the scatter-gather table associated with `queued_cmd` *qc*.

### LOCKING

`spin_lock_irqsave(host lock)`

### RETURNS

Zero on success, negative on error.

# swap\_buf\_le16

## LINUX

Kernel Hackers Manual February 2010

### Name

`swap_buf_le16` — swap halves of 16-bit words in place

### Synopsis

```
void swap_buf_le16 (u16 * buf, unsigned int buf_words);
```

### Arguments

*buf*

Buffer to swap

*buf\_words*

Number of 16-bit words in buffer.

### Description

Swap halves of 16-bit words if needed to convert from little-endian byte order to native cpu byte order, or vice-versa.

### LOCKING

Inherited from caller.

# ata\_qc\_new

## LINUX

Kernel Hackers Manual February 2010

### Name

`ata_qc_new` — Request an available ATA command, for queueing

### Synopsis

```
struct ata_queued_cmd * ata_qc_new (struct ata_port * ap);
```

### Arguments

*ap*

Port associated with device *dev*

### LOCKING

None.

# ata\_qc\_new\_init

## LINUX

Kernel Hackers Manual February 2010

### Name

`ata_qc_new_init` — Request an available ATA command, and initialize it

## Synopsis

```
struct ata_queued_cmd * ata_qc_new_init (struct ata_device *  
dev);
```

## Arguments

*dev*

Device from whom we request an available command structure

## LOCKING

None.

## ata\_qc\_free

### LINUX

Kernel Hackers Manual February 2010

## Name

`ata_qc_free` — free unused `ata_queued_cmd`

## Synopsis

```
void ata_qc_free (struct ata_queued_cmd * qc);
```

## Arguments

*qc*

Command to complete

## Description

Designed to free unused `ata_queued_cmd` object in case something prevents using it.

## LOCKING

`spin_lock_irqsave(host lock)`

## ata\_qc\_issue

### LINUX

Kernel Hackers Manual February 2010

## Name

`ata_qc_issue` — issue taskfile to device

## Synopsis

```
void ata_qc_issue (struct ata_queued_cmd * qc);
```

## Arguments

*qc*

command to issue to device

## Description

Prepare an ATA command to submission to device. This includes mapping the data into a DMA-able area, filling in the S/G table, and finally writing the taskfile to hardware, starting the command.

## LOCKING

spin\_lock\_irqsave(host lock)

# ata\_phys\_link\_online

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_phys_link_online` — test whether the given link is online

## Synopsis

```
bool ata_phys_link_online (struct ata_link * link);
```

## Arguments

*link*

ATA link to test

## Description

Test whether *link* is online. Note that this function returns 0 if online status of *link* cannot be obtained, so `ata_link_online(link) != !ata_link_offline(link)`.

## LOCKING

None.

## RETURNS

True if the port online status is available and online.

# ata\_phys\_link\_offline

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_phys_link_offline` — test whether the given link is offline

## Synopsis

```
bool ata_phys_link_offline (struct ata_link * link);
```

## Arguments

*link*

ATA link to test

## Description

Test whether *link* is offline. Note that this function returns 0 if offline status of *link* cannot be obtained, so `ata_link_online(link) != !ata_link_offline(link)`.

## LOCKING

None.

## RETURNS

True if the port offline status is available and offline.

# ata\_dev\_init

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_dev_init` — Initialize an `ata_device` structure

## Synopsis

```
void ata_dev_init (struct ata_device * dev);
```



## Arguments

*dev*

Device structure to initialize

## Description

Initialize *dev* in preparation for probing.

## LOCKING

Inherited from caller.

# ata\_link\_init

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_link_init` — Initialize an `ata_link` structure

## Synopsis

```
void ata_link_init (struct ata_port * ap, struct ata_link *  
link, int pmp);
```

## Arguments

*ap*

ATA port link is attached to

*link*

Link structure to initialize

*pmp*

Port multiplier port number

## Description

Initialize *link*.

## LOCKING

Kernel thread context (may sleep)

# sata\_link\_init\_spd

## LINUX

Kernel Hackers Manual February 2010

## Name

`sata_link_init_spd` — Initialize `link->sata_spd_limit`

## Synopsis

```
int sata_link_init_spd (struct ata_link * link);
```

## Arguments

*link*

Link to configure sata\_spd\_limit for

## Description

Initialize *link*->[hw\_]sata\_spd\_limit to the currently configured value.

## LOCKING

Kernel thread context (may sleep).

## RETURNS

0 on success, -errno on failure.

# ata\_port\_alloc

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_port_alloc` — allocate and initialize basic ATA port resources

## Synopsis

```
struct ata_port * ata_port_alloc (struct ata_host * host);
```

## Arguments

*host*

ATA host this allocated port belongs to

## Description

Allocate and initialize basic ATA port resources.

## RETURNS

Allocate ATA port on success, NULL on failure.

## LOCKING

Inherited from calling layer (may sleep).

# ata\_finalize\_port\_ops

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_finalize_port_ops` — finalize ata\_port\_operations

## Synopsis

```
void ata_finalize_port_ops (struct ata_port_operations * ops);
```

## Arguments

*ops*

ata\_port\_operations to finalize

## Description

An ata\_port\_operations can inherit from another ops and that ops can again inherit from another. This can go on as many times as necessary as long as there is no loop in the inheritance chain.

Ops tables are finalized when the host is started. NULL or unspecified entries are inherited from the closet ancestor which has the method and the entry is populated with it. After finalization, the ops table directly points to all the methods and ->inherits is no longer necessary and cleared.

Using ATA\_OP\_NULL, inheriting ops can force a method to NULL.

## LOCKING

None.

## ata\_port\_detach

### LINUX

Kernel Hackers Manual February 2010

### Name

ata\_port\_detach — Detach ATA port in prepration of device removal

### Synopsis

```
void ata_port_detach (struct ata_port * ap);
```

## Arguments

*ap*

ATA port to be detached

## Description

Detach all ATA devices and the associated SCSI devices of *ap*; then, remove the associated SCSI host. *ap* is guaranteed to be quiescent on return from this function.

## LOCKING

Kernel thread context (may sleep).

# Chapter 6. libata SCSI translation/emulation

## ata\_std\_bios\_param

### LINUX

Kernel Hackers Manual February 2010

### Name

`ata_std_bios_param` — generic bios head/sector/cylinder calculator used by sd.

### Synopsis

```
int ata_std_bios_param (struct scsi_device * sdev, struct
block_device * bdev, sector_t capacity, int geom[]);
```

### Arguments

*sdev*

SCSI device for which BIOS geometry is to be determined

*bdev*

block device associated with *sdev*

*capacity*

capacity of SCSI device

*geom[]*

location to which geometry will be output

## Description

Generic bios head/sector/cylinder calculator used by sd. Most BIOSes nowadays expect a XXX/255/16 (CHS) mapping. Some situations may arise where the disk is not bootable if this is not used.

## LOCKING

Defined by the SCSI layer. We don't really care.

## RETURNS

Zero.

# ata\_scsi\_slave\_config

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_scsi_slave_config` — Set SCSI device attributes

## Synopsis

```
int ata_scsi_slave_config (struct scsi_device * sdev);
```

## Arguments

*sdev*

SCSI device to examine



## Description

This is called before we actually start reading and writing to the device, to configure certain SCSI mid-layer behaviors.

## LOCKING

Defined by SCSI layer. We don't really care.

# ata\_scsi\_slave\_destroy

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_scsi_slave_destroy` — SCSI device is about to be destroyed

## Synopsis

```
void ata_scsi_slave_destroy (struct scsi_device * sdev);
```

## Arguments

*sdev*

SCSI device to be destroyed

## Description

*sdev* is about to be destroyed for hot/warm unplugging. If this unplugging was initiated by libata as indicated by `NULL dev->sdev`, this function doesn't have to do

anything. Otherwise, SCSI layer initiated warm-unplug is in progress. Clear dev->sdev, schedule the device for ATA detach and invoke EH.

## LOCKING

Defined by SCSI layer. We don't really care.

# ata\_scsi\_change\_queue\_depth

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_scsi_change_queue_depth` — SCSI callback for queue depth config

## Synopsis

```
int ata_scsi_change_queue_depth (struct scsi_device * sdev,
int queue_depth);
```

## Arguments

*sdev*

SCSI device to configure queue depth for

*queue\_depth*

new queue depth

## Description

This is libata standard `hostt->change_queue_depth` callback. SCSI will call into this callback when user tries to set queue depth via `sysfs`.

## LOCKING

SCSI layer (we don't care)

## RETURNS

Newly configured queue depth.

# ata\_scsi\_queuecmd

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_scsi_queuecmd` — Issue SCSI cdb to libata-managed device

## Synopsis

```
int ata_scsi_queuecmd (struct scsi_cmnd * cmd, void (*done)
(struct scsi_cmnd *));
```

## Arguments

*cmd*

SCSI command to be sent

*done*

Completion function, called when command is complete

## Description

In some cases, this function translates SCSI commands into ATA taskfiles, and queues the taskfiles to be sent to hardware. In other cases, this function simulates a SCSI device by evaluating and responding to certain SCSI commands. This creates the overall effect of ATA and ATAPI devices appearing as SCSI devices.

## LOCKING

Releases scsi-layer-held lock, and obtains host lock.

## RETURNS

Return value from `__ata_scsi_queuecmd` if *cmd* can be queued, 0 otherwise.

# ata\_scsi\_simulate

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_scsi_simulate` — simulate SCSI command on ATA device

## Synopsis

```
void ata_scsi_simulate (struct ata_device * dev, struct
scsi_cmnd * cmd, void (*done) (struct scsi_cmnd *));
```

## Arguments

*dev*

the target device

*cmd*

SCSI command being sent to device.

*done*

SCSI command completion function.

## Description

Interprets and directly executes a select list of SCSI commands that can be handled internally.

## LOCKING

spin\_lock\_irqsave(host lock)

# ata\_sas\_port\_alloc

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_sas_port_alloc` — Allocate port for a SAS attached SATA device

## Synopsis

```
struct ata_port * ata_sas_port_alloc (struct ata_host * host,  
struct ata_port_info * port_info, struct Scsi_Host * shost);
```

## Arguments

*host*

ATA host container for all SAS ports

*port\_info*

Information from low-level host driver

*shost*

SCSI host that the scsi device is attached to

## LOCKING

PCI/etc. bus probe sem.

## RETURNS

ata\_port pointer on success / NULL on failure.

# ata\_sas\_port\_start

## LINUX

Kernel Hackers Manual February 2010

## Name

ata\_sas\_port\_start — Set port up for dma.

## Synopsis

```
int ata_sas_port_start (struct ata_port * ap);
```

## Arguments

*ap*

Port to initialize

## Description

Called just after data structures for each port are initialized.

May be used as the `port_start` entry in `ata_port_operations`.

## LOCKING

Inherited from caller.

# ata\_sas\_port\_stop

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_sas_port_stop` — Undo `ata_sas_port_start`

## Synopsis

```
void ata_sas_port_stop (struct ata_port * ap);
```

## Arguments

*ap*

Port to shut down

## Description

May be used as the `port_stop` entry in `ata_port_operations`.

## LOCKING

Inherited from caller.

# ata\_sas\_port\_init

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_sas_port_init` — Initialize a SATA device

## Synopsis

```
int ata_sas_port_init (struct ata_port * ap);
```



## Arguments

*ap*

SATA port to initialize

## LOCKING

PCI/etc. bus probe sem.

## RETURNS

Zero on success, non-zero on error.

# ata\_sas\_port\_destroy

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_sas_port_destroy` — Destroy a SATA port allocated by `ata_sas_port_alloc`

## Synopsis

```
void ata_sas_port_destroy (struct ata_port * ap);
```

## Arguments

*ap*

SATA port to destroy

# ata\_sas\_slave\_configure

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_sas_slave_configure` — Default `slave_config` routine for libata devices

## Synopsis

```
int ata_sas_slave_configure (struct scsi_device * sdev, struct  
ata_port * ap);
```

## Arguments

*sdev*

SCSI device to configure

*ap*

ATA port to which SCSI device is attached

## RETURNS

Zero.

# ata\_sas\_queuecmd

## LINUX

Kernel Hackers Manual February 2010

### Name

`ata_sas_queuecmd` — Issue SCSI cdb to libata-managed device

### Synopsis

```
int ata_sas_queuecmd (struct scsi_cmnd * cmd, void (*done)
(struct scsi_cmnd *), struct ata_port * ap);
```

### Arguments

*cmd*

SCSI command to be sent

*done*

Completion function, called when command is complete

*ap*

ATA port to which the command is being sent

### RETURNS

Return value from `__ata_scsi_queuecmd` if *cmd* can be queued, 0 otherwise.

# ata\_get\_identity

## LINUX

Kernel Hackers Manual February 2010

### Name

`ata_get_identity` — Handler for HDIO\_GET\_IDENTITY ioctl

### Synopsis

```
int ata_get_identity (struct scsi_device * sdev, void __user *  
arg);
```

### Arguments

*sdev*

SCSI device to get identify data for

*arg*

User buffer area for identify data

### LOCKING

Defined by the SCSI layer. We don't really care.

### RETURNS

Zero on success, negative errno on error.

# ata\_cmd\_ioctl

## LINUX

Kernel Hackers Manual February 2010

### Name

`ata_cmd_ioctl` — Handler for HDIO\_DRIVE\_CMD ioctl

### Synopsis

```
int ata_cmd_ioctl (struct scsi_device * scsidev, void __user *  
arg);
```

### Arguments

*scsidev*

Device to which we are issuing command

*arg*

User provided data for issuing command

### LOCKING

Defined by the SCSI layer. We don't really care.

### RETURNS

Zero on success, negative errno on error.

# ata\_task\_ioctl

## LINUX

Kernel Hackers Manual February 2010

### Name

`ata_task_ioctl` — Handler for HDIO\_DRIVE\_TASK ioctl

### Synopsis

```
int ata_task_ioctl (struct scsi_device * scsidev, void __user  
* arg);
```

### Arguments

*scsidev*

Device to which we are issuing command

*arg*

User provided data for issuing command

### LOCKING

Defined by the SCSI layer. We don't really care.

### RETURNS

Zero on success, negative errno on error.

# ata\_scsi\_qc\_new

## LINUX

Kernel Hackers Manual February 2010

### Name

`ata_scsi_qc_new` — acquire new `ata_queued_cmd` reference

### Synopsis

```
struct ata_queued_cmd * ata_scsi_qc_new (struct ata_device *  
dev, struct scsi_cmnd * cmd, void (*done) (struct scsi_cmnd  
*));
```

### Arguments

*dev*

ATA device to which the new command is attached

*cmd*

SCSI command that originated this ATA command

*done*

SCSI command completion function

### Description

Obtain a reference to an unused `ata_queued_cmd` structure, which is the basic libata structure representing a single ATA command sent to the hardware.

If a command was available, fill in the SCSI-specific portions of the structure with information on the current command.

## LOCKING

`spin_lock_irqsave(host lock)`

## RETURNS

Command allocated, or `NULL` if none available.

# ata\_dump\_status

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_dump_status` — user friendly display of error info

## Synopsis

```
void ata_dump_status (unsigned id, struct ata_taskfile * tf);
```

## Arguments

*id*

id of the port in question

*tf*

ptr to filled out taskfile



## Description

Decode and dump the ATA error/status registers for the user so that they have some idea what really happened at the non make-believe layer.

## LOCKING

inherited from caller

# ata\_to\_sense\_error

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_to_sense_error` — convert ATA error to SCSI error

## Synopsis

```
void ata_to_sense_error (unsigned id, u8 drv_stat, u8 drv_err,  
u8 * sk, u8 * asc, u8 * ascq, int verbose);
```

## Arguments

*id*

ATA device number

*drv\_stat*

value contained in ATA status register

*drv\_err*

value contained in ATA error register

*sk*

the sense key we'll fill out

*asc*

the additional sense code we'll fill out

*ascq*

the additional sense code qualifier we'll fill out

*verbose*

be verbose

## Description

Converts an ATA error into a SCSI error. Fill out pointers to SK, ASC, and ASCQ bytes for later use in fixed or descriptor format sense blocks.

## LOCKING

`spin_lock_irqsave(host lock)`

# ata\_gen\_ata\_sense

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_gen_ata_sense` — generate a SCSI fixed sense block

## Synopsis

```
void ata_gen_ata_sense (struct ata_queued_cmd * qc);
```

## Arguments

*qc*

Command that we are erroring out

## Description

Generate sense block for a failed ATA command *qc*. Descriptor format is used to accomodate LBA48 block address.

## LOCKING

None.

# atapi\_drain\_needed

## LINUX

Kernel Hackers Manual February 2010

## Name

`atapi_drain_needed` — Check whether data transfer may overflow

## Synopsis

```
int atapi_drain_needed (struct request * rq);
```

## Arguments

*rq*

request to be checked

## Description

ATAPI commands which transfer variable length data to host might overflow due to application error or hardware bug. This function checks whether overflow should be drained and ignored for *request*.

## LOCKING

None.

## RETURNS

1 if ; otherwise, 0.

# ata\_scsi\_start\_stop\_xlat

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_scsi_start_stop_xlat` — Translate SCSI START STOP UNIT command

## Synopsis

```
unsigned int ata_scsi_start_stop_xlat (struct ata_queued_cmd *  
qc);
```

## Arguments

*qc*

Storage for translated ATA taskfile

## Description

Sets up an ATA taskfile to issue STANDBY (to stop) or READ VERIFY (to start). Perhaps these commands should be preceded by CHECK POWER MODE to see what power mode the device is already in. [See SAT revision 5 at [www.t10.org](http://www.t10.org)]

## LOCKING

spin\_lock\_irqsave(host lock)

## RETURNS

Zero on success, non-zero on error.

# ata\_scsi\_flush\_xlat

**LINUX**

## Name

`ata_scsi_flush_xlat` — Translate SCSI SYNCHRONIZE CACHE command

## Synopsis

```
unsigned int ata_scsi_flush_xlat (struct ata_queued_cmd * qc);
```

## Arguments

*qc*

Storage for translated ATA taskfile

## Description

Sets up an ATA taskfile to issue FLUSH CACHE or FLUSH CACHE EXT.

## LOCKING

`spin_lock_irqsave(host lock)`

## RETURNS

Zero on success, non-zero on error.

# scsi\_6\_lba\_len

## LINUX

Kernel Hackers Manual February 2010

### Name

`scsi_6_lba_len` — Get LBA and transfer length

### Synopsis

```
void scsi_6_lba_len (const u8 * cdb, u64 * plba, u32 * plen);
```

### Arguments

*cdb*

SCSI command to translate

*plba*

the LBA

*plen*

the transfer length

### Description

Calculate LBA and transfer length for 6-byte commands.

# scsi\_10\_lba\_len

## LINUX

Kernel Hackers Manual February 2010

### Name

`scsi_10_lba_len` — Get LBA and transfer length

### Synopsis

```
void scsi_10_lba_len (const u8 * cdb, u64 * plba, u32 * plen);
```

### Arguments

*cdb*

SCSI command to translate

*plba*

the LBA

*plen*

the transfer length

### Description

Calculate LBA and transfer length for 10-byte commands.



# scsi\_16\_lba\_len

## LINUX

Kernel Hackers Manual February 2010

### Name

`scsi_16_lba_len` — Get LBA and transfer length

### Synopsis

```
void scsi_16_lba_len (const u8 * cdb, u64 * plba, u32 * plen);
```

### Arguments

*cdb*

SCSI command to translate

*plba*

the LBA

*plen*

the transfer length

### Description

Calculate LBA and transfer length for 16-byte commands.

# ata\_scsi\_verify\_xlat

## LINUX

Kernel Hackers Manual February 2010

### Name

`ata_scsi_verify_xlat` — Translate SCSI VERIFY command into an ATA one

### Synopsis

```
unsigned int ata_scsi_verify_xlat (struct ata_queued_cmd *  
qc);
```

### Arguments

*qc*

Storage for translated ATA taskfile

### Description

Converts SCSI VERIFY command to an ATA READ VERIFY command.

### LOCKING

`spin_lock_irqsave(host lock)`

### RETURNS

Zero on success, non-zero on error.

# ata\_scsi\_rw\_xlat

## LINUX

Kernel Hackers Manual February 2010

### Name

`ata_scsi_rw_xlat` — Translate SCSI r/w command into an ATA one

### Synopsis

```
unsigned int ata_scsi_rw_xlat (struct ata_queued_cmd * qc);
```

### Arguments

*qc*

Storage for translated ATA taskfile

### Description

Converts any of six SCSI read/write commands into the ATA counterpart, including starting sector (LBA), sector count, and taking into account the device's LBA48 support.

Commands `READ_6`, `READ_10`, `READ_16`, `WRITE_6`, `WRITE_10`, and `WRITE_16` are currently supported.

### LOCKING

`spin_lock_irqsave(host lock)`

### RETURNS

Zero on success, non-zero on error.

# ata\_scsi\_translate

## LINUX

Kernel Hackers Manual February 2010

### Name

`ata_scsi_translate` — Translate then issue SCSI command to ATA device

### Synopsis

```
int ata_scsi_translate (struct ata_device * dev, struct
scsi_cmnd * cmd, void (*done) (struct scsi_cmnd *),
ata_xlat_func_t xlat_func);
```

### Arguments

*dev*

ATA device to which the command is addressed

*cmd*

SCSI command to execute

*done*

SCSI command completion function

*xlat\_func*

Actor which translates *cmd* to an ATA taskfile

## Description

Our `->queuecommand` function has decided that the SCSI command issued can be directly translated into an ATA command, rather than handled internally.

This function sets up an `ata_queued_cmd` structure for the SCSI command, and sends that `ata_queued_cmd` to the hardware.

The `xlat_func` argument (actor) returns 0 if ready to execute ATA command, else 1 to finish translation. If 1 is returned then `cmd->result` (and possibly `cmd->sense_buffer`) are assumed to be set reflecting an error condition or clean (early) termination.

## LOCKING

`spin_lock_irqsave(host lock)`

## RETURNS

0 on success, `SCSI_ML_QUEUE_DEVICE_BUSY` if the command needs to be deferred.

# ata\_scsi\_rbuf\_get

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_scsi_rbuf_get` — Map response buffer.

## Synopsis

```
void * ata_scsi_rbuf_get (struct scsi_cmnd * cmd, bool
copy_in, unsigned long * flags);
```

## Arguments

*cmd*

SCSI command containing buffer to be mapped.

*copy\_in*

copy in from user buffer

*flags*

unsigned long variable to store irq enable status

## Description

Prepare buffer for simulated SCSI commands.

## LOCKING

spin\_lock\_irqsave(ata\_scsi\_rbuf\_lock) on success

## RETURNS

Pointer to response buffer.

# ata\_scsi\_rbuf\_put

## LINUX

Kernel Hackers Manual February 2010

## Name

ata\_scsi\_rbuf\_put — Unmap response buffer.

## Synopsis

```
void ata_scsi_rbuf_put (struct scsi_cmnd * cmd, bool copy_out,  
unsigned long * flags);
```

## Arguments

*cmd*

SCSI command containing buffer to be unmapped.

*copy\_out*

copy out result

*flags*

*flags* passed to `ata_scsi_rbuf_get`

## Description

Returns rbuf buffer. The result is copied to *cmd*'s buffer if *copy\_back* is true.

## LOCKING

Unlocks `ata_scsi_rbuf_lock`.

## ata\_scsi\_rbuf\_fill

**LINUX**

## Name

`ata_scsi_rbuf_fill` — wrapper for SCSI command simulators

## Synopsis

```
void ata_scsi_rbuf_fill (struct ata_scsi_args * args, unsigned
int (*actor) (struct ata_scsi_args *args, u8 *rbuf));
```

## Arguments

*args*

device IDENTIFY data / SCSI command of interest.

*actor*

Callback hook for desired SCSI command simulator

## Description

Takes care of the hard work of simulating a SCSI command... Mapping the response buffer, calling the command's handler, and handling the handler's return value. This return value indicates whether the handler wishes the SCSI command to be completed successfully (0), or not (in which case `cmd->result` and sense buffer are assumed to be set).

## LOCKING

`spin_lock_irqsave(host lock)`



# ata\_scsiop\_inq\_std

## LINUX

Kernel Hackers Manual February 2010

### Name

`ata_scsiop_inq_std` — Simulate INQUIRY command

### Synopsis

```
unsigned int ata_scsiop_inq_std (struct ata_scsi_args * args,  
u8 * rbuf);
```

### Arguments

*args*

device IDENTIFY data / SCSI command of interest.

*rbuf*

Response buffer, to which simulated SCSI cmd output is sent.

### Description

Returns standard device identification data associated with non-VPD INQUIRY command output.

### LOCKING

`spin_lock_irqsave(host lock)`

# ata\_scsiop\_inq\_00

## LINUX

Kernel Hackers Manual February 2010

### Name

`ata_scsiop_inq_00` — Simulate INQUIRY VPD page 0, list of pages

### Synopsis

```
unsigned int ata_scsiop_inq_00 (struct ata_scsi_args * args,  
u8 * rbuf);
```

### Arguments

*args*

device IDENTIFY data / SCSI command of interest.

*rbuf*

Response buffer, to which simulated SCSI cmd output is sent.

### Description

Returns list of inquiry VPD pages available.

### LOCKING

`spin_lock_irqsave(host lock)`

# ata\_scsiop\_inq\_80

## LINUX

Kernel Hackers Manual February 2010

### Name

`ata_scsiop_inq_80` — Simulate INQUIRY VPD page 80, device serial number

### Synopsis

```
unsigned int ata_scsiop_inq_80 (struct ata_scsi_args * args,  
u8 * rbuf);
```

### Arguments

*args*

device IDENTIFY data / SCSI command of interest.

*rbuf*

Response buffer, to which simulated SCSI cmd output is sent.

### Description

Returns ATA device serial number.

### LOCKING

`spin_lock_irqsave(host lock)`

# ata\_scsiop\_inq\_83

## LINUX

Kernel Hackers Manual February 2010

### Name

`ata_scsiop_inq_83` — Simulate INQUIRY VPD page 83, device identity

### Synopsis

```
unsigned int ata_scsiop_inq_83 (struct ata_scsi_args * args,  
u8 * rbuf);
```

### Arguments

*args*

device IDENTIFY data / SCSI command of interest.

*rbuf*

Response buffer, to which simulated SCSI cmd output is sent.

### Yields two logical unit device identification designators

- vendor specific ASCII containing the ATA serial number - SAT defined “t10 vendor id based” containing ASCII vendor name (“ATA ”), model and serial numbers.

### LOCKING

`spin_lock_irqsave(host lock)`

# ata\_scsiop\_inq\_89

## LINUX

Kernel Hackers Manual February 2010

### Name

`ata_scsiop_inq_89` — Simulate INQUIRY VPD page 89, ATA info

### Synopsis

```
unsigned int ata_scsiop_inq_89 (struct ata_scsi_args * args,  
u8 * rbuf);
```

### Arguments

*args*

device IDENTIFY data / SCSI command of interest.

*rbuf*

Response buffer, to which simulated SCSI cmd output is sent.

### Description

Yields SAT-specified ATA VPD page.

### LOCKING

`spin_lock_irqsave(host lock)`

# ata\_scsiop\_noop

## LINUX

Kernel Hackers Manual February 2010

### Name

`ata_scsiop_noop` — Command handler that simply returns success.

### Synopsis

```
unsigned int ata_scsiop_noop (struct ata_scsi_args * args, u8  
* rbuf);
```

### Arguments

*args*

device IDENTIFY data / SCSI command of interest.

*rbuf*

Response buffer, to which simulated SCSI cmd output is sent.

### Description

No operation. Simply returns success to caller, to indicate that the caller should successfully complete this SCSI command.

### LOCKING

`spin_lock_irqsave(host lock)`

# ata\_msense\_caching

## LINUX

Kernel Hackers Manual February 2010

### Name

`ata_msense_caching` — Simulate MODE SENSE caching info page

### Synopsis

```
unsigned int ata_msense_caching (u16 * id, u8 * buf);
```

### Arguments

*id*

device IDENTIFY data

*buf*

output buffer

### Description

Generate a caching info page, which conditionally indicates write caching to the SCSI layer, depending on device capabilities.

### LOCKING

None.

## ata\_msense\_ctl\_mode

### LINUX

Kernel Hackers Manual February 2010

### Name

`ata_msense_ctl_mode` — Simulate MODE SENSE control mode page

### Synopsis

```
unsigned int ata_msense_ctl_mode (u8 * buf);
```

### Arguments

*buf*

output buffer

### Description

Generate a generic MODE SENSE control mode page.

### LOCKING

None.

## ata\_msense\_rw\_recovery

### LINUX



## Name

`ata_msense_rw_recovery` — Simulate MODE SENSE r/w error recovery page

## Synopsis

```
unsigned int ata_msense_rw_recovery (u8 * buf);
```

## Arguments

*buf*

output buffer

## Description

Generate a generic MODE SENSE r/w error recovery page.

## LOCKING

None.

## `ata_scsiop_mode_sense`

**LINUX**

## Name

`ata_scsiop_mode_sense` — Simulate MODE SENSE 6, 10 commands

## Synopsis

```
unsigned int ata_scsiop_mode_sense (struct ata_scsi_args *  
args, u8 * rbuf);
```

## Arguments

*args*

device IDENTIFY data / SCSI command of interest.

*rbuf*

Response buffer, to which simulated SCSI cmd output is sent.

## Description

Simulate MODE SENSE commands. Assume this is invoked for direct access devices (e.g. disks) only. There should be no block descriptor for other device types.

## LOCKING

`spin_lock_irqsave(host lock)`

# ata\_scsiop\_read\_cap

**LINUX**

## Name

`ata_scsiop_read_cap` — Simulate READ CAPACITY[ 16] commands

## Synopsis

```
unsigned int ata_scsiop_read_cap (struct ata_scsi_args * args,  
u8 * rbuf);
```

## Arguments

*args*

device IDENTIFY data / SCSI command of interest.

*rbuf*

Response buffer, to which simulated SCSI cmd output is sent.

## Description

Simulate READ CAPACITY commands.

## LOCKING

None.

## `ata_scsiop_report_luns`

**LINUX**

## Name

`ata_scsiop_report_luns` — Simulate REPORT LUNS command

## Synopsis

```
unsigned int ata_scsiop_report_luns (struct ata_scsi_args *  
args, u8 * rbuf);
```

## Arguments

*args*

device IDENTIFY data / SCSI command of interest.

*rbuf*

Response buffer, to which simulated SCSI cmd output is sent.

## Description

Simulate REPORT LUNS command.

## LOCKING

`spin_lock_irqsave(host lock)`

## atapi\_xlat

## LINUX

## Name

`ata_pi_xlat` — Initialize PACKET taskfile

## Synopsis

```
unsigned int ata_pi_xlat (struct ata_queued_cmd * qc);
```

## Arguments

*qc*  
command structure to be initialized

## LOCKING

`spin_lock_irqsave(host lock)`

## RETURNS

Zero on success, non-zero on failure.

## `ata_scsi_find_dev`

**LINUX**

## Name

`ata_scsi_find_dev` — lookup `ata_device` from `scsi_cmnd`

## Synopsis

```
struct ata_device * ata_scsi_find_dev (struct ata_port * ap,  
const struct scsi_device * scsidev);
```

## Arguments

*ap*

ATA port to which the device is attached

*scsidev*

SCSI device from which we derive the ATA device

## Description

Given various information provided in struct `scsi_cmnd`, map that onto an ATA bus, and using that mapping determine which `ata_device` is associated with the SCSI command to be sent.

## LOCKING

`spin_lock_irqsave(host lock)`

## RETURNS

Associated ATA device, or `NULL` if not found.

# ata\_scsi\_pass\_thru

## LINUX

Kernel Hackers Manual February 2010

### Name

`ata_scsi_pass_thru` — convert ATA pass-thru CDB to taskfile

### Synopsis

```
unsigned int ata_scsi_pass_thru (struct ata_queued_cmd * qc);
```

### Arguments

*qc*

command structure to be initialized

### Description

Handles either 12 or 16-byte versions of the CDB.

### RETURNS

Zero on success, non-zero on failure.

# ata\_get\_xlat\_func

## LINUX

## Name

`ata_get_xlat_func` — check if SCSI to ATA translation is possible

## Synopsis

```
ata_xlat_func_t ata_get_xlat_func (struct ata_device * dev, u8  
cmd);
```

## Arguments

*dev*

ATA device

*cmd*

SCSI command opcode to consider

## Description

Look up the SCSI command given, and determine whether the SCSI command is to be translated or simulated.

## RETURNS

Pointer to translation function if possible, `NULL` if not.

# ata\_scsi\_dump\_cdb

**LINUX**



## Name

`ata_scsi_dump_cdb` — dump SCSI command contents to dmesg

## Synopsis

```
void ata_scsi_dump_cdb (struct ata_port * ap, struct scsi_cmnd  
* cmd);
```

## Arguments

*ap*

ATA port to which the command was being sent

*cmd*

SCSI command to dump

## Description

Prints the contents of a SCSI command via `printk`.

# ata\_scsi\_offline\_dev

## LINUX

## Name

`ata_scsi_offline_dev` — offline attached SCSI device

## Synopsis

```
int ata_scsi_offline_dev (struct ata_device * dev);
```

## Arguments

*dev*

ATA device to offline attached SCSI device for

## Description

This function is called from `ata_eh_hotplug` and responsible for taking the SCSI device attached to *dev* offline. This function is called with host lock which protects `dev->sdev` against clearing.

## LOCKING

`spin_lock_irqsave(host lock)`

## RETURNS

1 if attached SCSI device exists, 0 otherwise.

## ata\_scsi\_remove\_dev

### LINUX

Kernel Hackers Manual February 2010

## Name

`ata_scsi_remove_dev` — remove attached SCSI device

## Synopsis

```
void ata_scsi_remove_dev (struct ata_device * dev);
```

## Arguments

*dev*

ATA device to remove attached SCSI device for

## Description

This function is called from `ata_eh_scsi_hotplug` and responsible for removing the SCSI device attached to *dev*.

## LOCKING

Kernel thread context (may sleep).

# ata\_scsi\_media\_change\_notify

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_scsi_media_change_notify` — send media change event

## Synopsis

```
void ata_scsi_media_change_notify (struct ata_device * dev);
```

## Arguments

*dev*

Pointer to the disk device with media change event

## Description

Tell the block layer to send a media change notification event.

## LOCKING

spin\_lock\_irqsave(host lock)

# ata\_scsi\_hotplug

## LINUX

Kernel Hackers Manual February 2010

## Name

ata\_scsi\_hotplug — SCSI part of hotplug

## Synopsis

```
void ata_scsi_hotplug (struct work_struct * work);
```

## Arguments

*work*

Pointer to ATA port to perform SCSI hotplug on

## Description

Perform SCSI part of hotplug. It's executed from a separate workqueue after EH completes. This is necessary because SCSI hot plugging requires working EH and hot unplugging is synchronized with hot plugging with a mutex.

## LOCKING

Kernel thread context (may sleep).

# ata\_scsi\_user\_scan

## LINUX

Kernel Hackers Manual February 2010

## Name

`ata_scsi_user_scan` — indication for user-initiated bus scan

## Synopsis

```
int ata_scsi_user_scan (struct Scsi_Host * shost, unsigned int  
channel, unsigned int id, unsigned int lun);
```

## Arguments

*shost*

SCSI host to scan

*channel*

Channel to scan

*id*

ID to scan

*lun*

LUN to scan

## Description

This function is called when user explicitly requests bus scan. Set probe pending flag and invoke EH.

## LOCKING

SCSI layer (we don't care)

## RETURNS

Zero.

# ata\_scsi\_dev\_rescan

**LINUX**

## Name

`ata_scsi_dev_rescan` — initiate `scsi_rescan_device`

## Synopsis

```
void ata_scsi_dev_rescan (struct work_struct * work);
```

## Arguments

*work*

Pointer to ATA port to perform `scsi_rescan_device`

## Description

After ATA pass thru (SAT) commands are executed successfully, libata need to propagate the changes to SCSI layer. This function must be executed from `ata_aux_wq` such that `sdev attach/detach` don't race with `rescan`.

## LOCKING

Kernel thread context (may sleep).





# Chapter 7. ATA errors and exceptions

This chapter tries to identify what error/exception conditions exist for ATA/ATAPI devices and describe how they should be handled in implementation-neutral way.

The term 'error' is used to describe conditions where either an explicit error condition is reported from device or a command has timed out.

The term 'exception' is either used to describe exceptional conditions which are not errors (say, power or hotplug events), or to describe both errors and non-error exceptional conditions. Where explicit distinction between error and exception is necessary, the term 'non-error exception' is used.

## 7.1. Exception categories

Exceptions are described primarily with respect to legacy taskfile + bus master IDE interface. If a controller provides other better mechanism for error reporting, mapping those into categories described below shouldn't be difficult.

In the following sections, two recovery actions - reset and reconfiguring transport - are mentioned. These are described further in Section 7.2.

### 7.1.1. HSM violation

This error is indicated when STATUS value doesn't match HSM requirement during issuing or execution any ATA/ATAPI command.

#### Examples

- ATA\_STATUS doesn't contain !BSY && DRDY && !DRQ while trying to issue a command.
- !BSY && !DRQ during PIO data transfer.
- DRQ on command completion.
- !BSY && ERR after CDB transfer starts but before the last byte of CDB is transferred. ATA/ATAPI standard states that "The device shall not terminate the PACKET command with an error before the last byte of the command packet has been written" in the error outputs description of PACKET command and the state diagram doesn't include such transitions.

In these cases, HSM is violated and not much information regarding the error can be acquired from STATUS or ERROR register. IOW, this error can be anything - driver bug, faulty device, controller and/or cable.

As HSM is violated, reset is necessary to restore known state. Reconfiguring transport for lower speed might be helpful too as transmission errors sometimes cause this kind of errors.

### 7.1.2. ATA/ATAPI device error (non-NCQ / non-CHECK CONDITION)

These are errors detected and reported by ATA/ATAPI devices indicating device problems. For this type of errors, STATUS and ERROR register values are valid and describe error condition. Note that some of ATA bus errors are detected by ATA/ATAPI devices and reported using the same mechanism as device errors. Those cases are described later in this section.

For ATA commands, this type of errors are indicated by !BSY && ERR during command execution and on completion.

For ATAPI commands,

- !BSY && ERR && ABRT right after issuing PACKET indicates that PACKET command is not supported and falls in this category.
- !BSY && ERR(==CHK) && !ABRT after the last byte of CDB is transferred indicates CHECK CONDITION and doesn't fall in this category.
- !BSY && ERR(==CHK) && ABRT after the last byte of CDB is transferred \*probably\* indicates CHECK CONDITION and doesn't fall in this category.

Of errors detected as above, the followings are not ATA/ATAPI device errors but ATA bus errors and should be handled according to Section 7.1.5.

#### CRC error during data transfer

This is indicated by ICRC bit in the ERROR register and means that corruption occurred during data transfer. Upto ATA/ATAPI-7, the standard specifies that this bit is only applicable to UDMA transfers but ATA/ATAPI-8 draft revision 1f says that the bit may be applicable to multiword DMA and PIO.

#### ABRT error during data transfer or on completion

Upto ATA/ATAPI-7, the standard specifies that ABRT could be set on ICRC errors and on cases where a device is not able to complete a command. Combined with the fact that MWDMA and PIO transfer errors aren't allowed to use ICRC bit upto ATA/ATAPI-7, it seems to imply that ABRT bit alone could indicate transfer errors.

However, ATA/ATAPI-8 draft revision 1f removes the part that ICRC errors can turn on ABRT. So, this is kind of gray area. Some heuristics are needed here.

ATA/ATAPI device errors can be further categorized as follows.

#### Media errors

This is indicated by UNC bit in the ERROR register. ATA devices reports UNC error only after certain number of retries cannot recover the data, so there's nothing much else to do other than notifying upper layer.

READ and WRITE commands report CHS or LBA of the first failed sector but ATA/ATAPI standard specifies that the amount of transferred data on error completion is indeterminate, so we cannot assume that sectors preceding the failed sector have been transferred and thus cannot complete those sectors successfully as SCSI does.

#### Media changed / media change requested error

<<TODO: fill here>>

#### Address error

This is indicated by IDNF bit in the ERROR register. Report to upper layer.

#### Other errors

This can be invalid command or parameter indicated by ABRT ERROR bit or some other error condition. Note that ABRT bit can indicate a lot of things including ICRC and Address errors. Heuristics needed.

Depending on commands, not all STATUS/ERROR bits are applicable. These non-applicable bits are marked with "na" in the output descriptions but upto ATA/ATAPI-7 no definition of "na" can be found. However, ATA/ATAPI-8 draft revision 1f describes "N/A" as follows.

##### 3.2.3.3a N/A

A keyword the indicates a field has no defined value in this standard and should not be checked by the host or device. N/A fields should be cleared to zero.

So, it seems reasonable to assume that "na" bits are cleared to zero by devices and thus need no explicit masking.

### 7.1.3. ATAPI device CHECK CONDITION

ATAPI device CHECK CONDITION error is indicated by set CHK bit (ERR bit) in the STATUS register after the last byte of CDB is transferred for a PACKET command. For this kind of errors, sense data should be acquired to gather information regarding the errors. REQUEST SENSE packet command should be used to acquire sense data.

Once sense data is acquired, this type of errors can be handled similarly to other SCSI errors. Note that sense data may indicate ATA bus error (e.g. Sense Key 04h HARDWARE ERROR && ASC/ASCQ 47h/00h SCSI PARITY ERROR). In such cases, the error should be considered as an ATA bus error and handled according to Section 7.1.5.

### 7.1.4. ATA device error (NCQ)

NCQ command error is indicated by cleared BSY and set ERR bit during NCQ command phase (one or more NCQ commands outstanding). Although STATUS and ERROR registers will contain valid values describing the error, READ LOG EXT is required to clear the error condition, determine which command has failed and acquire more information.

READ LOG EXT Log Page 10h reports which tag has failed and taskfile register values describing the error. With this information the failed command can be handled as a normal ATA command error as in Section 7.1.2 and all other in-flight commands must be retried. Note that this retry should not be counted - it's likely that commands retried this way would have completed normally if it were not for the failed command.

Note that ATA bus errors can be reported as ATA device NCQ errors. This should be handled as described in Section 7.1.5.

If READ LOG EXT Log Page 10h fails or reports NQ, we're thoroughly screwed. This condition should be treated according to Section 7.1.1.

### 7.1.5. ATA bus error

ATA bus error means that data corruption occurred during transmission over ATA bus (SATA or PATA). This type of errors can be indicated by

- ICRC or ABRT error as described in Section 7.1.2.
- Controller-specific error completion with error information indicating transmission error.

- On some controllers, command timeout. In this case, there may be a mechanism to determine that the timeout is due to transmission error.
- Unknown/random errors, timeouts and all sorts of weirdities.

As described above, transmission errors can cause wide variety of symptoms ranging from device ICRC error to random device lockup, and, for many cases, there is no way to tell if an error condition is due to transmission error or not; therefore, it's necessary to employ some kind of heuristic when dealing with errors and timeouts. For example, encountering repetitive ABRT errors for known supported command is likely to indicate ATA bus error.

Once it's determined that ATA bus errors have possibly occurred, lowering ATA bus transmission speed is one of actions which may alleviate the problem. See Section 7.2.3 for more information.

### **7.1.6. PCI bus error**

Data corruption or other failures during transmission over PCI (or other system bus). For standard BMDMA, this is indicated by Error bit in the BMDMA Status register. This type of errors must be logged as it indicates something is very wrong with the system. Resetting host controller is recommended.

### **7.1.7. Late completion**

This occurs when timeout occurs and the timeout handler finds out that the timed out command has completed successfully or with error. This is usually caused by lost interrupts. This type of errors must be logged. Resetting host controller is recommended.

### **7.1.8. Unknown error (timeout)**

This is when timeout occurs and the command is still processing or the host and device are in unknown state. When this occurs, HSM could be in any valid or invalid state. To bring the device to known state and make it forget about the timed out command, resetting is necessary. The timed out command may be retried.

Timeouts can also be caused by transmission errors. Refer to Section 7.1.5 for more details.

## 7.1.9. Hotplug and power management exceptions

<<TODO: fill here>>

## 7.2. EH recovery actions

This section discusses several important recovery actions.

### 7.2.1. Clearing error condition

Many controllers require its error registers to be cleared by error handler. Different controllers may have different requirements.

For SATA, it's strongly recommended to clear at least SError register during error handling.

### 7.2.2. Reset

During EH, resetting is necessary in the following cases.

- HSM is in unknown or invalid state
- HBA is in unknown or invalid state
- EH needs to make HBA/device forget about in-flight commands
- HBA/device behaves weirdly

Resetting during EH might be a good idea regardless of error condition to improve EH robustness. Whether to reset both or either one of HBA and device depends on situation but the following scheme is recommended.

- When it's known that HBA is in ready state but ATA/ATAPI device is in unknown state, reset only device.
- If HBA is in unknown state, reset both HBA and device.

HBA resetting is implementation specific. For a controller complying to taskfile/BMDMA PCI IDE, stopping active DMA transaction may be sufficient iff BMDMA state is the only HBA context. But even mostly taskfile/BMDMA PCI IDE complying controllers may have implementation specific requirements and mechanism to reset themselves. This must be addressed by specific drivers.

OTOH, ATA/ATAPI standard describes in detail ways to reset ATA/ATAPI devices.

#### PATA hardware reset

This is hardware initiated device reset signalled with asserted PATA RESET-signal. There is no standard way to initiate hardware reset from software although some hardware provides registers that allow driver to directly tweak the RESET- signal.

#### Software reset

This is achieved by turning CONTROL SRST bit on for at least 5us. Both PATA and SATA support it but, in case of SATA, this may require controller-specific support as the second Register FIS to clear SRST should be transmitted while BSY bit is still set. Note that on PATA, this resets both master and slave devices on a channel.

#### EXECUTE DEVICE DIAGNOSTIC command

Although ATA/ATAPI standard doesn't describe exactly, EDD implies some level of resetting, possibly similar level with software reset. Host-side EDD protocol can be handled with normal command processing and most SATA controllers should be able to handle EDD's just like other commands. As in software reset, EDD affects both devices on a PATA bus.

Although EDD does reset devices, this doesn't suit error handling as EDD cannot be issued while BSY is set and it's unclear how it will act when device is in unknown/weird state.

#### ATAPI DEVICE RESET command

This is very similar to software reset except that reset can be restricted to the selected device without affecting the other device sharing the cable.

#### SATA phy reset

This is the preferred way of resetting a SATA device. In effect, it's identical to PATA hardware reset. Note that this can be done with the standard SCR Control register. As such, it's usually easier to implement than software reset.

One more thing to consider when resetting devices is that resetting clears certain configuration parameters and they need to be set to their previous or newly adjusted values after reset.

Parameters affected are.

- CHS set up with INITIALIZE DEVICE PARAMETERS (seldomly used)
- Parameters set with SET FEATURES including transfer mode setting

- Block count set with SET MULTIPLE MODE
- Other parameters (SET MAX, MEDIA LOCK...)

ATA/ATAPI standard specifies that some parameters must be maintained across hardware or software reset, but doesn't strictly specify all of them. Always reconfiguring needed parameters after reset is required for robustness. Note that this also applies when resuming from deep sleep (power-off).

Also, ATA/ATAPI standard requires that IDENTIFY DEVICE / IDENTIFY PACKET DEVICE is issued after any configuration parameter is updated or a hardware reset and the result used for further operation. OS driver is required to implement revalidation mechanism to support this.

### **7.2.3. Reconfigure transport**

For both PATA and SATA, a lot of corners are cut for cheap connectors, cables or controllers and it's quite common to see high transmission error rate. This can be mitigated by lowering transmission speed.

The following is a possible scheme Jeff Garzik suggested.

If more than \$N (3?) transmission errors happen in 15 minutes,

- if SATA, decrease SATA PHY speed. if speed cannot be decreased,
- decrease UDMA xfer speed. if at UDMA0, switch to PIO4,
- decrease PIO xfer speed. if at PIO3, complain, but continue



# Chapter 8. ata\_piix Internals

## ich\_pata\_cable\_detect

### LINUX

Kernel Hackers Manual February 2010

### Name

`ich_pata_cable_detect` — Probe host controller cable detect info

### Synopsis

```
int ich_pata_cable_detect (struct ata_port * ap);
```

### Arguments

*ap*

Port for which cable detect info is desired

### Description

Read 80c cable indicator from ATA PCI device's PCI config register. This register is normally set by firmware (BIOS).

### LOCKING

None (inherited from caller).

# piix\_pata\_prereset

## LINUX

Kernel Hackers Manual February 2010

### Name

`piix_pata_prereset` — prereset for PATA host controller

### Synopsis

```
int piix_pata_prereset (struct ata_link * link, unsigned long
deadline);
```

### Arguments

*link*

Target link

*deadline*

deadline jiffies for the operation

### LOCKING

None (inherited from caller).

# piix\_set\_piomode

## LINUX

## Name

`piix_set_piomode` — Initialize host controller PATA PIO timings

## Synopsis

```
void piix_set_piomode (struct ata_port * ap, struct ata_device  
* adev);
```

## Arguments

*ap*

Port whose timings we are configuring

*adev*

um

## Description

Set PIO mode for device, in host controller PCI config space.

## LOCKING

None (inherited from caller).

## do\_pata\_set\_dmamode

**LINUX**

## Name

`do_pata_set_dmamode` — Initialize host controller PATA PIO timings

## Synopsis

```
void do_pata_set_dmamode (struct ata_port * ap, struct  
ata_device * adev, int isich);
```

## Arguments

*ap*

Port whose timings we are configuring

*adev*

Drive in question

*isich*

set if the chip is an ICH device

## Description

Set UDMA mode for device, in host controller PCI config space.

## LOCKING

None (inherited from caller).

# piix\_set\_dmamode

## LINUX

Kernel Hackers Manual February 2010

### Name

`piix_set_dmamode` — Initialize host controller PATA DMA timings

### Synopsis

```
void piix_set_dmamode (struct ata_port * ap, struct ata_device  
* adev);
```

### Arguments

*ap*

Port whose timings we are configuring

*adev*

um

### Description

Set MW/UDMA mode for device, in host controller PCI config space.

### LOCKING

None (inherited from caller).

# ich\_set\_dmamode

## LINUX

Kernel Hackers Manual February 2010

### Name

`ich_set_dmamode` — Initialize host controller PATA DMA timings

### Synopsis

```
void ich_set_dmamode (struct ata_port * ap, struct ata_device  
* adev);
```

### Arguments

*ap*

Port whose timings we are configuring

*adev*

um

### Description

Set MW/UDMA mode for device, in host controller PCI config space.

### LOCKING

None (inherited from caller).

# piix\_check\_450nx\_errata

## LINUX

Kernel Hackers Manual February 2010

### Name

`piix_check_450nx_errata` — Check for problem 450NX setup

### Synopsis

```
int piix_check_450nx_errata (struct pci_dev * ata_dev);
```

### Arguments

*ata\_dev*

the PCI device to check

### Description

Check for the present of 450NX errata #19 and errata #25. If they are found return an error code so we can turn off DMA

# piix\_init\_one

## LINUX

## Name

`piix_init_one` — Register PIIX ATA PCI device with kernel services

## Synopsis

```
int piix_init_one (struct pci_dev * pdev, const struct
pci_device_id * ent);
```

## Arguments

*pdev*

PCI device to register

*ent*

Entry in `piix_pci_tbl` matching with *pdev*

## Description

Called from kernel PCI layer. We probe for combined mode (sigh), and then hand over control to libata, for it to do the rest.

## LOCKING

Inherited from PCI layer (may sleep).

## RETURNS

Zero on success, or -ERRNO value.



# Chapter 9. sata\_sil Internals

## sil\_set\_mode

### LINUX

Kernel Hackers Manual February 2010

### Name

`sil_set_mode` — wrap `set_mode` functions

### Synopsis

```
int sil_set_mode (struct ata_link * link, struct ata_device **  
r_failed);
```

### Arguments

*link*

link to set up

*r\_failed*

returned device when we fail

### Description

Wrap the libata method for device setup as after the setup we need to inspect the results and do some configuration work

## **sil\_dev\_config**

### **LINUX**

Kernel Hackers Manual February 2010

### **Name**

`sil_dev_config` — Apply device/host-specific errata fixups

### **Synopsis**

```
void sil_dev_config (struct ata_device * dev);
```

### **Arguments**

*dev*

Device to be examined

### **Description**

After the IDENTIFY [PACKET] DEVICE step is complete, and a device is known to be present, this function is called. We apply two errata fixups which are specific to Silicon Image, a Seagate and a Maxtor fixup.

For certain Seagate devices, we must limit the maximum sectors to under 8K.

For certain Maxtor devices, we must not program the drive beyond udma5.

Both fixups are unfairly pessimistic. As soon as I get more information on these errata, I will create a more exhaustive list, and apply the fixups to only the specific devices/hosts/firmwares that need it.

20040111 - Seagate drives affected by the Mod15Write bug are blacklisted The Maxtor quirk is in the blacklist, but I'm keeping the original pessimistic fix for the following reasons... - There seems to be less info on it, only one device gleaned off the Windows driver, maybe only one is affected. More info would be greatly appreciated. - But then again UDMA5 is hardly anything to complain about





# Chapter 10. Thanks

The bulk of the ATA knowledge comes thanks to long conversations with Andre Hedrick ([www.linux-ide.org](http://www.linux-ide.org)), and long hours pondering the ATA and SCSI specifications.

Thanks to Alan Cox for pointing out similarities between SATA and SCSI, and in general for motivation to hack on libata.

libata's device detection method, `ata_pio_devchk`, and in general all the early probing was based on extensive study of Hale Landis's probe/reset code in his ATADRVR driver ([www.ata-atapi.com](http://www.ata-atapi.com)).

