

# Linux Filesystems API

## Linux Filesystems API

This documentation is free software; you can redistribute it and/or modify it under the terms of the GNU General Public License as published by the Free Software Foundation; either version 2 of the License, or (at your option) any later version.

This program is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU General Public License for more details.

You should have received a copy of the GNU General Public License along with this program; if not, write to the Free Software Foundation, Inc., 59 Temple Place, Suite 330, Boston, MA 02111-1307 USA

For more details see the file COPYING in the source distribution of Linux.

# Table of Contents

<b>1. The Linux VFS .....</b>	<b>1</b>
1.1. The Filesystem types.....	1
enum positive_aop_returns .....	1
inc_nlink .....	2
drop_nlink .....	2
clear_nlink.....	3
inode_inc_iversion .....	4
1.2. The Directory Cache .....	5
__d_drop .....	5
d_invalidate .....	6
shrink_dcache_sb .....	7
have_submounts .....	8
shrink_dcache_parent .....	8
d_alloc.....	9
d_instantiate .....	10
d_alloc_root .....	11
d_obtain_alias .....	12
d_splice_alias .....	13
d_add_ci .....	14
d_lookup .....	15
d_validate .....	16
d_delete .....	17
d_rehash .....	18
dentry_update_name_case .....	19
d_materialise_unique .....	20
d_path.....	20
find_inode_number .....	22
d_add.....	22
d_add_unique.....	23
dget_dlock.....	24
d_unhashed .....	25
1.3. Inode Handling.....	26
inode_init_always .....	26
inode_sb_list_add .....	27
__insert_inode_hash .....	28
remove_inode_hash .....	29
new_inode .....	29
unlock_new_inode .....	30
iget5_locked.....	31
iget_locked.....	32
iunique.....	33

ilookup5_nowait.....	34
ilookup5 .....	36
ilookup .....	37
iput .....	38
bmap.....	39
touch_atime.....	40
file_update_time.....	41
inode_init_owner .....	41
inode_owner_or_capable .....	42
make_bad_inode .....	43
is_bad_inode .....	44
iget_failed .....	45
1.4. Registration and Superblocks .....	46
deactivate_locked_super .....	46
deactivate_super .....	46
generic_shutdown_super.....	47
sget .....	48
get_super .....	49
get_super_thawed .....	50
freeze_super .....	51
thaw_super .....	52
1.5. File Locks.....	53
posix_lock_file.....	53
posix_lock_file_wait.....	54
locks_mandatory_area .....	55
__break_lease.....	56
lease_get_mtime .....	57
generic_setlease .....	58
vfs_setlease .....	59
flock_lock_file_wait.....	60
vfs_test_lock .....	61
vfs_lock_file.....	62
posix_unblock_lock .....	63
vfs_cancel_lock.....	64
lock_may_read.....	65
lock_may_write.....	66
locks_mandatory_locked .....	67
fcntl_getlease .....	68
fcntl_setlease.....	69
sys_flock .....	70
1.6. Other Functions.....	71
mpage_readpages .....	71
mpage_writepages.....	73

generic_permission .....	74
inode_permission .....	75
file_permission .....	76
path_get.....	77
path_put.....	78
release_open_intent.....	79
vfs_path_lookup.....	80
lookup_one_len.....	81
lookup_create .....	82
sync_mapping_buffers .....	83
mark_buffer_dirty .....	84
__bread.....	84
block_invalidatepage.....	85
ll_rw_block .....	86
bh_uptodate_or_lock.....	88
bh_submit_read.....	88
bio_alloc_bioset .....	89
bio_alloc.....	90
bio_kmalloc.....	91
bio_put .....	92
__bio_clone.....	93
bio_clone.....	94
bio_get_nr_vecs .....	95
bio_add_pc_page .....	96
bio_add_page .....	97
bio_uncopy_user .....	98
bio_copy_user .....	99
bio_map_user .....	100
bio_unmap_user.....	101
bio_map_kern .....	102
bio_copy_kern.....	103
bio_endio.....	104
bio_sector_offset.....	105
bioset_create .....	106
seq_open .....	107
seq_read .....	108
seq_lseek.....	109
seq_release .....	110
seq_escape.....	111
mangle_path.....	112
seq_path .....	113
seq_write .....	114
seq_hlist_start .....	115

seq_hlist_start_head .....	116
seq_hlist_next .....	117
seq_hlist_start_rcu .....	117
seq_hlist_start_head_rcu .....	118
seq_hlist_next_rcu .....	119
register_filesystem .....	121
unregister_filesystem .....	121
__mark_inode_dirty .....	122
writeback_inodes_sb_nr .....	123
writeback_inodes_sb .....	124
try_to_writeback_inodes_sb_nr .....	125
writeback_inodes_sb_if_idle .....	126
writeback_inodes_sb_nr_if_idle .....	127
sync_inodes_sb .....	128
write_inode_now .....	129
sync_inode .....	129
sync_inode_metadata .....	130
freeze_bdev .....	131
thaw_bdev .....	132
bdgrab .....	133
bd_link_disk_holder .....	134
bd_unlink_disk_holder .....	135
check_disk_size_change .....	136
revalidate_disk .....	137
blkdev_get .....	138
blkdev_get_by_path .....	139
blkdev_get_by_dev .....	140
lookup_bdev .....	142
<b>2. The proc filesystem .....</b>	<b>145</b>
2.1. sysctl interface .....	145
register_sysctl_paths .....	145
register_sysctl_table .....	146
unregister_sysctl_table .....	146
proc_dostring .....	147
proc_dointvec .....	149
proc_dointvec_minmax .....	150
proc_doulongvec_minmax .....	151
proc_doulongvec_ms_jiffies_minmax .....	152
proc_dointvec_jiffies .....	153
proc_dointvec_userhz_jiffies .....	155
proc_dointvec_ms_jiffies .....	156
2.2. proc filesystem interface .....	157
proc_flush_task .....	157

<b>3. Events based on file descriptors.....</b>	<b>159</b>
eventfd_signal .....	159
eventfd_ctx_get.....	160
eventfd_ctx_put.....	160
eventfd_ctx_remove_wait_queue.....	161
eventfd_ctx_read.....	162
eventfd_fget .....	164
eventfd_ctx_fdget.....	164
eventfd_ctx_fileget.....	165
<b>4. The Filesystem for Exporting Kernel Objects.....</b>	<b>167</b>
sysfs_create_file.....	167
sysfs_add_file_to_group .....	167
sysfs_chmod_file.....	168
sysfs_remove_file.....	169
sysfs_remove_file_from_group .....	170
sysfs_schedule_callback .....	171
sysfs_create_link.....	172
sysfs_remove_link .....	173
sysfs_rename_link.....	174
sysfs_create_bin_file.....	175
sysfs_remove_bin_file .....	175
<b>5. The debugfs filesystem.....</b>	<b>177</b>
5.1. debugfs interface .....	177
debugfs_create_file .....	177
debugfs_create_dir .....	178
debugfs_create_symlink .....	179
debugfs_remove .....	180
debugfs_remove_recursive.....	181
debugfs_rename .....	182
debugfs_initialized .....	183
debugfs_create_u8 .....	184
debugfs_create_u16 .....	185
debugfs_create_u32 .....	186
debugfs_create_u64 .....	188
debugfs_create_x8 .....	189
debugfs_create_x16 .....	190
debugfs_create_x32 .....	191
debugfs_create_x64 .....	192
debugfs_create_size_t.....	193
debugfs_create_bool .....	194
debugfs_create_blob .....	195

<b>6. The Linux Journalling API .....</b>	<b>199</b>
6.1. Overview .....	199
6.1.1. Details .....	199
6.1.2. Summary .....	201
6.2. Data Types .....	202
6.2.1. Structures .....	202
typedef handle_t.....	202
typedef journal_t.....	203
struct handle_s .....	203
struct journal_s.....	205
6.3. Functions.....	210
6.3.1. Journal Level.....	210
journal_init_dev .....	210
journal_init_inode.....	212
journal_create.....	212
journal_load .....	213
journal_destroy .....	214
journal_check_used_features .....	215
journal_check_available_features .....	216
journal_set_features .....	217
journal_update_format.....	218
journal_flush .....	219
journal_wipe .....	220
journal_abort.....	221
journal_errno.....	222
journal_clear_err .....	223
journal_ack_err .....	224
journal_recover .....	224
journal_skip_recovery.....	225
6.3.2. Transaction Level .....	226
journal_start .....	226
journal_extend.....	227
journal_restart .....	228
journal_lock_updates .....	229
journal_unlock_updates .....	230
journal_get_write_access .....	231
journal_get_create_access.....	232
journal_get_undo_access .....	233
journal_dirty_data.....	234
journal_dirty_metadata .....	235
journal_forget.....	237
journal_stop.....	238
journal_force_commit.....	239



journal_try_to_free_buffers .....	239
journal_invalidatepage .....	241
6.4. See also .....	242
<b>7. splice API.....</b>	<b>243</b>
splice_to_pipe .....	243
generic_file_splice_read .....	244
splice_from_pipe_feed.....	245
splice_from_pipe_next.....	246
splice_from_pipe_begin.....	247
splice_from_pipe_end.....	247
__splice_from_pipe.....	248
splice_from_pipe.....	249
generic_file_splice_write .....	251
generic_splice_sendpage.....	252
splice_direct_to_actor.....	253
do_splice_direct .....	254
<b>8. pipes API.....</b>	<b>257</b>
struct pipe_buffer .....	257
struct pipe_inode_info .....	258
generic_pipe_buf_map.....	260
generic_pipe_buf_unmap.....	261
generic_pipe_buf_steal .....	262
generic_pipe_buf_get.....	263
generic_pipe_buf_confirm .....	264
generic_pipe_buf_release .....	265



# Chapter 1. The Linux VFS

## 1.1. The Filesystem types

### enum positive\_aop\_returns

**LINUX**

Kernel Hackers Manual October 2016

#### Name

enum positive\_aop\_returns — aop return codes with specific semantics

#### Synopsis

```
enum positive_aop_returns {
    AOP_WRITEPAGE_ACTIVATE,
    AOP_TRUNCATED_PAGE
};
```

#### Constants

##### AOP\_WRITEPAGE\_ACTIVATE

Informs the caller that page writeback has completed, that the page is still locked, and should be considered active. The VM uses this hint to return the page to the active list -- it won't be a candidate for writeback again in the near future. Other callers must be careful to unlock the page if they get this return. Returned by `writepage`;

##### AOP\_TRUNCATED\_PAGE

The AOP method that was handed a locked page has unlocked it and the page might have been truncated. The caller should back up to acquiring a new page and trying again. The aop will be taking reasonable precautions not to livelock. If the caller held a page reference, it should drop it before retrying. Returned by `readpage`.

## Description

`address_space_operation` functions return these large constants to indicate special semantics to the caller. These are much larger than the bytes in a page to allow for functions that return the number of bytes operated on in a given page.

## inc\_nlink

### LINUX

Kernel Hackers Manual October 2016

## Name

`inc_nlink` — directly increment an inode's link count

## Synopsis

```
void inc_nlink (struct inode * inode);
```

## Arguments

*inode*

inode

## Description

This is a low-level filesystem helper to replace any direct filesystem manipulation of `i_nlink`. Currently, it is only here for parity with `dec_nlink`.

# drop\_nlink

## LINUX

Kernel Hackers Manual October 2016

### Name

`drop_nlink` — directly drop an inode's link count

### Synopsis

```
void drop_nlink (struct inode * inode);
```

### Arguments

*inode*

inode

### Description

This is a low-level filesystem helper to replace any direct filesystem manipulation of `i_nlink`. In cases where we are attempting to track writes to the filesystem, a decrement to zero means an imminent write when the file is truncated and actually unlinked on the filesystem.

# clear\_nlink

## LINUX

## Name

`clear_nlink` — directly zero an inode's link count

## Synopsis

```
void clear_nlink (struct inode * inode);
```

## Arguments

*inode*

inode

## Description

This is a low-level filesystem helper to replace any direct filesystem manipulation of `i_nlink`. See `drop_nlink` for why we care about `i_nlink` hitting zero.

# inode\_inc\_iversion

## LINUX

## Name

`inode_inc_iversion` — increments `i_version`

## Synopsis

```
void inode_inc_iversion (struct inode * inode);
```

## Arguments

*inode*

inode that need to be updated

## Description

Every time the inode is modified, the `i_version` field will be incremented. The filesystem has to be mounted with `i_version` flag

## 1.2. The Directory Cache

### \_\_d\_drop

**LINUX**

Kernel Hackers Manual October 2016

### Name

`__d_drop` — drop a dentry

## Synopsis

```
void __d_drop (struct dentry * dentry);
```

## Arguments

*dentry*

dentry to drop

## Description

`d_drop` unhashes the entry from the parent dentry hashes, so that it won't be found through a VFS lookup any more. Note that this is different from deleting the dentry - `d_delete` will try to mark the dentry negative if possible, giving a successful `_negative_` lookup, while `d_drop` will just make the cache lookup fail.

`d_drop` is used mainly for stuff that wants to invalidate a dentry for some reason (NFS timeouts or autofs deletes).

`__d_drop` requires `dentry->d_lock`.

## d\_invalidate

### LINUX

Kernel Hackers Manual October 2016

## Name

`d_invalidate` — invalidate a dentry

## Synopsis

```
int d_invalidate (struct dentry * dentry);
```



## Arguments

*dentry*

dentry to invalidate

## Description

Try to invalidate the dentry if it turns out to be possible. If there are other dentries that can be reached through this one we can't delete it and we return -EBUSY. On success we return 0.

no dcache lock.

# shrink\_dcache\_sb

## LINUX

Kernel Hackers Manual October 2016

## Name

`shrink_dcache_sb` — shrink dcache for a superblock

## Synopsis

```
void shrink_dcache_sb (struct super_block * sb);
```

## Arguments

*sb*

superblock

## Description

Shrink the dcache for the specified super block. This is used to free the dcache before unmounting a file system.

# have\_submounts

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`have_submounts` — check for mounts over a dentry

## Synopsis

```
int have_submounts (struct dentry * parent);
```

## Arguments

*parent*

dentry to check.

## Description

Return true if the parent or its subdirectories contain a mount point

# shrink\_dcache\_parent

## LINUX

Kernel Hackers ManualOctober 2016

### Name

`shrink_dcache_parent` — prune dcache

### Synopsis

```
void shrink_dcache_parent (struct dentry * parent);
```

### Arguments

*parent*

parent of entries to prune

### Description

Prune the dcache to remove unused children of the parent dentry.

# d\_alloc

## LINUX

Kernel Hackers ManualOctober 2016

### Name

`d_alloc` — allocate a dcache entry

## Synopsis

```
struct dentry * d_alloc (struct dentry * parent, const struct  
qstr * name);
```

## Arguments

*parent*

parent of entry to allocate

*name*

qstr of the name

## Description

Allocates a dentry. It returns `NULL` if there is insufficient memory available. On a success the dentry is returned. The name passed in is copied and the copy passed in may be reused after this call.

## d\_instantiate

### LINUX

Kernel Hackers Manual October 2016

## Name

`d_instantiate` — fill in inode information for a dentry

## Synopsis

```
void d_instantiate (struct dentry * entry, struct inode *  
inode);
```

## Arguments

*entry*

dentry to complete

*inode*

inode to attach to this dentry

## Description

Fill in inode information in the entry.

This turns negative dentries into productive full members of society.

NOTE! This assumes that the inode count has been incremented (or otherwise set) by the caller to indicate that it is now in use by the dcache.

## d\_alloc\_root

**LINUX**

Kernel Hackers ManualOctober 2016

## Name

d\_alloc\_root — allocate root dentry

## Synopsis

```
struct dentry * d_alloc_root (struct inode * root_inode);
```

## Arguments

*root\_inode*

inode to allocate the root for

## Description

Allocate a root (“/”) dentry for the inode given. The inode is instantiated and returned. `NULL` is returned if there is insufficient memory or the inode passed is `NULL`.

## d\_obtain\_alias

### LINUX

Kernel Hackers Manual October 2016

## Name

`d_obtain_alias` — find or allocate a dentry for a given inode

## Synopsis

```
struct dentry * d_obtain_alias (struct inode * inode);
```

## Arguments

*inode*

inode to allocate the dentry for

## Description

Obtain a dentry for an inode resulting from NFS filehandle conversion or similar open by handle operations. The returned dentry may be anonymous, or may have a full name (if the inode was already in the cache).

When called on a directory inode, we must ensure that the inode only ever has one dentry. If a dentry is found, that is returned instead of allocating a new one.

On successful return, the reference to the inode has been transferred to the dentry. In case of an error the reference on the inode is released. To make it easier to use in export operations a `NULL` or `IS_ERR` inode may be passed in and will be the error will be propagate to the return value, with a `NULL` *inode* replaced by `ERR_PTR(-ESTALE)`.

## d\_splice\_alias

### LINUX

Kernel Hackers Manual October 2016

## Name

`d_splice_alias` — splice a disconnected dentry into the tree if one exists

## Synopsis

```
struct dentry * d_splice_alias (struct inode * inode, struct
dentry * dentry);
```

## Arguments

*inode*

the inode which may have a disconnected dentry

*dentry*

a negative dentry which we want to point to the inode.

## Description

If *inode* is a directory and has a 'disconnected' dentry (i.e. `IS_ROOT` and `DCACHE_DISCONNECTED`), then `d_move` that in place of the given dentry and return it, else simply `d_add` the inode to the dentry and return `NULL`.

This is needed in the lookup routine of any filesystem that is exportable (via `knfsd`) so that we can build `dcache` paths to directories effectively.

If a dentry was found and moved, then it is returned. Otherwise `NULL` is returned. This matches the expected return value of `->lookup`.

## d\_add\_ci

### LINUX

Kernel Hackers Manual October 2016

## Name

`d_add_ci` — lookup or allocate new dentry with case-exact name

## Synopsis

```
struct dentry * d_add_ci (struct dentry * dentry, struct inode
* inode, struct qstr * name);
```



## Arguments

*dentry*

the negative dentry that was passed to the parent's lookup func

*inode*

the inode case-insensitive lookup has found

*name*

the case-exact name to be associated with the returned dentry

## Description

This is to avoid filling the dcache with case-insensitive names to the same inode, only the actual correct case is stored in the dcache for case-insensitive filesystems.

For a case-insensitive lookup match and if the the case-exact dentry already exists in in the dcache, use it and return it.

If no entry exists with the exact case name, allocate new dentry with the exact case, and return the spliced entry.

## d\_lookup

**LINUX**

Kernel Hackers Manual October 2016

### Name

d\_lookup — search for a dentry

### Synopsis

```
struct dentry * d_lookup (struct dentry * parent, struct qstr
* name);
```

## Arguments

*parent*

parent dentry

*name*

qstr of name we wish to find

## Returns

dentry, or NULL

`d_lookup` searches the children of the parent dentry for the name in question. If the dentry is found its reference count is incremented and the dentry is returned. The caller must use `dput` to free the entry when it has finished using it. `NULL` is returned if the dentry does not exist.

## d\_validate

### LINUX

Kernel Hackers Manual October 2016

## Name

`d_validate` — verify dentry provided from insecure source (deprecated)

## Synopsis

```
int d_validate (struct dentry * dentry, struct dentry *  
                dparent);
```

## Arguments

*dentry*

The dentry alleged to be valid child of *dparent*

*dparent*

The parent dentry (known to be valid)

## Description

An insecure source has sent us a dentry, here we verify it and `dget` it. This is used by `ncpfs` in its `readdir` implementation. Zero is returned if the dentry is invalid.

This function is slow for big directories, and deprecated, do not use it.

## d\_delete

### LINUX

Kernel Hackers Manual October 2016

### Name

`d_delete` — delete a dentry

### Synopsis

```
void d_delete (struct dentry * dentry);
```

## Arguments

*dentry*

The dentry to delete

## Description

Turn the dentry into a negative dentry if possible, otherwise remove it from the hash queues so it can be deleted later

# d\_rehash

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`d_rehash` — add an entry back to the hash

## Synopsis

```
void d_rehash (struct dentry * entry);
```

## Arguments

*entry*

dentry to add to the hash

## Description

Adds a dentry to the hash according to its name.

# dentry\_update\_name\_case

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`dentry_update_name_case` — update case insensitive dentry with a new name

## Synopsis

```
void dentry_update_name_case (struct dentry * dentry, struct
qstr * name);
```

## Arguments

*dentry*

dentry to be updated

*name*

new name

## Description

Update a case insensitive dentry with new case of name.

dentry must have been returned by `d_lookup` with name *name*. Old and new name lengths must match (ie. no `d_compare` which allows mismatched name lengths).

Parent inode `i_mutex` must be held over `d_lookup` and into this call (to keep renames and concurrent inserts, and `readdir(2)` away).

## d\_materialise\_unique

### LINUX

Kernel Hackers Manual October 2016

### Name

`d_materialise_unique` — introduce an inode into the tree

### Synopsis

```
struct dentry * d_materialise_unique (struct dentry * dentry,  
struct inode * inode);
```

### Arguments

*dentry*

candidate dentry

*inode*

inode to bind to the dentry, to which aliases may be attached

### Description

Introduces an dentry into the tree, substituting an extant disconnected root directory alias in its place if there is one

# d\_path

## LINUX

Kernel Hackers Manual October 2016

## Name

`d_path` — return the path of a dentry

## Synopsis

```
char * d_path (const struct path * path, char * buf, int
buflen);
```

## Arguments

*path*

path to report

*buf*

buffer to return value in

*buflen*

buffer length

## Description

Convert a dentry into an ASCII path name. If the entry has been deleted the string “(deleted)” is appended. Note that this is ambiguous.

Returns a pointer into the buffer or an error code if the path was too long. Note: Callers should use the returned pointer, not the passed in buffer, to use the name! The implementation often starts at an offset into the buffer, and may leave 0 bytes at the start.

“buflen” should be positive.

# find\_inode\_number

## LINUX

Kernel Hackers Manual October 2016

### Name

`find_inode_number` — check for dentry with name

### Synopsis

```
ino_t find_inode_number (struct dentry * dir, struct qstr *  
name);
```

### Arguments

*dir*

directory to check

*name*

Name to find.

### Description

Check whether a dentry already exists for the given name, and return the inode number if it has an inode. Otherwise 0 is returned.

This routine is used to post-process directory listings for filesystems using synthetic inode numbers, and is necessary to keep `getcwd` working.



# d\_add

## LINUX

Kernel Hackers Manual October 2016

### Name

d\_add — add dentry to hash queues

### Synopsis

```
void d_add (struct dentry * entry, struct inode * inode);
```

### Arguments

*entry*

dentry to add

*inode*

The inode to attach to this dentry

### Description

This adds the entry to the hash queues and initializes *inode*. The entry was actually filled in earlier during `d_alloc`.

# d\_add\_unique

## LINUX

## Name

`d_add_unique` — add dentry to hash queues without aliasing

## Synopsis

```
struct dentry * d_add_unique (struct dentry * entry, struct
inode * inode);
```

## Arguments

*entry*

dentry to add

*inode*

The inode to attach to this dentry

## Description

This adds the entry to the hash queues and initializes *inode*. The entry was actually filled in earlier during `d_alloc`.

## dget\_dlock

**LINUX**

## Name

`dget_dlock` — get a reference to a dentry

## Synopsis

```
struct dentry * dget_dlock (struct dentry * dentry);
```

## Arguments

*dentry*

dentry to get a reference to

## Description

Given a dentry or `NULL` pointer increment the reference count if appropriate and return the dentry. A dentry will not be destroyed when it has references.

# d\_unhashed

## LINUX

## Name

`d_unhashed` — is dentry hashed

## Synopsis

```
int d_unhashed (struct dentry * dentry);
```

## Arguments

*dentry*

entry to check

## Description

Returns true if the dentry passed is not currently hashed.

# 1.3. Inode Handling

## inode\_init\_always

**LINUX**

Kernel Hackers ManualOctober 2016

## Name

`inode_init_always` — perform inode structure intialisation

## Synopsis

```
int inode_init_always (struct super_block * sb, struct inode *  
inode);
```

## Arguments

*sb*

superblock inode belongs to

*inode*

inode to initialise

## Description

These are initializations that need to be done on every inode allocation as the fields are not initialised by slab allocation.

# inode\_sb\_list\_add

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`inode_sb_list_add` — add inode to the superblock list of inodes

## Synopsis

```
void inode_sb_list_add (struct inode * inode);
```

## Arguments

*inode*

inode to add

# \_\_insert\_inode\_hash

**LINUX**

Kernel Hackers ManualOctober 2016

## Name

`__insert_inode_hash` — hash an inode

## Synopsis

```
void __insert_inode_hash (struct inode * inode, unsigned long  
hashval);
```

## Arguments

*inode*

unhashed inode

*hashval*

unsigned long value used to locate this object in the inode\_hashtable.

## Description

Add an inode to the inode hash for this superblock.

# remove\_inode\_hash

## LINUX

Kernel Hackers Manual October 2016

### Name

`remove_inode_hash` — remove an inode from the hash

### Synopsis

```
void remove_inode_hash (struct inode * inode);
```

### Arguments

*inode*

inode to unhash

### Description

Remove an inode from the superblock.

# new\_inode

## LINUX

## Name

`new_inode` — obtain an inode

## Synopsis

```
struct inode * new_inode (struct super_block * sb);
```

## Arguments

*sb*

superblock

## Description

Allocates a new inode for given superblock. The default `gfp_mask` for allocations related to `inode->i_mapping` is `GFP_HIGHUSER_MOVABLE`. If `HIGHMEM` pages are unsuitable or it is known that pages allocated for the page cache are not reclaimable or migratable, `mapping_set_gfp_mask` must be called with suitable flags on the newly created inode's mapping

# unlock\_new\_inode

## LINUX

## Name

`unlock_new_inode` — clear the `I_NEW` state and wake up any waiters



## Synopsis

```
void unlock_new_inode (struct inode * inode);
```

## Arguments

*inode*

new inode to unlock

## Description

Called when the inode is fully initialised to clear the new state of the inode and wake up anyone waiting for the inode to finish initialisation.

# iget5\_locked

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`iget5_locked` — obtain an inode from a mounted file system

## Synopsis

```
struct inode * iget5_locked (struct super_block * sb, unsigned  
long hashval, int (*test) (struct inode *, void *), int (*set)  
(struct inode *, void *), void * data);
```

## Arguments

*sb*

super block of file system

*hashval*

hash value (usually inode number) to get

*test*

callback used for comparisons between inodes

*set*

callback used to initialize a new struct inode

*data*

opaque data pointer to pass to *test* and *set*

## Description

Search for the inode specified by *hashval* and *data* in the inode cache, and if present it is return it with an increased reference count. This is a generalized version of `iget_locked` for file systems where the inode number is not sufficient for unique identification of an inode.

If the inode is not in cache, allocate a new inode and return it locked, hashed, and with the `I_NEW` flag set. The file system gets to fill it in before unlocking it via `unlock_new_inode`.

Note both *test* and *set* are called with the `inode_hash_lock` held, so can't sleep.

## iget\_locked

**LINUX**

## Name

`iget_locked` — obtain an inode from a mounted file system

## Synopsis

```
struct inode * iget_locked (struct super_block * sb, unsigned  
long ino);
```

## Arguments

*sb*

super block of file system

*ino*

inode number to get

## Description

Search for the inode specified by *ino* in the inode cache and if present return it with an increased reference count. This is for file systems where the inode number is sufficient for unique identification of an inode.

If the inode is not in cache, allocate a new inode and return it locked, hashed, and with the `I_NEW` flag set. The file system gets to fill it in before unlocking it via `unlock_new_inode`.

# iunique

**LINUX**

## Name

`iunique` — get a unique inode number

## Synopsis

```
ino_t iunique (struct super_block * sb, ino_t max_reserved);
```

## Arguments

*sb*

superblock

*max\_reserved*

highest reserved inode number

## Description

Obtain an inode number that is unique on the system for a given superblock. This is used by file systems that have no natural permanent inode numbering system. An inode number is returned that is higher than the reserved limit but unique.

## BUGS

With a large number of inodes live on the file system this function currently becomes quite slow.

# ilookup5\_nowait

## LINUX

Kernel Hackers Manual October 2016

### Name

`ilookup5_nowait` — search for an inode in the inode cache

### Synopsis

```
struct inode * ilookup5_nowait (struct super_block * sb,
unsigned long hashval, int (*test) (struct inode *, void *),
void * data);
```

### Arguments

*sb*

super block of file system to search

*hashval*

hash value (usually inode number) to search for

*test*

callback used for comparisons between inodes

*data*

opaque data pointer to pass to *test*

### Description

Search for the inode specified by *hashval* and *data* in the inode cache. If the inode is in the cache, the inode is returned with an incremented reference count.

## Note

`I_NEW` is not waited upon so you have to be very careful what you do with the returned inode. You probably should be using `ilookup5` instead.

## Note2

`test` is called with the `inode_hash_lock` held, so can't sleep.

# ilookup5

## LINUX

Kernel Hackers Manual October 2016

## Name

`ilookup5` — search for an inode in the inode cache

## Synopsis

```
struct inode * ilookup5 (struct super_block * sb, unsigned
long hashval, int (*test) (struct inode *, void *), void *
data);
```

## Arguments

*sb*

super block of file system to search

*hashval*

hash value (usually inode number) to search for

*test*

callback used for comparisons between inodes

*data*opaque data pointer to pass to *test*

## Description

Search for the inode specified by *hashval* and *data* in the inode cache, and if the inode is in the cache, return the inode with an incremented reference count. Waits on I\_NEW before returning the inode. returned with an incremented reference count.

This is a generalized version of `ilookup` for file systems where the inode number is not sufficient for unique identification of an inode.

## Note

*test* is called with the `inode_hash_lock` held, so can't sleep.

# ilookup

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`ilookup` — search for an inode in the inode cache

## Synopsis

```
struct inode * ilookup (struct super_block * sb, unsigned long
ino);
```

## Arguments

*sb*

super block of file system to search

*ino*

inode number to search for

## Description

Search for the inode *ino* in the inode cache, and if the inode is in the cache, the inode is returned with an incremented reference count.

# iput

## LINUX

Kernel Hackers ManualOctober 2016

## Name

iput — put an inode

## Synopsis

```
void iput (struct inode * inode);
```

## Arguments

*inode*

inode to put



## Description

Puts an inode, dropping its usage count. If the inode use count hits zero, the inode is then freed and may also be destroyed.

Consequently, `iput` can sleep.

# bmap

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`bmap` — find a block number in a file

## Synopsis

```
sector_t bmap (struct inode * inode, sector_t block);
```

## Arguments

*inode*

inode of file

*block*

block to find

## Description

Returns the block number on the device holding the inode that is the disk block number for the block of the file requested. That is, asked for block 4 of inode 1 the

function will return the disk block relative to the disk start that holds that block of the file.

## touch\_atime

### LINUX

Kernel Hackers Manual October 2016

### Name

`touch_atime` — update the access time

### Synopsis

```
void touch_atime (struct vfsmount * mnt, struct dentry *  
dentry);
```

### Arguments

*mnt*

mount the inode is accessed on

*dentry*

dentry accessed

### Description

Update the accessed time on an inode and mark it for writeback. This function automatically handles read only file systems and media, as well as the “noatime” flag and inode specific “noatime” markers.

# file\_update\_time

## LINUX

Kernel Hackers Manual October 2016

### Name

`file_update_time` — update mtime and ctime time

### Synopsis

```
int file_update_time (struct file * file);
```

### Arguments

*file*

file accessed

### Description

Update the mtime and ctime members of an inode and mark the inode for writeback. Note that this function is meant exclusively for usage in the file write path of filesystems, and filesystems may choose to explicitly ignore update via this function with the S\_NOCMTIME inode flag, e.g. for network filesystem where these timestamps are handled by the server. This can return an error for file systems who need to allocate space in order to update an inode.

# inode\_init\_owner

**LINUX**

Kernel Hackers Manual October 2016

## Name

`inode_init_owner` — Init uid,gid,mode for new inode according to posix standards

## Synopsis

```
void inode_init_owner (struct inode * inode, const struct  
inode * dir, mode_t mode);
```

## Arguments

*inode*

New inode

*dir*

Directory inode

*mode*

mode of the new inode

# inode\_owner\_or\_capable

**LINUX**

## Name

`inode_owner_or_capable` — check current task permissions to inode

## Synopsis

```
bool inode_owner_or_capable (const struct inode * inode);
```

## Arguments

*inode*

inode being checked

## Description

Return true if current either has CAP\_FOWNER to the inode, or owns the file.

# make\_bad\_inode

## LINUX

## Name

`make_bad_inode` — mark an inode bad due to an I/O error

## Synopsis

```
void make_bad_inode (struct inode * inode);
```

## Arguments

*inode*

Inode to mark bad

## Description

When an inode cannot be read due to a media or remote network failure this function makes the inode “bad” and causes I/O operations on it to fail from this point on.

## is\_bad\_inode

### LINUX

Kernel Hackers Manual October 2016

## Name

`is_bad_inode` — is an inode errored

## Synopsis

```
int is_bad_inode (struct inode * inode);
```

## Arguments

*inode*

inode to test

## Description

Returns true if the inode in question has been marked as bad.

# iget\_failed

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`iget_failed` — Mark an under-construction inode as dead and release it

## Synopsis

```
void iget_failed (struct inode * inode);
```

## Arguments

*inode*

The inode to discard

## Description

Mark an under-construction inode as dead and release it.

## 1.4. Registration and Superblocks

### deactivate\_locked\_super

#### LINUX

Kernel Hackers ManualOctober 2016

#### Name

`deactivate_locked_super` — drop an active reference to superblock

#### Synopsis

```
void deactivate_locked_super (struct super_block * s);
```

#### Arguments

*s*

superblock to deactivate

#### Description

Drops an active reference to superblock, converting it into a temporary one if there is no other active references left. In that case we tell fs driver to shut it down and drop the temporary reference we had just acquired.

Caller holds exclusive lock on superblock; that lock is released.



# deactivate\_super

## LINUX

Kernel Hackers Manual October 2016

### Name

`deactivate_super` — drop an active reference to superblock

### Synopsis

```
void deactivate_super (struct super_block * s);
```

### Arguments

*s*  
superblock to deactivate

### Description

Variant of `deactivate_locked_super`, except that superblock is *\*not\** locked by caller. If we are going to drop the final active reference, lock will be acquired prior to that.

# generic\_shutdown\_super

## LINUX

## Name

`generic_shutdown_super` — common helper for `->kill_sb`

## Synopsis

```
void generic_shutdown_super (struct super_block * sb);
```

## Arguments

*sb*

superblock to kill

## Description

`generic_shutdown_super` does all fs-independent work on superblock shutdown. Typical `->kill_sb` should pick all fs-specific objects that need destruction out of superblock, call `generic_shutdown_super` and release aforementioned objects. Note: dentries and inodes `_are_` taken care of and do not need specific handling.

Upon calling this function, the filesystem may no longer alter or rearrange the set of dentries belonging to this `super_block`, nor may it change the attachments of dentries to inodes.

# sget

**LINUX**

## Name

`sget` — find or create a superblock

## Synopsis

```
struct super_block * sget (struct file_system_type * type, int
(*test) (struct super_block *,void *), int (*set) (struct
super_block *,void *), void * data);
```

## Arguments

*type*

filesystem type superblock should belong to

*test*

comparison callback

*set*

setup callback

*data*

argument to each of them

## get\_super

**LINUX**

## Name

`get_super` — get the superblock of a device

## Synopsis

```
struct super_block * get_super (struct block_device * bdev);
```

## Arguments

*bdev*

device to get the superblock for

## Description

Scans the superblock list and finds the superblock of the file system mounted on the device given. `NULL` is returned if no match is found.

# get\_super\_thawed

## LINUX

## Name

`get_super_thawed` — get thawed superblock of a device

## Synopsis

```
struct super_block * get_super_thawed (struct block_device *
bdev);
```

## Arguments

*bdev*

device to get the superblock for

## Description

Scans the superblock list and finds the superblock of the file system mounted on the device. The superblock is returned once it is thawed (or immediately if it was not frozen). `NULL` is returned if no match is found.

## freeze\_super

### LINUX

Kernel Hackers Manual October 2016

## Name

`freeze_super` — lock the filesystem and force it into a consistent state

## Synopsis

```
int freeze_super (struct super_block * sb);
```

## Arguments

*sb*

the super to lock

## Description

Syncs the super to make sure the filesystem is consistent and calls the fs's `freeze_fs`. Subsequent calls to this without first thawing the fs will return `-EBUSY`.

# thaw\_super

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`thaw_super` — - unlock filesystem

## Synopsis

```
int thaw_super (struct super_block * sb);
```

## Arguments

*sb*

the super to thaw

## Description

Unlocks the filesystem and marks it writeable again after `freeze_super`.

## 1.5. File Locks

### `posix_lock_file`

#### LINUX

Kernel Hackers Manual October 2016

#### Name

`posix_lock_file` — Apply a POSIX-style lock to a file

#### Synopsis

```
int posix_lock_file (struct file * filp, struct file_lock *  
fl, struct file_lock * conflock);
```

#### Arguments

*filp*

The file to apply the lock to

*fl*

The lock to be applied

*conflock*

Place to return a copy of the conflicting lock, if found.

## Description

Add a POSIX style lock to a file. We merge adjacent & overlapping locks whenever possible. POSIX locks are sorted by owner task, then by starting address

Note that if called with an FL\_EXISTS argument, the caller may determine whether or not a lock was successfully freed by testing the return value for -ENOENT.

# posix\_lock\_file\_wait

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`posix_lock_file_wait` — Apply a POSIX-style lock to a file

## Synopsis

```
int posix_lock_file_wait (struct file * filp, struct file_lock  
* fl);
```

## Arguments

*filp*

The file to apply the lock to

*fl*

The lock to be applied



## Description

Add a POSIX style lock to a file. We merge adjacent & overlapping locks whenever possible. POSIX locks are sorted by owner task, then by starting address

# locks\_mandatory\_area

## LINUX

Kernel Hackers Manual October 2016

## Name

`locks_mandatory_area` — Check for a conflicting lock

## Synopsis

```
int locks_mandatory_area (int read_write, struct inode *
inode, struct file * filp, loff_t offset, size_t count);
```

## Arguments

*read\_write*

FLOCK\_VERIFY\_WRITE for exclusive access, FLOCK\_VERIFY\_READ for shared

*inode*

the file to check

*filp*

how the file was opened (if it was)

*offset*

start of area to check

*count*

length of area to check

## Description

Searches the inode's list of locks to find any POSIX locks which conflict. This function is called from `rw_verify_area` and `locks_verify_truncate`.

## \_\_break\_lease

### LINUX

Kernel Hackers Manual October 2016

## Name

`__break_lease` — revoke all outstanding leases on file

## Synopsis

```
int __break_lease (struct inode * inode, unsigned int mode);
```

## Arguments

*inode*

the inode of the file to return

*mode*

the open mode (read or write)

## Description

`break_lease` (inlined for speed) has checked there already is at least some kind of lock (maybe a lease) on this file. Leases are broken on a call to `open` or `truncate`. This function can sleep unless you specified `O_NONBLOCK` to your `open`.

## lease\_get\_mtime

### LINUX

Kernel Hackers Manual October 2016

## Name

`lease_get_mtime` — get the last modified time of an inode

## Synopsis

```
void lease_get_mtime (struct inode * inode, struct timespec *  
time);
```

## Arguments

*inode*

the inode

*time*

pointer to a `timespec` which will contain the last modified time

## Description

This is to force NFS clients to flush their caches for files with exclusive leases. The justification is that if someone has an exclusive lease, then they could be modifying it.

## generic\_setlease

### LINUX

Kernel Hackers Manual October 2016

### Name

`generic_setlease` — sets a lease on an open file

### Synopsis

```
int generic_setlease (struct file * filp, long arg, struct  
file_lock ** flp);
```

### Arguments

*filp*

file pointer

*arg*

type of lease to obtain

*flp*

input - `file_lock` to use, output - `file_lock` inserted

## Description

The (input) `flp->fl_lmops->fl_break` function is required by `break_lease`.  
Called with `file_lock_lock` held.

# vfs\_setlease

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`vfs_setlease` — sets a lease on an open file

## Synopsis

```
int vfs_setlease (struct file * filp, long arg, struct  
file_lock ** lease);
```

## Arguments

*filp*

file pointer

*arg*

type of lease to obtain

*lease*

`file_lock` to use

## Description

Call this to establish a lease on the file. The (\*lease)->fl\_lmops->fl\_break operation must be set; if not, break\_lease will oops!

This will call the filesystem's setlease file method, if defined. Note that there is no getlease method; instead, the filesystem setlease method should call back to setlease to add a lease to the inode's lease list, where fcntl\_getlease can find it. Since fcntl\_getlease only reports whether the current task holds a lease, a cluster filesystem need only do this for leases held by processes on this node.

There is also no break\_lease method; filesystems that handle their own leases should break leases themselves from the filesystem's open, create, and (on truncate) setattr methods.

## Warning

the only current setlease methods exist only to disable leases in certain cases. More vfs changes may be required to allow a full filesystem lease implementation.

# flock\_lock\_file\_wait

## LINUX

Kernel Hackers ManualOctober 2016

## Name

flock\_lock\_file\_wait — Apply a FLOCK-style lock to a file

## Synopsis

```
int flock_lock_file_wait (struct file * filp, struct file_lock
* fl);
```

## Arguments

*filp*

The file to apply the lock to

*fl*

The lock to be applied

## Description

Add a FLOCK style lock to a file.

# vfs\_test\_lock

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`vfs_test_lock` — test file byte range lock

## Synopsis

```
int vfs_test_lock (struct file * filp, struct file_lock * fl);
```

## Arguments

*filp*

The file to test lock for

*fl*

The lock to test; also used to hold result

## Description

Returns -ERRNO on failure. Indicates presence of conflicting lock by setting `conf->fl_type` to something other than `F_UNLCK`.

# vfs\_lock\_file

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`vfs_lock_file` — file byte range lock

## Synopsis

```
int vfs_lock_file (struct file * filp, unsigned int cmd,  
struct file_lock * fl, struct file_lock * conf);
```

## Arguments

*filp*

The file to apply the lock to

*cmd*

type of locking operation (`F_SETLK`, `F_GETLK`, etc.)



*fl*

The lock to be applied

*conf*

Place to return a copy of the conflicting lock, if found.

## Description

A caller that doesn't care about the conflicting lock may pass NULL as the final argument.

If the filesystem defines a private `->lock` method, then *conf* will be left unchanged; so a caller that cares should initialize it to some acceptable default.

To avoid blocking kernel daemons, such as `lockd`, that need to acquire POSIX locks, the `->lock` interface may return asynchronously, before the lock has been granted or denied by the underlying filesystem, if (and only if) `fl_grant` is set. Callers expecting `->lock` to return asynchronously will only use `F_SETLK`, not `F_SETLKW`; they will set `FL_SLEEP` if (and only if) the request is for a blocking lock. When `->lock` does return asynchronously, it must return `FILE_LOCK_DEFERRED`, and call `->fl_grant` when the lock request completes. If the request is for non-blocking lock the file system should return `FILE_LOCK_DEFERRED` then try to get the lock and call the callback routine with the result. If the request timed out the callback routine will return a nonzero return code and the file system should release the lock. The file system is also responsible to keep a corresponding posix lock when it grants a lock so the VFS can find out which locks are locally held and do the correct lock cleanup when required. The underlying filesystem must not drop the kernel lock or call `->fl_grant` before returning to the caller with a `FILE_LOCK_DEFERRED` return code.

## posix\_unblock\_lock

### LINUX

Kernel Hackers Manual October 2016

### Name

`posix_unblock_lock` — stop waiting for a file lock

## Synopsis

```
int posix_unblock_lock (struct file * filp, struct file_lock *  
waiter);
```

## Arguments

*filp*

how the file was opened

*waiter*

the lock which was waiting

## Description

lockd needs to block waiting for locks.

# vfs\_cancel\_lock

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`vfs_cancel_lock` — file byte range unblock lock

## Synopsis

```
int vfs_cancel_lock (struct file * filp, struct file_lock *  
fl);
```

## Arguments

*filp*

The file to apply the unblock to

*fl*

The lock to be unblocked

## Description

Used by lock managers to cancel blocked requests

# lock\_may\_read

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`lock_may_read` — checks that the region is free of locks

## Synopsis

```
int lock_may_read (struct inode * inode, loff_t start,  
unsigned long len);
```

## Arguments

*inode*

the inode that is being read

*start*

the first byte to read

*len*

the number of bytes to read

## Description

Emulates Windows locking requirements. Whole-file mandatory locks (share modes) can prohibit a read and byte-range POSIX locks can prohibit a read if they overlap.

N.B. this function is only ever called from knfsd and ownership of locks is never checked.

## lock\_may\_write

### LINUX

Kernel Hackers Manual October 2016

### Name

`lock_may_write` — checks that the region is free of locks

### Synopsis

```
int lock_may_write (struct inode * inode, loff_t start,  
unsigned long len);
```

## Arguments

*inode*

the inode that is being written

*start*

the first byte to write

*len*

the number of bytes to write

## Description

Emulates Windows locking requirements. Whole-file mandatory locks (share modes) can prohibit a write and byte-range POSIX locks can prohibit a write if they overlap.

N.B. this function is only ever called from knfsd and ownership of locks is never checked.

# locks\_mandatory\_locked

## LINUX

Kernel Hackers Manual October 2016

## Name

`locks_mandatory_locked` — Check for an active lock

## Synopsis

```
int locks_mandatory_locked (struct inode * inode);
```

## Arguments

*inode*

the file to check

## Description

Searches the inode's list of locks to find any POSIX locks which conflict. This function is called from `locks_verify_locked` only.

# fcntl\_getlease

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`fcntl_getlease` — Enquire what lease is currently active

## Synopsis

```
int fcntl_getlease (struct file * filp);
```

## Arguments

*filp*

the file

## Description

The value returned by this function will be one of (if no lease break is pending):

`F_RDLCK` to indicate a shared lease is held.

`F_WRLCK` to indicate an exclusive lease is held.

`F_UNLCK` to indicate no lease is held.

(if a lease break is pending):

`F_RDLCK` to indicate an exclusive lease needs to be changed to a shared lease (or removed).

`F_UNLCK` to indicate the lease needs to be removed.

## XXX

sfr & willy disagree over whether `F_INPROGRESS` should be returned to userspace.

## fcntl\_setlease

### LINUX

Kernel Hackers Manual October 2016

## Name

`fcntl_setlease` — sets a lease on an open file

## Synopsis

```
int fcntl_setlease (unsigned int fd, struct file * filp, long arg);
```

## Arguments

*fd*

open file descriptor

*filp*

file pointer

*arg*

type of lease to obtain

## Description

Call this `fcntl` to establish a lease on the file. Note that you also need to call `F_SETSIG` to receive a signal when the lease is broken.

## sys\_flock

### LINUX

Kernel Hackers Manual October 2016

## Name

`sys_flock` — flock system call.

## Synopsis

```
long sys_flock (unsigned int fd, unsigned int cmd);
```



## Arguments

*fd*

the file descriptor to lock.

*cmd*

the type of lock to apply.

## Description

Apply a `FL_FLOCK` style lock to an open file descriptor. The *cmd* can be one of

`LOCK_SH` -- a shared lock.

`LOCK_EX` -- an exclusive lock.

`LOCK_UN` -- remove an existing lock.

`LOCK_MAND` -- a ‘mandatory’ flock. This exists to emulate Windows Share Modes.

`LOCK_MAND` can be combined with `LOCK_READ` or `LOCK_WRITE` to allow other processes read and write access respectively.

## 1.6. Other Functions

### `mpage_readpages`

#### **LINUX**

Kernel Hackers Manual October 2016

#### **Name**

`mpage_readpages` — populate an address space with some pages & start reads against them

## Synopsis

```
int mpage_readpages (struct address_space * mapping, struct  
list_head * pages, unsigned nr_pages, get_block_t get_block);
```

## Arguments

*mapping*

the *address\_space*

*pages*

The address of a *list\_head* which contains the target pages. These pages have their *->index* populated and are otherwise uninitialised. The page at *pages->prev* has the lowest file offset, and reads should be issued in *pages->prev* to *pages->next* order.

*nr\_pages*

The number of pages at *\*pages*

*get\_block*

The filesystem's block mapper function.

## Description

This function walks the pages and the blocks within each page, building and emitting large BIOs.

If anything unusual happens, such as:

- encountering a page which has buffers
- encountering a page which has a non-hole after a hole
- encountering a page with non-contiguous blocks

then this code just gives up and calls the *buffer\_head*-based read function. It does handle a page which has holes at the end - that is a common case: the end-of-file on *blocksize < PAGE\_CACHE\_SIZE* setups.

## BH\_Boundary explanation

There is a problem. The mpage read code assembles several pages, gets all their disk mappings, and then submits them all. That's fine, but obtaining the disk mappings may require I/O. Reads of indirect blocks, for example.

So an mpage read of the first 16 blocks of an ext2 file will cause I/O to be

## submitted in the following order

12 0 1 2 3 4 5 6 7 8 9 10 11 13 14 15 16

because the indirect block has to be read to get the mappings of blocks 13,14,15,16. Obviously, this impacts performance.

So what we do it to allow the filesystem's `get_block` function to set `BH_Boundary` when it maps block 11. `BH_Boundary` says: mapping of the block after this one will require I/O against a block which is probably close to this one. So you should push what I/O you have currently accumulated.

This all causes the disk requests to be issued in the correct order.

# mpage\_writepages

## LINUX

Kernel Hackers Manual October 2016

## Name

`mpage_writepages` — walk the list of dirty pages of the given address space & writepage all of them

## Synopsis

```
int mpage_writepages (struct address_space * mapping, struct
writeback_control * wbc, get_block_t get_block);
```

## Arguments

*mapping*

address space structure to write

*wbc*

subtract the number of written pages from `*wbc->nr_to_write`

*get\_block*

the filesystem's block mapper function. If this is NULL then use `a_ops->writepage`. Otherwise, go direct-to-BIO.

## Description

This is a library function, which implements the `writepages` `address_space_operation`.

If a page is already under I/O, `generic_writepages` skips it, even if it's dirty. This is desirable behaviour for memory-cleaning writeback, but it is INCORRECT for data-integrity system calls such as `fsync`. `fsync` and `msync` need to guarantee that all the data which was dirty at the time the call was made get new I/O started against them. If `wbc->sync_mode` is `WB_SYNC_ALL` then we were called for data integrity and we must wait for existing IO to complete.

## generic\_permission

**LINUX**

Kernel Hackers Manual October 2016

### Name

`generic_permission` — check for access rights on a Posix-like filesystem

## Synopsis

```
int generic_permission (struct inode * inode, int mask,
unsigned int flags, int (*check_acl) (struct inode *inode, int
mask, unsigned int flags));
```

## Arguments

*inode*

inode to check access rights for

*mask*

right to check for (MAY\_READ, MAY\_WRITE, MAY\_EXEC)

*flags*

IPERM\_FLAG\_ flags.

*check\_acl*

optional callback to check for Posix ACLs

## Description

Used to check for read/write/execute permissions on a file. We use “fsuid” for this, letting us set arbitrary permissions for filesystem access without changing the “normal” uids which are used for other things.

`generic_permission` is rcu-walk aware. It returns `-ECHILD` in case an rcu-walk request cannot be satisfied (eg. requires blocking or too much complexity). It would then be called again in ref-walk mode.

## inode\_permission

**LINUX**

## Name

`inode_permission` — check for access rights to a given inode

## Synopsis

```
int inode_permission (struct inode * inode, int mask);
```

## Arguments

*inode*

inode to check permission on

*mask*

right to check for (MAY\_READ, MAY\_WRITE, MAY\_EXEC)

## Description

Used to check for read/write/execute permissions on an inode. We use “fsuid” for this, letting us set arbitrary permissions for filesystem access without changing the “normal” uids which are used for other things.

## file\_permission

**LINUX**

## Name

`file_permission` — check for additional access rights to a given file

## Synopsis

```
int file_permission (struct file * file, int mask);
```

## Arguments

*file*

file to check access rights for

*mask*

right to check for (MAY\_READ, MAY\_WRITE, MAY\_EXEC)

## Description

Used to check for read/write/execute permissions on an already opened file.

## Note

Do not use this function in new code. All access checks should be done using `inode_permission`.

## path\_get

**LINUX**

## Name

`path_get` — get a reference to a path

## Synopsis

```
void path_get (struct path * path);
```

## Arguments

*path*

path to get the reference to

## Description

Given a path increment the reference count to the dentry and the vfsmount.

## `path_put`

### LINUX

## Name

`path_put` — put a reference to a path



## Synopsis

```
void path_put (struct path * path);
```

## Arguments

*path*

path to put the reference to

## Description

Given a path decrement the reference count to the dentry and the vfsmount.

# release\_open\_intent

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`release_open_intent` — free up open intent resources

## Synopsis

```
void release_open_intent (struct nameidata * nd);
```

## Arguments

*nd*

pointer to nameidata

## vfs\_path\_lookup

### LINUX

Kernel Hackers Manual October 2016

## Name

`vfs_path_lookup` — lookup a file path relative to a dentry-vfsmount pair

## Synopsis

```
int vfs_path_lookup (struct dentry * dentry, struct vfsmount *  
mnt, const char * name, unsigned int flags, struct nameidata *  
nd);
```

## Arguments

*dentry*

pointer to dentry of the base directory

*mnt*

pointer to vfs mount of the base directory

*name*

pointer to file name

*flags*

lookup flags

*nd*

pointer to nameidata

## lookup\_one\_len

### LINUX

Kernel Hackers Manual October 2016

### Name

`lookup_one_len` — filesystem helper to lookup single pathname component

### Synopsis

```
struct dentry * lookup_one_len (const char * name, struct  
dentry * base, int len);
```

### Arguments

*name*

pathname component to lookup

*base*

base directory to lookup from

*len*

maximum length *len* should be interpreted to

## Description

Note that this routine is purely a helper for filesystem usage and should not be called by generic code. Also note that by using this function the `nameidata` argument is passed to the filesystem methods and a filesystem using this helper needs to be prepared for that.

# lookup\_create

## LINUX

Kernel Hackers Manual October 2016

## Name

`lookup_create` — lookup a dentry, creating it if it doesn't exist

## Synopsis

```
struct dentry * lookup_create (struct nameidata * nd, int  
is_dir);
```

## Arguments

*nd*

nameidata info

*is\_dir*

directory flag

## Description

Simple function to lookup and return a dentry and create it if it doesn't exist. Is SMP-safe.

Returns with `nd->path.dentry->d_inode->i_mutex` locked.

# sync\_mapping\_buffers

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`sync_mapping_buffers` — write out & wait upon a mapping's “associated” buffers

## Synopsis

```
int sync_mapping_buffers (struct address_space * mapping);
```

## Arguments

*mapping*

the mapping which wants those buffers written

## Description

Starts I/O against the buffers at `mapping->private_list`, and waits upon that I/O.

Basically, this is a convenience function for `fsync`. *mapping* is a file or directory which needs those buffers to be written for a successful `fsync`.

# mark\_buffer\_dirty

## LINUX

Kernel Hackers Manual October 2016

### Name

`mark_buffer_dirty` — mark a `buffer_head` as needing writeout

### Synopsis

```
void mark_buffer_dirty (struct buffer_head * bh);
```

### Arguments

*bh*

the `buffer_head` to mark dirty

### Description

`mark_buffer_dirty` will set the dirty bit against the buffer, then set its backing page dirty, then tag the page as dirty in its `address_space`'s radix tree and then attach the `address_space`'s inode to its superblock's dirty inode list.

`mark_buffer_dirty` is atomic. It takes `bh->b_page->mapping->private_lock`, `mapping->tree_lock` and `mapping->host->i_lock`.

# \_\_bread

## LINUX

Kernel Hackers ManualOctober 2016

### Name

`__bread` — reads a specified block and returns the bh

### Synopsis

```
struct buffer_head * __bread (struct block_device * bdev,  
sector_t block, unsigned size);
```

### Arguments

*bdev*

the block\_device to read from

*block*

number of block

*size*

size (in bytes) to read

### Description

Reads a specified block, and returns buffer head that contains it. It returns NULL if the block was unreadable.

# block\_invalidatepage

## LINUX

Kernel Hackers Manual October 2016

### Name

`block_invalidatepage` — invalidate part of all of a buffer-backed page

### Synopsis

```
void block_invalidatepage (struct page * page, unsigned long  
offset);
```

### Arguments

*page*

the page which is affected

*offset*

the index of the truncation point

### Description

`block_invalidatepage` is called when all or part of the page has become invalidated by a truncate operation.

`block_invalidatepage` does not have to release all buffers, but it must ensure that no dirty buffer is left outside *offset* and that no I/O is underway against any of the blocks which are outside the truncation point. Because the caller is about to free (and possibly reuse) those blocks on-disk.



# ll\_rw\_block

## LINUX

Kernel Hackers Manual October 2016

### Name

`ll_rw_block` — level access to block devices (DEPRECATED)

### Synopsis

```
void ll_rw_block (int rw, int nr, struct buffer_head * bhs[]);
```

### Arguments

*rw*

whether to READ or WRITE or maybe READA (readahead)

*nr*

number of struct buffer\_heads in the array

*bhs*[]

array of pointers to struct buffer\_head

### Description

`ll_rw_block` takes an array of pointers to struct buffer\_heads, and requests an I/O operation on them, either a READ or a WRITE. The third READA option is described in the documentation for `generic_make_request` which `ll_rw_block` calls.

This function drops any buffer that it cannot get a lock on (with the BH\_Lock state bit), any buffer that appears to be clean when doing a write request, and any buffer that appears to be up-to-date when doing read request. Further it marks as clean buffers that are processed for writing (the buffer cache won't assume that they are actually clean until the buffer gets unlocked).

`ll_rw_block` sets `b_end_io` to simple completion handler that marks the buffer up-to-date (if appropriate), unlocks the buffer and wakes any waiters.

All of the buffers must be for the same device, and must also be a multiple of the current approved size for the device.

## **bh\_uptodate\_or\_lock**

### **LINUX**

Kernel Hackers Manual October 2016

### **Name**

`bh_uptodate_or_lock` — Test whether the buffer is uptodate

### **Synopsis**

```
int bh_uptodate_or_lock (struct buffer_head * bh);
```

### **Arguments**

*bh*

struct buffer\_head

### **Description**

Return true if the buffer is up-to-date and false, with the buffer locked, if not.

# bh\_submit\_read

## LINUX

Kernel Hackers ManualOctober 2016

### Name

`bh_submit_read` — Submit a locked buffer for reading

### Synopsis

```
int bh_submit_read (struct buffer_head * bh);
```

### Arguments

*bh*

struct buffer\_head

### Description

Returns zero on success and -EIO on error.

# bio\_alloc\_bioset

## LINUX

Kernel Hackers ManualOctober 2016

### Name

`bio_alloc_bioset` — allocate a bio for I/O

## Synopsis

```
struct bio * bio_alloc_bioset (gfp_t gfp_mask, int nr_iovecs,
struct bio_set * bs);
```

## Arguments

*gfp\_mask*

the GFP\_ mask given to the slab allocator

*nr\_iovecs*

number of iovecs to pre-allocate

*bs*

the bio\_set to allocate from.

## Description

bio\_alloc\_bioset will try its own mempool to satisfy the allocation. If `__GFP_WAIT` is set then we will block on the internal pool waiting for a struct bio to become free.

Note that the caller must set `->bi_destructor` on successful return of a bio, to do the appropriate freeing of the bio once the reference count drops to zero.

## bio\_alloc

### LINUX

Kernel Hackers Manual October 2016

## Name

`bio_alloc` — allocate a new bio, memory pool backed

## Synopsis

```
struct bio * bio_alloc (gfp_t gfp_mask, int nr_iovecs);
```

## Arguments

*gfp\_mask*

allocation mask to use

*nr\_iovecs*

number of iovecs

## Description

`bio_alloc` will allocate a bio and associated `bio_vec` array that can hold at least *nr\_iovecs* entries. Allocations will be done from the `fs_bio_set`. Also see *bio\_alloc\_bioset* and *bio\_kmalloc*.

If `__GFP_WAIT` is set, then `bio_alloc` will always be able to allocate a bio. This is due to the mempool guarantees. To make this work, callers must never allocate more than 1 bio at a time from this pool. Callers that need to allocate more than 1 bio must always submit the previously allocated bio for IO before attempting to allocate a new one. Failure to do so can cause livelocks under memory pressure.

## RETURNS

Pointer to new bio on success, NULL on failure.

## bio\_kmalloc

**LINUX**

## Name

`bio_kmalloc` — allocate a bio for I/O using `kmalloc`

## Synopsis

```
struct bio * bio_kmalloc (gfp_t gfp_mask, int nr_iovecs);
```

## Arguments

*gfp\_mask*

the GFP\_ mask given to the slab allocator

*nr\_iovecs*

number of iovecs to pre-allocate

## Description

Allocate a new bio with *nr\_iovecs* bvecs. If *gfp\_mask* contains `__GFP_WAIT`, the allocation is guaranteed to succeed.

# bio\_put

## LINUX

## Name

`bio_put` — release a reference to a bio

## Synopsis

```
void bio_put (struct bio * bio);
```

## Arguments

*bio*

bio to release reference to

## Description

Put a reference to a struct bio, either one you have gotten with `bio_alloc`, `bio_get` or `bio_clone`. The last put of a bio will free it.

## \_\_bio\_clone

### LINUX

Kernel Hackers ManualOctober 2016

## Name

`__bio_clone` — clone a bio

## Synopsis

```
void __bio_clone (struct bio * bio, struct bio * bio_src);
```

## Arguments

*bio*

destination bio

*bio\_src*

bio to clone

## Description

Clone a bio. Caller will own the returned bio, but not the actual data it points to. Reference count of returned bio will be one.

# bio\_clone

## LINUX

Kernel Hackers ManualOctober 2016

## Name

bio\_clone — clone a bio

## Synopsis

```
struct bio * bio_clone (struct bio * bio, gfp_t gfp_mask);
```

## Arguments

*bio*

bio to clone



*gfp\_mask*

allocation priority

## Description

Like `__bio_clone`, only also allocates the returned bio

# bio\_get\_nr\_vecs

## LINUX

Kernel Hackers Manual October 2016

## Name

`bio_get_nr_vecs` — return approx number of vecs

## Synopsis

```
int bio_get_nr_vecs (struct block_device * bdev);
```

## Arguments

*bdev*

I/O target

## Description

Return the approximate number of pages we can send to this target. There's no guarantee that you will be able to fit this number of pages into a bio, it does not account for dynamic restrictions that vary on offset.

# bio\_add\_pc\_page

**LINUX**

Kernel Hackers Manual October 2016

## Name

`bio_add_pc_page` — attempt to add page to bio

## Synopsis

```
int bio_add_pc_page (struct request_queue * q, struct bio *  
bio, struct page * page, unsigned int len, unsigned int  
offset);
```

## Arguments

*q*  
the target queue

*bio*  
destination bio

*page*  
page to add

*len*  
vec entry length

*offset*  
vec entry offset

## Description

Attempt to add a page to the `bio_vec` maplist. This can fail for a number of reasons, such as the bio being full or target block device limitations. The target block device must allow bio's up to `PAGE_SIZE`, so it is always possible to add a single page to an empty bio.

This should only be used by `REQ_PC` bios.

## bio\_add\_page

### LINUX

Kernel Hackers Manual October 2016

## Name

`bio_add_page` — attempt to add page to bio

## Synopsis

```
int bio_add_page (struct bio * bio, struct page * page,
unsigned int len, unsigned int offset);
```

## Arguments

*bio*

destination bio

*page*

page to add

*len*

vec entry length

*offset*

vec entry offset

## Description

Attempt to add a page to the `bio_vec` maplist. This can fail for a number of reasons, such as the bio being full or target block device limitations. The target block device must allow bio's up to `PAGE_SIZE`, so it is always possible to add a single page to an empty bio.

# bio\_uncopy\_user

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`bio_uncopy_user` — finish previously mapped bio

## Synopsis

```
int bio_uncopy_user (struct bio * bio);
```

## Arguments

*bio*

bio being terminated

## Description

Free pages allocated from `bio_copy_user` and write back data to user space in case of a read.

# bio\_copy\_user

## LINUX

Kernel Hackers Manual October 2016

## Name

`bio_copy_user` — copy user data to bio

## Synopsis

```
struct bio * bio_copy_user (struct request_queue * q, struct
rq_map_data * map_data, unsigned long uaddr, unsigned int len,
int write_to_vm, gfp_t gfp_mask);
```

## Arguments

*q*

destination block queue

*map\_data*

pointer to the `rq_map_data` holding pages (if necessary)

*uaddr*

start of user address

*len*

length in bytes

*write\_to\_vm*

bool indicating writing to pages or not

*gfp\_mask*

memory allocation flags

## Description

Prepares and returns a bio for indirect user io, bouncing data to/from kernel pages as necessary. Must be paired with call `bio_uncopy_user` on io completion.

# bio\_map\_user

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`bio_map_user` — map user address into bio

## Synopsis

```
struct bio * bio_map_user (struct request_queue * q, struct  
block_device * bdev, unsigned long uaddr, unsigned int len,  
int write_to_vm, gfp_t gfp_mask);
```

## Arguments

*q*

the struct request\_queue for the bio

*bdev*

destination block device

*uaddr*

start of user address

*len*

length in bytes

*write\_to\_vm*

bool indicating writing to pages or not

*gfp\_mask*

memory allocation flags

## Description

Map the user space address into a bio suitable for io to a block device. Returns an error pointer in case of error.

# bio\_unmap\_user

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`bio_unmap_user` — unmap a bio

## Synopsis

```
void bio_unmap_user (struct bio * bio);
```

## Arguments

*bio*

the bio being unmapped

## Description

Unmap a bio previously mapped by `bio_map_user`. Must be called with a process context.

`bio_unmap_user` may sleep.

## bio\_map\_kern

### LINUX

Kernel Hackers Manual October 2016

## Name

`bio_map_kern` — map kernel address into bio

## Synopsis

```
struct bio * bio_map_kern (struct request_queue * q, void *  
data, unsigned int len, gfp_t gfp_mask);
```

## Arguments

*q*

the struct request\_queue for the bio



*data*

pointer to buffer to map

*len*

length in bytes

*gfp\_mask*

allocation flags for bio allocation

## Description

Map the kernel address into a bio suitable for io to a block device. Returns an error pointer in case of error.

# bio\_copy\_kern

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`bio_copy_kern` — copy kernel address into bio

## Synopsis

```
struct bio * bio_copy_kern (struct request_queue * q, void *
data, unsigned int len, gfp_t gfp_mask, int reading);
```

## Arguments

<i>q</i>	the struct request_queue for the bio
<i>data</i>	pointer to buffer to copy
<i>len</i>	length in bytes
<i>gfp_mask</i>	allocation flags for bio and page allocation
<i>reading</i>	data direction is READ

## Description

copy the kernel address into a bio suitable for io to a block device. Returns an error pointer in case of error.

## bio\_endio

### LINUX

Kernel Hackers ManualOctober 2016

## Name

`bio_endio` — end I/O on a bio

## Synopsis

```
void bio_endio (struct bio * bio, int error);
```

## Arguments

*bio*

*bio*

*error*

error, if any

## Description

`bio_endio` will end I/O on the whole `bio`. `bio_endio` is the preferred way to end I/O on a `bio`, it takes care of clearing `BIO_UPTODATE` on error. `error` is 0 on success, and one of the established `-Exxx` (`-EIO`, for instance) error values in case something went wrong. No one should call `bi_end_io` directly on a `bio` unless they own it and thus know that it has an `end_io` function.

## bio\_sector\_offset

### LINUX

Kernel Hackers Manual October 2016

## Name

`bio_sector_offset` — Find hardware sector offset in `bio`

## Synopsis

```
sector_t bio_sector_offset (struct bio * bio, unsigned short
index, unsigned int offset);
```

## Arguments

*bio*

bio to inspect

*index*

bio\_vec index

*offset*

offset in bv\_page

## Description

Return the number of hardware sectors between beginning of bio and an end point indicated by a bio\_vec index and an offset within that vector's page.

## bioset\_create

**LINUX**

Kernel Hackers Manual October 2016

## Name

bioset\_create — Create a bio\_set

## Synopsis

```
struct bio_set * bioset_create (unsigned int pool_size,  
unsigned int front_pad);
```

## Arguments

*pool\_size*

Number of bio and bio\_vecs to cache in the mempool

*front\_pad*

Number of bytes to allocate in front of the returned bio

## Description

Set up a `bio_set` to be used with `bio_alloc_bioset`. Allows the caller to ask for a number of bytes to be allocated in front of the bio. Front pad allocation is useful for embedding the bio inside another structure, to avoid allocating extra data to go with the bio. Note that the bio must be embedded at the END of that structure always, or things will break badly.

# seq\_open

## LINUX

Kernel Hackers Manual October 2016

## Name

`seq_open` — initialize sequential file

## Synopsis

```
int seq_open (struct file * file, const struct seq_operations
* op);
```

## Arguments

*file*

file we initialize

*op*

method table describing the sequence

## Description

`seq_open` sets *file*, associating it with a sequence described by *op*. *op->start* sets the iterator up and returns the first element of sequence. *op->stop* shuts it down. *op->next* returns the next element of sequence. *op->show* prints element into the buffer. In case of error *->start* and *->next* return `ERR_PTR(error)`. In the end of sequence they return `NULL`. *->show* returns 0 in case of success and negative number in case of error. Returning `SEQ_SKIP` means “discard this element and move on”.

## seq\_read

### LINUX

Kernel Hackers Manual October 2016

## Name

`seq_read` — *->read* method for sequential files.

## Synopsis

```
ssize_t seq_read (struct file * file, char __user * buf,  
size_t size, loff_t * ppos);
```

## Arguments

*file*

the file to read from

*buf*

the buffer to read to

*size*

the maximum number of bytes to read

*ppos*

the current position in the file

## Description

Ready-made ->f\_op->read

## seq\_lseek

**LINUX**

Kernel Hackers ManualOctober 2016

## Name

seq\_lseek — ->llseek method for sequential files.

## Synopsis

```
loff_t seq_lseek (struct file * file, loff_t offset, int  
origin);
```

## Arguments

*file*

the file in question

*offset*

new position

*origin*

0 for absolute, 1 for relative position

## Description

Ready-made ->f\_op->llseek

## seq\_release

### LINUX

Kernel Hackers ManualOctober 2016

## Name

seq\_release — free the structures associated with sequential file.

## Synopsis

```
int seq_release (struct inode * inode, struct file * file);
```



## Arguments

*inode*

file->f\_path.dentry->d\_inode

*file*

file in question

## Description

Frees the structures associated with sequential file; can be used as  
->f\_op->release if you don't have private data to destroy.

## seq\_escape

### LINUX

Kernel Hackers Manual October 2016

## Name

seq\_escape — print string into buffer, escaping some characters

## Synopsis

```
int seq_escape (struct seq_file * m, const char * s, const
char * esc);
```

## Arguments

*m*

target buffer

*s*

string

*esc*

set of characters that need escaping

## Description

Puts string into buffer, replacing each occurrence of character from *esc* with usual octal escape. Returns 0 in case of success, -1 - in case of overflow.

# mangle\_path

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`mangle_path` — mangle and copy path to buffer beginning

## Synopsis

```
char * mangle_path (char * s, char * p, char * esc);
```

## Arguments

*s*

buffer start

*p*

beginning of path in above buffer

*esc*

set of characters that need escaping

## Description

Copy the path from *p* to *s*, replacing each occurrence of character from *esc* with usual octal escape. Returns pointer past last written character in *s*, or NULL in case of failure.

# seq\_path

## LINUX

Kernel Hackers ManualOctober 2016

## Name

*seq\_path* — *seq\_file* interface to print a pathname

## Synopsis

```
int seq_path (struct seq_file * m, struct path * path, char *
esc);
```

## Arguments

*m*the *seq\_file* handle*path*

the struct path to print

*esc*

set of characters to escape in the output

## Description

return the absolute path of 'path', as represented by the dentry / mnt pair in the path parameter.

# seq\_write

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`seq_write` — write arbitrary data to buffer

## Synopsis

```
int seq_write (struct seq_file * seq, const void * data,
size_t len);
```

## Arguments

*seq*

seq\_file identifying the buffer to which data should be written

*data*

data address

*len*

number of bytes

## Description

Return 0 on success, non-zero otherwise.

# seq\_hlist\_start

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`seq_hlist_start` — start an iteration of a hlist

## Synopsis

```
struct hlist_node * seq_hlist_start (struct hlist_head * head,  
loff_t pos);
```

## Arguments

*head*

the head of the hlist

*pos*

the start position of the sequence

## Description

Called at `seq_file->op->start`.

# seq\_hlist\_start\_head

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`seq_hlist_start_head` — start an iteration of a hlist

## Synopsis

```
struct hlist_node * seq_hlist_start_head (struct hlist_head *  
head, loff_t pos);
```

## Arguments

*head*

the head of the hlist

*pos*

the start position of the sequence

## Description

Called at `seq_file->op->start`. Call this function if you want to print a header at the top of the output.

# seq\_hlist\_next

## LINUX

Kernel Hackers ManualOctober 2016

### Name

`seq_hlist_next` — move to the next position of the hlist

### Synopsis

```
struct hlist_node * seq_hlist_next (void * v, struct  
hlist_head * head, loff_t * ppos);
```

### Arguments

*v*

the current iterator

*head*

the head of the hlist

*ppos*

the current position

### Description

Called at `seq_file->op->next`.

# seq\_hlist\_start\_rcu

## LINUX

Kernel Hackers Manual October 2016

### Name

`seq_hlist_start_rcu` — start an iteration of a hlist protected by RCU

### Synopsis

```
struct hlist_node * seq_hlist_start_rcu (struct hlist_head *  
head, loff_t pos);
```

### Arguments

*head*

the head of the hlist

*pos*

the start position of the sequence

### Description

Called at `seq_file->op->start`.

This list-traversal primitive may safely run concurrently with the `_rcu` list-mutation primitives such as `hlist_add_head_rcu` as long as the traversal is guarded by `rcu_read_lock`.



# seq\_hlist\_start\_head\_rcu

## LINUX

Kernel Hackers ManualOctober 2016

### Name

`seq_hlist_start_head_rcu` — start an iteration of a hlist protected by RCU

### Synopsis

```
struct hlist_node * seq_hlist_start_head_rcu (struct  
hlist_head * head, loff_t pos);
```

### Arguments

*head*

the head of the hlist

*pos*

the start position of the sequence

### Description

Called at `seq_file->op->start`. Call this function if you want to print a header at the top of the output.

This list-traversal primitive may safely run concurrently with the `_rcu` list-mutation primitives such as `hlist_add_head_rcu` as long as the traversal is guarded by `rcu_read_lock`.

# seq\_hlist\_next\_rcu

## LINUX

Kernel Hackers Manual October 2016

### Name

`seq_hlist_next_rcu` — move to the next position of the hlist protected by RCU

### Synopsis

```
struct hlist_node * seq_hlist_next_rcu (void * v, struct  
hlist_head * head, loff_t * ppos);
```

### Arguments

*v*

the current iterator

*head*

the head of the hlist

*ppos*

the current position

### Description

Called at `seq_file->op->next`.

This list-traversal primitive may safely run concurrently with the `_rcu` list-mutation primitives such as `hlist_add_head_rcu` as long as the traversal is guarded by `rcu_read_lock`.

# register\_filesystem

## LINUX

Kernel Hackers Manual October 2016

### Name

`register_filesystem` — register a new filesystem

### Synopsis

```
int register_filesystem (struct file_system_type * fs);
```

### Arguments

*fs*

the file system structure

### Description

Adds the file system passed to the list of file systems the kernel is aware of for mount and other syscalls. Returns 0 on success, or a negative errno code on an error.

The struct `file_system_type` that is passed is linked into the kernel structures and must not be freed until the file system has been unregistered.

# unregister\_filesystem

## LINUX

## Name

`unregister_filesystem` — unregister a file system

## Synopsis

```
int unregister_filesystem (struct file_system_type * fs);
```

## Arguments

*fs*

filesystem to unregister

## Description

Remove a file system that was previously successfully registered with the kernel. An error is returned if the file system is not found. Zero is returned on a success.

Once this function has returned the struct `file_system_type` structure may be freed or reused.

# \_\_mark\_inode\_dirty

## LINUX

## Name

`__mark_inode_dirty` — internal function

## Synopsis

```
void __mark_inode_dirty (struct inode * inode, int flags);
```

## Arguments

*inode*

inode to mark

*flags*

what kind of dirty (i.e. I\_DIRTY\_SYNC) Mark an inode as dirty. Callers should use `mark_inode_dirty` or `mark_inode_dirty_sync`.

## Description

Put the inode on the super block's dirty list.

CAREFUL! We mark it dirty unconditionally, but move it onto the dirty list only if it is hashed or if it refers to a blockdev. If it was not hashed, it will never be added to the dirty list even if it is later hashed, as it will have been marked dirty already.

In short, make sure you hash any inodes *\_before\_* you start marking them dirty.

Note that for blockdevs, `inode->dirtyed_when` represents the dirtying time of the block-special inode (`/dev/hda1`) itself. And the `->dirtyed_when` field of the kernel-internal blockdev inode represents the dirtying time of the blockdev's pages. This is why for `I_DIRTY_PAGES` we always use `page->mapping->host`, so the page-dirtying time is recorded in the internal blockdev inode.

# writeback\_inodes\_sb\_nr

**LINUX**

## Name

`writeback_inodes_sb_nr` — writeback dirty inodes from given `super_block`

## Synopsis

```
void writeback_inodes_sb_nr (struct super_block * sb, unsigned  
long nr);
```

## Arguments

*sb*

the superblock

*nr*

the number of pages to write

## Description

Start writeback on some inodes on this `super_block`. No guarantees are made on how many (if any) will be written, and this function does not wait for IO completion of submitted IO.

## `writeback_inodes_sb`

**LINUX**

## Name

`writeback_inodes_sb` — writeback dirty inodes from given `super_block`

## Synopsis

```
void writeback_inodes_sb (struct super_block * sb);
```

## Arguments

*sb*

the superblock

## Description

Start writeback on some inodes on this `super_block`. No guarantees are made on how many (if any) will be written, and this function does not wait for IO completion of submitted IO.

# try\_to\_writeback\_inodes\_sb\_nr

## LINUX

## Name

`try_to_writeback_inodes_sb_nr` — try to start writeback if none underway

## Synopsis

```
int try_to_writeback_inodes_sb_nr (struct super_block * sb,
unsigned long nr);
```

## Arguments

*sb*

the superblock

*nr*

the number of pages to write

## Description

Invoke `writeback_inodes_sb_nr` if no writeback is currently underway. Returns 1 if writeback was started, 0 if not.

# writeback\_inodes\_sb\_if\_idle

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`writeback_inodes_sb_if_idle` — start writeback if none underway

## Synopsis

```
int writeback_inodes_sb_if_idle (struct super_block * sb);
```



## Arguments

*sb*

the superblock

## Description

Invoke `writeback_inodes_sb` if no writeback is currently underway. Returns 1 if writeback was started, 0 if not.

# writeback\_inodes\_sb\_nr\_if\_idle

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`writeback_inodes_sb_nr_if_idle` — start writeback if none underway

## Synopsis

```
int writeback_inodes_sb_nr_if_idle (struct super_block * sb,  
unsigned long nr);
```

## Arguments

*sb*

the superblock

*nr*

the number of pages to write

## Description

Invoke `writeback_inodes_sb` if no writeback is currently underway. Returns 1 if writeback was started, 0 if not.

# sync\_inodes\_sb

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`sync_inodes_sb` — sync sb inode pages

## Synopsis

```
void sync_inodes_sb (struct super_block * sb);
```

## Arguments

*sb*

the superblock

## Description

This function writes and waits on any dirty inode belonging to this `super_block`.

# write\_inode\_now

## LINUX

Kernel Hackers Manual October 2016

### Name

`write_inode_now` — write an inode to disk

### Synopsis

```
int write_inode_now (struct inode * inode, int sync);
```

### Arguments

*inode*

inode to write to disk

*sync*

whether the write should be synchronous or not

### Description

This function commits an inode to disk immediately if it is dirty. This is primarily needed by knfsd.

The caller must either have a ref on the inode or must have set I\_WILL\_FREE.

# sync\_inode

## LINUX

Kernel Hackers ManualOctober 2016

### Name

`sync_inode` — write an inode and its pages to disk.

### Synopsis

```
int sync_inode (struct inode * inode, struct writeback_control  
* wbc);
```

### Arguments

*inode*

the inode to sync

*wbc*

controls the writeback mode

### Description

`sync_inode` will write an inode and its pages to disk. It will also correctly update the inode on its superblock's dirty inode lists and will update `inode->i_state`.

The caller must have a ref on the inode.

# sync\_inode\_metadata

## LINUX

Kernel Hackers Manual October 2016

### Name

`sync_inode_metadata` — write an inode to disk

### Synopsis

```
int sync_inode_metadata (struct inode * inode, int wait);
```

### Arguments

*inode*

the inode to sync

*wait*

wait for I/O to complete.

### Description

Write an inode to disk and adjust its dirty state after completion.

### Note

only writes the actual inode, no associated data or other metadata.

# freeze\_bdev

## LINUX

Kernel Hackers Manual October 2016

### Name

`freeze_bdev` — - lock a filesystem and force it into a consistent state

### Synopsis

```
struct super_block * freeze_bdev (struct block_device * bdev);
```

### Arguments

*bdev*

blockdevice to lock

### Description

If a superblock is found on this device, we take the `s_umount` semaphore on it to make sure nobody unmounts until the snapshot creation is done. The reference counter (`bd_fsfreeze_count`) guarantees that only the last unfreeze process can unfreeze the frozen filesystem actually when multiple freeze requests arrive simultaneously. It counts up in `freeze_bdev` and count down in `thaw_bdev`. When it becomes 0, `thaw_bdev` will unfreeze actually.

# thaw\_bdev

## LINUX

## Name

`thaw_bdev` — - unlock filesystem

## Synopsis

```
int thaw_bdev (struct block_device * bdev, struct super_block
* sb);
```

## Arguments

*bdev*

blockdevice to unlock

*sb*

associated superblock

## Description

Unlocks the filesystem and marks it writeable again after `freeze_bdev`.

# bdgrab

## LINUX

## Name

`bdgrab` — - Grab a reference to an already referenced block device

## Synopsis

```
struct block_device * bdgrab (struct block_device * bdev);
```

## Arguments

*bdev*

Block device to grab a reference to.

## bd\_link\_disk\_holder

### LINUX

Kernel Hackers Manual October 2016

## Name

`bd_link_disk_holder` — create symlinks between holding disk and slave  
`bdev`

## Synopsis

```
int bd_link_disk_holder (struct block_device * bdev, struct  
gendisk * disk);
```

## Arguments

*bdev*

the claimed slave bdev



*disk*

the holding disk

## Description

DON'T USE THIS UNLESS YOU'RE ALREADY USING IT.

This functions creates the following sysfs symlinks.

- from “slaves” directory of the holder *disk* to the claimed *bdev* - from “holders” directory of the *bdev* to the holder *disk*

For example, if /dev/dm-0 maps to /dev/sda and disk for dm-0 is passed to `bd_link_disk_holder`, then:

```
/sys/block/dm-0/slaves/sda --> /sys/block/sda /sys/block/sda/holders/dm-0 -->
/sys/block/dm-0
```

The caller must have claimed *bdev* before calling this function and ensure that both *bdev* and *disk* are valid during the creation and lifetime of these symlinks.

## CONTEXT

Might sleep.

## RETURNS

0 on success, -errno on failure.

# bd\_unlink\_disk\_holder

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`bd_unlink_disk_holder` — destroy symlinks created by `bd_link_disk_holder`

## Synopsis

```
void bd_unlink_disk_holder (struct block_device * bdev, struct  
gendisk * disk);
```

## Arguments

*bdev*

the calimed slave bdev

*disk*

the holding disk

## Description

DON'T USE THIS UNLESS YOU'RE ALREADY USING IT.

## CONTEXT

Might sleep.

# check\_disk\_size\_change

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`check_disk_size_change` — checks for disk size change and adjusts bdev size.

## Synopsis

```
void check_disk_size_change (struct gendisk * disk, struct
block_device * bdev);
```

## Arguments

*disk*

struct gendisk to check

*bdev*

struct bdev to adjust.

## Description

This routine checks to see if the bdev size does not match the disk size and adjusts it if it differs.

# revalidate\_disk

## LINUX

Kernel Hackers Manual October 2016

## Name

`revalidate_disk` — wrapper for lower-level driver's `revalidate_disk` call-back

## Synopsis

```
int revalidate_disk (struct gendisk * disk);
```

## Arguments

*disk*

struct gendisk to be revalidated

## Description

This routine is a wrapper for lower-level driver's `revalidate_disk` call-backs. It is used to do common pre and post operations needed for all `revalidate_disk` operations.

## blkdev\_get

### LINUX

Kernel Hackers Manual October 2016

## Name

`blkdev_get` — open a block device

## Synopsis

```
int blkdev_get (struct block_device * bdev, fmode_t mode, void  
* holder);
```

## Arguments

*bdev*

block\_device to open

*mode*

FMODE\_\* mask

*holder*

exclusive holder identifier

## Description

Open *bdev* with *mode*. If *mode* includes FMODE\_EXCL, *bdev* is open with exclusive access. Specifying FMODE\_EXCL with NULL *holder* is invalid. Exclusive opens may nest for the same *holder*.

On success, the reference count of *bdev* is unchanged. On failure, *bdev* is put.

## CONTEXT

Might sleep.

## RETURNS

0 on success, -errno on failure.

# blkdev\_get\_by\_path

## LINUX

Kernel Hackers Manual October 2016

## Name

blkdev\_get\_by\_path — open a block device by name

## Synopsis

```
struct block_device * blkdev_get_by_path (const char * path,  
fmode_t mode, void * holder);
```

## Arguments

*path*

path to the block device to open

*mode*

FMODE\_\* mask

*holder*

exclusive holder identifier

## Description

Open the blockdevice described by the device file at *path*. *mode* and *holder* are identical to `blkdev_get`.

On success, the returned `block_device` has reference count of one.

## CONTEXT

Might sleep.

## RETURNS

Pointer to `block_device` on success, `ERR_PTR(-errno)` on failure.

# blkdev\_get\_by\_dev

## LINUX

Kernel Hackers Manual October 2016

### Name

`blkdev_get_by_dev` — open a block device by device number

### Synopsis

```
struct block_device * blkdev_get_by_dev (dev_t dev, fmode_t
mode, void * holder);
```

### Arguments

*dev*

device number of block device to open

*mode*

`FMODE_*` mask

*holder*

exclusive holder identifier

### Description

Open the blockdevice described by device number *dev*, *mode* and *holder* are identical to `blkdev_get`.

Use it ONLY if you really do not have anything better - i.e. when you are behind a truly sucky interface and all you are given is a device number. `_Never_` to be used for internal purposes. If you ever need it - reconsider your API.

On success, the returned `block_device` has reference count of one.

## CONTEXT

Might sleep.

## RETURNS

Pointer to `block_device` on success, `ERR_PTR(-errno)` on failure.

# lookup\_bdev

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`lookup_bdev` — lookup a struct `block_device` by name

## Synopsis

```
struct block_device * lookup_bdev (const char * pathname);
```

## Arguments

*pathname*

special file representing the block device

## Description

Get a reference to the blockdevice at *pathname* in the current namespace if possible and return it. Return `ERR_PTR(error)` otherwise.







# Chapter 2. The proc filesystem

## 2.1. sysctl interface

### register\_sysctl\_paths

#### LINUX

Kernel Hackers Manual October 2016

#### Name

`register_sysctl_paths` — register a sysctl table hierarchy

#### Synopsis

```
struct ctl_table_header * register_sysctl_paths (const struct  
ctl_path * path, struct ctl_table * table);
```

#### Arguments

*path*

The path to the directory the sysctl table is in.

*table*

the top-level table structure

#### Description

Register a sysctl table hierarchy. *table* should be a filled in `ctl_table` array. A completely 0 filled entry terminates the table.

See `__register_sysctl_paths` for more details.

# register\_sysctl\_table

## LINUX

Kernel Hackers Manual October 2016

### Name

`register_sysctl_table` — register a sysctl table hierarchy

### Synopsis

```
struct ctl_table_header * register_sysctl_table (struct  
ctl_table * table);
```

### Arguments

*table*

the top-level table structure

### Description

Register a sysctl table hierarchy. *table* should be a filled in `ctl_table` array. A completely 0 filled entry terminates the table.

See `register_sysctl_paths` for more details.

# unregister\_sysctl\_table

## LINUX

Kernel Hackers Manual October 2016

### Name

`unregister_sysctl_table` — unregister a sysctl table hierarchy

### Synopsis

```
void unregister_sysctl_table (struct ctl_table_header *  
header);
```

### Arguments

*header*

the header returned from `register_sysctl_table`

### Description

Unregisters the sysctl table and all children. proc entries may not actually be removed until they are no longer used by anyone.

# proc\_dostring

## LINUX

## Name

`proc_dostring` — read a string sysctl

## Synopsis

```
int proc_dostring (struct ctl_table * table, int write, void  
__user * buffer, size_t * lenp, loff_t * ppos);
```

## Arguments

*table*

the sysctl table

*write*

TRUE if this is a write to the sysctl file

*buffer*

the user buffer

*lenp*

the size of the user buffer

*ppos*

file position

## Description

Reads/writes a string from/to the user buffer. If the kernel buffer provided is not large enough to hold the string, the string is truncated. The copied string is `NULL`-terminated. If the string is being read by the user process, it is copied and a newline `'\n'` is added. It is truncated if the buffer is not large enough.

Returns 0 on success.

# proc\_dointvec

## LINUX

Kernel Hackers Manual October 2016

### Name

`proc_dointvec` — read a vector of integers

### Synopsis

```
int proc_dointvec (struct ctl_table * table, int write, void  
__user * buffer, size_t * lenp, loff_t * ppos);
```

### Arguments

*table*

the sysctl table

*write*

TRUE if this is a write to the sysctl file

*buffer*

the user buffer

*lenp*

the size of the user buffer

*ppos*

file position

## Description

Reads/writes up to `table->maxlen/sizeof(unsigned int)` integer values from/to the user buffer, treated as an ASCII string.

Returns 0 on success.

# proc\_dointvec\_minmax

## LINUX

Kernel Hackers Manual October 2016

## Name

`proc_dointvec_minmax` — read a vector of integers with min/max values

## Synopsis

```
int proc_dointvec_minmax (struct ctl_table * table, int write,  
void __user * buffer, size_t * lenp, loff_t * ppos);
```

## Arguments

*table*

the sysctl table

*write*

TRUE if this is a write to the sysctl file

*buffer*

the user buffer



*lenp*

the size of the user buffer

*ppos*

file position

## Description

Reads/writes up to `table->maxlen/sizeof(unsigned int)` integer values from/to the user buffer, treated as an ASCII string.

This routine will ensure the values are within the range specified by `table->extra1` (min) and `table->extra2` (max).

Returns 0 on success.

# proc\_doulongvec\_minmax

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`proc_doulongvec_minmax` — read a vector of long integers with min/max values

## Synopsis

```
int proc_doulongvec_minmax (struct ctl_table * table, int
write, void __user * buffer, size_t * lenp, loff_t * ppos);
```

## Arguments

*table*

the sysctl table

*write*

TRUE if this is a write to the sysctl file

*buffer*

the user buffer

*lenp*

the size of the user buffer

*ppos*

file position

## Description

Reads/writes up to `table->maxlen/sizeof(unsigned long)` unsigned long values from/to the user buffer, treated as an ASCII string.

This routine will ensure the values are within the range specified by `table->extra1` (min) and `table->extra2` (max).

Returns 0 on success.

# proc\_doulongvec\_ms\_jiffies\_minmax

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`proc_doulongvec_ms_jiffies_minmax` — read a vector of millisecond values with min/max values

## Synopsis

```
int proc_doulongvec_ms_jiffies_minmax (struct ctl_table *  
table, int write, void __user * buffer, size_t * lenp, loff_t  
* ppos);
```

## Arguments

*table*

the sysctl table

*write*

TRUE if this is a write to the sysctl file

*buffer*

the user buffer

*lenp*

the size of the user buffer

*ppos*

file position

## Description

Reads/writes up to `table->maxlen/sizeof(unsigned long)` unsigned long values from/to the user buffer, treated as an ASCII string. The values are treated as milliseconds, and converted to jiffies when they are stored.

This routine will ensure the values are within the range specified by `table->extra1` (min) and `table->extra2` (max).

Returns 0 on success.

# proc\_dointvec\_jiffies

## LINUX

Kernel Hackers ManualOctober 2016

### Name

`proc_dointvec_jiffies` — read a vector of integers as seconds

### Synopsis

```
int proc_dointvec_jiffies (struct ctl_table * table, int
write, void __user * buffer, size_t * lenp, loff_t * ppos);
```

### Arguments

*table*

the sysctl table

*write*

TRUE if this is a write to the sysctl file

*buffer*

the user buffer

*lenp*

the size of the user buffer

*ppos*

file position

## Description

Reads/writes up to `table->maxlen/sizeof(unsigned int)` integer values from/to the user buffer, treated as an ASCII string. The values read are assumed to be in seconds, and are converted into jiffies.

Returns 0 on success.

# proc\_dointvec\_userhz\_jiffies

## LINUX

Kernel Hackers Manual October 2016

## Name

`proc_dointvec_userhz_jiffies` — read a vector of integers as 1/USER\_HZ seconds

## Synopsis

```
int proc_dointvec_userhz_jiffies (struct ctl_table * table,
int write, void __user * buffer, size_t * lenp, loff_t *
ppos);
```

## Arguments

*table*

the sysctl table

*write*

TRUE if this is a write to the sysctl file

*buffer*

the user buffer

*lenp*

the size of the user buffer

*ppos*

pointer to the file position

## Description

Reads/writes up to `table->maxlen/sizeof(unsigned int)` integer values from/to the user buffer, treated as an ASCII string. The values read are assumed to be in 1/USER\_HZ seconds, and are converted into jiffies.

Returns 0 on success.

# proc\_dointvec\_ms\_jiffies

## LINUX

Kernel Hackers Manual October 2016

## Name

`proc_dointvec_ms_jiffies` — read a vector of integers as 1 milliseconds

## Synopsis

```
int proc_dointvec_ms_jiffies (struct ctl_table * table, int
write, void __user * buffer, size_t * lenp, loff_t * ppos);
```

## Arguments

*table*

the sysctl table

*write*

TRUE if this is a write to the sysctl file

*buffer*

the user buffer

*lenp*

the size of the user buffer

*ppos*

the current position in the file

## Description

Reads/writes up to `table->maxlen/sizeof(unsigned int)` integer values from/to the user buffer, treated as an ASCII string. The values read are assumed to be in 1/1000 seconds, and are converted into jiffies.

Returns 0 on success.

## 2.2. proc filesystem interface

### proc\_flush\_task

**LINUX**

## Name

`proc_flush_task` — Remove dcache entries for *task* from the `/proc` dcache.

## Synopsis

```
void proc_flush_task (struct task_struct * task);
```

## Arguments

*task*

task that should be flushed.

## Description

When flushing dentries from `proc`, one needs to flush them from global `proc` (`proc_mnt`) and from all the namespaces' `procs` this task was seen in. This call is supposed to do all of this job.

Looks in the dcache for `/proc/pid/proc/tgid/task/pid` if either directory is present flushes it and all of it's children from the dcache.

It is safe and reasonable to cache `/proc` entries for a task until that task exits. After that they just clog up the dcache with useless entries, possibly causing useful dcache entries to be flushed instead. This routine is provided to flush those useless dcache entries at process exit time.

## NOTE

This routine is just an optimization so it does not guarantee that no dcache entries will exist at process exit time it just makes it very unlikely that any will persist.



# Chapter 3. Events based on file descriptors

## eventfd\_signal

### LINUX

Kernel Hackers Manual October 2016

### Name

`eventfd_signal` — Adds *n* to the eventfd counter.

### Synopsis

```
int eventfd_signal (struct eventfd_ctx * ctx, int n);
```

### Arguments

*ctx*

[in] Pointer to the eventfd context.

*n*

[in] Value of the counter to be added to the eventfd internal counter. The value cannot be negative.

### Description

This function is supposed to be called by the kernel in paths that do not allow sleeping. In this function we allow the counter to reach the `ULLONG_MAX` value, and we signal this as overflow condition by returning a `POLLERR` to `poll(2)`.

Returns  $n$  in case of success, a non-negative number lower than  $n$  in case of overflow, or the following error codes:

-EINVAL : The value of  $n$  is negative.

## eventfd\_ctx\_get

### LINUX

Kernel Hackers Manual October 2016

### Name

eventfd\_ctx\_get — Acquires a reference to the internal eventfd context.

### Synopsis

```
struct eventfd_ctx * eventfd_ctx_get (struct eventfd_ctx *  
ctx);
```

### Arguments

*ctx*

[in] Pointer to the eventfd context.

### Returns

In case of success, returns a pointer to the eventfd context.

# eventfd\_ctx\_put

## LINUX

Kernel Hackers Manual October 2016

### Name

`eventfd_ctx_put` — Releases a reference to the internal eventfd context.

### Synopsis

```
void eventfd_ctx_put (struct eventfd_ctx * ctx);
```

### Arguments

*ctx*

[in] Pointer to eventfd context.

### Description

The eventfd context reference must have been previously acquired either with `eventfd_ctx_get` or `eventfd_ctx_fdget`.

# eventfd\_ctx\_remove\_wait\_queue

## LINUX

## Name

`eventfd_ctx_remove_wait_queue` — Read the current counter and removes wait queue.

## Synopsis

```
int eventfd_ctx_remove_wait_queue (struct eventfd_ctx * ctx,  
wait_queue_t * wait, __u64 * cnt);
```

## Arguments

*ctx*

[in] Pointer to eventfd context.

*wait*

[in] Wait queue to be removed.

*cnt*

[out] Pointer to the 64-bit counter value.

## Description

Returns 0 if successful, or the following error codes:

-EAGAIN : The operation would have blocked.

This is used to atomically remove a wait queue entry from the eventfd wait queue head, and read/reset the counter value.

# eventfd\_ctx\_read

## LINUX

Kernel Hackers Manual October 2016

### Name

`eventfd_ctx_read` — Reads the eventfd counter or wait if it is zero.

### Synopsis

```
ssize_t eventfd_ctx_read (struct eventfd_ctx * ctx, int
no_wait, __u64 * cnt);
```

### Arguments

*ctx*

[in] Pointer to eventfd context.

*no\_wait*

[in] Different from zero if the operation should not block.

*cnt*

[out] Pointer to the 64-bit counter value.

### Description

Returns 0 if successful, or the following error codes:

- EAGAIN : The operation would have blocked but *no\_wait* was non-zero.
- ERESTARTSYS : A signal interrupted the wait operation.

If *no\_wait* is zero, the function might sleep until the eventfd internal counter becomes greater than zero.

# eventfd\_fget

## LINUX

Kernel Hackers Manual October 2016

### Name

`eventfd_fget` — Acquire a reference of an eventfd file descriptor.

### Synopsis

```
struct file * eventfd_fget (int fd);
```

### Arguments

*fd*

[in] Eventfd file descriptor.

### Description

Returns a pointer to the eventfd file structure in case of success, or the

### following error pointer

-EBADF : Invalid *fd* file descriptor. -EINVAL : The *fd* file descriptor is not an eventfd file.

# eventfd\_ctx\_fdget

## LINUX

Kernel Hackers Manual October 2016

### Name

`eventfd_ctx_fdget` — Acquires a reference to the internal eventfd context.

### Synopsis

```
struct eventfd_ctx * eventfd_ctx_fdget (int fd);
```

### Arguments

*fd*

[in] Eventfd file descriptor.

### Description

Returns a pointer to the internal eventfd context, otherwise the error

### pointers returned by the following functions

`eventfd_fget`

# eventfd\_ctx\_fileget

## LINUX

## Name

`eventfd_ctx_fileget` — Acquires a reference to the internal eventfd context.

## Synopsis

```
struct eventfd_ctx * eventfd_ctx_fileget (struct file * file);
```

## Arguments

*file*

[in] Eventfd file pointer.

## Description

Returns a pointer to the internal eventfd context, otherwise the error

## pointer

-EINVAL : The *fd* file descriptor is not an eventfd file.



# Chapter 4. The Filesystem for Exporting Kernel Objects

## sysfs\_create\_file

**LINUX**

Kernel Hackers Manual October 2016

### Name

`sysfs_create_file` — create an attribute file for an object.

### Synopsis

```
int sysfs_create_file (struct kobject * kobj, const struct  
attribute * attr);
```

### Arguments

*kobj*

object we're creating for.

*attr*

attribute descriptor.

## sysfs\_add\_file\_to\_group

**LINUX**

## Name

`sysfs_add_file_to_group` — add an attribute file to a pre-existing group.

## Synopsis

```
int sysfs_add_file_to_group (struct kobject * kobj, const
struct attribute * attr, const char * group);
```

## Arguments

*kobj*

object we're acting for.

*attr*

attribute descriptor.

*group*

group name.

# sysfs\_chmod\_file

## LINUX

## Name

`sysfs_chmod_file` — update the modified mode value on an object attribute.

## Synopsis

```
int sysfs_chmod_file (struct kobject * kobj, const struct  
attribute * attr, mode_t mode);
```

## Arguments

*kobj*

object we're acting for.

*attr*

attribute descriptor.

*mode*

file permissions.

## sysfs\_remove\_file

### LINUX

Kernel Hackers Manual October 2016

## Name

`sysfs_remove_file` — remove an object attribute.

## Synopsis

```
void sysfs_remove_file (struct kobject * kobj, const struct  
attribute * attr);
```

## Arguments

*kobj*

object we're acting for.

*attr*

attribute descriptor.

## Description

Hash the attribute name and kill the victim.

# sysfs\_remove\_file\_from\_group

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`sysfs_remove_file_from_group` — remove an attribute file from a group.

## Synopsis

```
void sysfs_remove_file_from_group (struct kobject * kobj,  
const struct attribute * attr, const char * group);
```

## Arguments

*kobj*

object we're acting for.

*attr*

attribute descriptor.

*group*

group name.

## sysfs\_schedule\_callback

### LINUX

Kernel Hackers Manual October 2016

### Name

`sysfs_schedule_callback` — helper to schedule a callback for a kobject

### Synopsis

```
int sysfs_schedule_callback (struct kobject * kobj, void  
(*func) (void *), void * data, struct module * owner);
```

### Arguments

*kobj*

object we're acting for.

*func*

callback function to invoke later.

*data*

argument to pass to *func*.

*owner*

module owning the callback code

## Description

sysfs attribute methods must not unregister themselves or their parent kobject (which would amount to the same thing). Attempts to do so will deadlock, since unregistration is mutually exclusive with driver callbacks.

Instead methods can call this routine, which will attempt to allocate and schedule a workqueue request to call back *func* with *data* as its argument in the workqueue's process context. *kobj* will be pinned until *func* returns.

Returns 0 if the request was submitted, -ENOMEM if storage could not be allocated, -ENODEV if a reference to *owner* isn't available, -EAGAIN if a callback has already been scheduled for *kobj*.

# sysfs\_create\_link

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`sysfs_create_link` — create symlink between two objects.

## Synopsis

```
int sysfs_create_link (struct kobject * kobj, struct kobject *  
target, const char * name);
```

## Arguments

*kobj*

object whose directory we're creating the link in.

*target*

object we're pointing to.

*name*

name of the symlink.

## sysfs\_remove\_link

### LINUX

Kernel Hackers Manual October 2016

## Name

`sysfs_remove_link` — remove symlink in object's directory.

## Synopsis

```
void sysfs_remove_link (struct kobject * kobj, const char *  
name);
```

## Arguments

*kobj*

object we're acting for.

*name*

name of the symlink to remove.

## sysfs\_rename\_link

### LINUX

Kernel Hackers ManualOctober 2016

### Name

`sysfs_rename_link` — rename symlink in object’s directory.

### Synopsis

```
int sysfs_rename_link (struct kobject * kobj, struct kobject *  
targ, const char * old, const char * new);
```

### Arguments

*kobj*

object we’re acting for.

*targ*

object we’re pointing to.

*old*

previous name of the symlink.

*new*

new name of the symlink.



## Description

A helper function for the common rename symlink idiom.

# sysfs\_create\_bin\_file

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`sysfs_create_bin_file` — create binary file for object.

## Synopsis

```
int sysfs_create_bin_file (struct kobject * kobj, const struct  
bin_attribute * attr);
```

## Arguments

*kobj*

object.

*attr*

attribute descriptor.

# sysfs\_remove\_bin\_file

## LINUX

## Name

`sysfs_remove_bin_file` — remove binary file for object.

## Synopsis

```
void sysfs_remove_bin_file (struct kobject * kobj, const  
struct bin_attribute * attr);
```

## Arguments

*kobj*

object.

*attr*

attribute descriptor.

# Chapter 5. The debugfs filesystem

## 5.1. debugfs interface

### debugfs\_create\_file

#### LINUX

Kernel Hackers Manual October 2016

#### Name

`debugfs_create_file` — create a file in the debugfs filesystem

#### Synopsis

```
struct dentry * debugfs_create_file (const char * name, mode_t
mode, struct dentry * parent, void * data, const struct
file_operations * fops);
```

#### Arguments

*name*

a pointer to a string containing the name of the file to create.

*mode*

the permission that the file should have.

*parent*

a pointer to the parent dentry for this file. This should be a directory dentry if set. If this parameter is NULL, then the file will be created in the root of the debugfs filesystem.

*data*

a pointer to something that the caller will want to get to later on. The `inode.i_private` pointer will point to this value on the `open` call.

*fops*

a pointer to a struct `file_operations` that should be used for this file.

## Description

This is the basic “create a file” function for debugfs. It allows for a wide range of flexibility in creating a file, or a directory (if you want to create a directory, the `debugfs_create_dir` function is recommended to be used instead.)

This function will return a pointer to a dentry if it succeeds. This pointer must be passed to the `debugfs_remove` function when the file is to be removed (no automatic cleanup happens if your module is unloaded, you are responsible here.) If an error occurs, `NULL` will be returned.

If debugfs is not enabled in the kernel, the value `-ENODEV` will be returned.

# debugfs\_create\_dir

## LINUX

Kernel Hackers Manual October 2016

## Name

`debugfs_create_dir` — create a directory in the debugfs filesystem

## Synopsis

```
struct dentry * debugfs_create_dir (const char * name, struct
dentry * parent);
```

## Arguments

*name*

a pointer to a string containing the name of the directory to create.

*parent*

a pointer to the parent dentry for this file. This should be a directory dentry if set. If this parameter is NULL, then the directory will be created in the root of the debugfs filesystem.

## Description

This function creates a directory in debugfs with the given name.

This function will return a pointer to a dentry if it succeeds. This pointer must be passed to the `debugfs_remove` function when the file is to be removed (no automatic cleanup happens if your module is unloaded, you are responsible here.) If an error occurs, NULL will be returned.

If debugfs is not enabled in the kernel, the value `-ENODEV` will be returned.

# debugfs\_create\_symlink

## LINUX

Kernel Hackers Manual October 2016

## Name

`debugfs_create_symlink` — create a symbolic link in the debugfs filesystem

## Synopsis

```
struct dentry * debugfs_create_symlink (const char * name,
struct dentry * parent, const char * target);
```

## Arguments

*name*

a pointer to a string containing the name of the symbolic link to create.

*parent*

a pointer to the parent dentry for this symbolic link. This should be a directory dentry if set. If this parameter is NULL, then the symbolic link will be created in the root of the debugfs filesystem.

*target*

a pointer to a string containing the path to the target of the symbolic link.

## Description

This function creates a symbolic link with the given name in debugfs that links to the given target path.

This function will return a pointer to a dentry if it succeeds. This pointer must be passed to the `debugfs_remove` function when the symbolic link is to be removed (no automatic cleanup happens if your module is unloaded, you are responsible here.) If an error occurs, NULL will be returned.

If debugfs is not enabled in the kernel, the value `-ENODEV` will be returned.

## debugfs\_remove

### LINUX

Kernel Hackers Manual October 2016

### Name

`debugfs_remove` — removes a file or directory from the debugfs filesystem

## Synopsis

```
void debugfs_remove (struct dentry * dentry);
```

## Arguments

*dentry*

a pointer to a the dentry of the file or directory to be removed.

## Description

This function removes a file or directory in debugfs that was previously created with a call to another debugfs function (like `debugfs_create_file` or variants thereof.)

This function is required to be called in order for the file to be removed, no automatic cleanup of files will happen when a module is removed, you are responsible here.

# debugfs\_remove\_recursive

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`debugfs_remove_recursive` — recursively removes a directory

## Synopsis

```
void debugfs_remove_recursive (struct dentry * dentry);
```

## Arguments

*dentry*

a pointer to a the dentry of the directory to be removed.

## Description

This function recursively removes a directory tree in *debugfs* that was previously created with a call to another *debugfs* function (like `debugfs_create_file` or variants thereof.)

This function is required to be called in order for the file to be removed, no automatic cleanup of files will happen when a module is removed, you are responsible here.

# debugfs\_rename

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`debugfs_rename` — rename a file/directory in the *debugfs* filesystem

## Synopsis

```
struct dentry * debugfs_rename (struct dentry * old_dir,  
struct dentry * old_dentry, struct dentry * new_dir, const  
char * new_name);
```



## Arguments

*old\_dir*

a pointer to the parent dentry for the renamed object. This should be a directory dentry.

*old\_dentry*

dentry of an object to be renamed.

*new\_dir*

a pointer to the parent dentry where the object should be moved. This should be a directory dentry.

*new\_name*

a pointer to a string containing the target name.

## Description

This function renames a file/directory in debugfs. The target must not exist for rename to succeed.

This function will return a pointer to *old\_dentry* (which is updated to reflect renaming) if it succeeds. If an error occurs, `NULL` will be returned.

If debugfs is not enabled in the kernel, the value `-ENODEV` will be returned.

# debugfs\_initialized

## LINUX

Kernel Hackers Manual October 2016

## Name

`debugfs_initialized` — Tells whether debugfs has been registered

## Synopsis

```
bool debugfs_initialized ( void );
```

## Arguments

*void*

no arguments

## debugfs\_create\_u8

### LINUX

Kernel Hackers Manual October 2016

## Name

`debugfs_create_u8` — create a debugfs file that is used to read and write an unsigned 8-bit value

## Synopsis

```
struct dentry * debugfs_create_u8 (const char * name, mode_t  
mode, struct dentry * parent, u8 * value);
```

## Arguments

*name*

a pointer to a string containing the name of the file to create.

*mode*

the permission that the file should have

*parent*

a pointer to the parent dentry for this file. This should be a directory dentry if set. If this parameter is `NULL`, then the file will be created in the root of the debugfs filesystem.

*value*

a pointer to the variable that the file should read to and write from.

## Description

This function creates a file in debugfs with the given name that contains the value of the variable *value*. If the *mode* variable is so set, it can be read from, and written to.

This function will return a pointer to a dentry if it succeeds. This pointer must be passed to the `debugfs_remove` function when the file is to be removed (no automatic cleanup happens if your module is unloaded, you are responsible here.) If an error occurs, `NULL` will be returned.

If debugfs is not enabled in the kernel, the value `-ENODEV` will be returned. It is not wise to check for this value, but rather, check for `NULL` or `!NULL` instead as to eliminate the need for `#ifdef` in the calling code.

# debugfs\_create\_u16

## LINUX

Kernel Hackers Manual October 2016

## Name

`debugfs_create_u16` — create a debugfs file that is used to read and write an unsigned 16-bit value

## Synopsis

```
struct dentry * debugfs_create_u16 (const char * name, mode_t  
mode, struct dentry * parent, u16 * value);
```

## Arguments

*name*

a pointer to a string containing the name of the file to create.

*mode*

the permission that the file should have

*parent*

a pointer to the parent dentry for this file. This should be a directory dentry if set. If this parameter is `NULL`, then the file will be created in the root of the debugfs filesystem.

*value*

a pointer to the variable that the file should read to and write from.

## Description

This function creates a file in debugfs with the given name that contains the value of the variable *value*. If the *mode* variable is so set, it can be read from, and written to.

This function will return a pointer to a dentry if it succeeds. This pointer must be passed to the `debugfs_remove` function when the file is to be removed (no automatic cleanup happens if your module is unloaded, you are responsible here.) If an error occurs, `NULL` will be returned.

If debugfs is not enabled in the kernel, the value `-ENODEV` will be returned. It is not wise to check for this value, but rather, check for `NULL` or `!NULL` instead as to eliminate the need for `#ifdef` in the calling code.

# debugfs\_create\_u32

## LINUX

Kernel Hackers Manual October 2016

## Name

`debugfs_create_u32` — create a debugfs file that is used to read and write an unsigned 32-bit value

## Synopsis

```
struct dentry * debugfs_create_u32 (const char * name, mode_t
mode, struct dentry * parent, u32 * value);
```

## Arguments

*name*

a pointer to a string containing the name of the file to create.

*mode*

the permission that the file should have

*parent*

a pointer to the parent dentry for this file. This should be a directory dentry if set. If this parameter is `NULL`, then the file will be created in the root of the debugfs filesystem.

*value*

a pointer to the variable that the file should read to and write from.

## Description

This function creates a file in debugfs with the given name that contains the value of the variable *value*. If the *mode* variable is so set, it can be read from, and written to.

This function will return a pointer to a dentry if it succeeds. This pointer must be passed to the `debugfs_remove` function when the file is to be removed (no automatic cleanup happens if your module is unloaded, you are responsible here.) If an error occurs, `NULL` will be returned.

If `debugfs` is not enabled in the kernel, the value `-ENODEV` will be returned. It is not wise to check for this value, but rather, check for `NULL` or `!NULL` instead as to eliminate the need for `#ifdef` in the calling code.

## debugfs\_create\_u64

### LINUX

Kernel Hackers Manual October 2016

### Name

`debugfs_create_u64` — create a `debugfs` file that is used to read and write an unsigned 64-bit value

### Synopsis

```
struct dentry * debugfs_create_u64 (const char * name, mode_t
mode, struct dentry * parent, u64 * value);
```

### Arguments

*name*

a pointer to a string containing the name of the file to create.

*mode*

the permission that the file should have

*parent*

a pointer to the parent dentry for this file. This should be a directory dentry if set. If this parameter is `NULL`, then the file will be created in the root of the debugfs filesystem.

*value*

a pointer to the variable that the file should read to and write from.

## Description

This function creates a file in debugfs with the given name that contains the value of the variable *value*. If the *mode* variable is so set, it can be read from, and written to.

This function will return a pointer to a dentry if it succeeds. This pointer must be passed to the `debugfs_remove` function when the file is to be removed (no automatic cleanup happens if your module is unloaded, you are responsible here.) If an error occurs, `NULL` will be returned.

If debugfs is not enabled in the kernel, the value `-ENODEV` will be returned. It is not wise to check for this value, but rather, check for `NULL` or `!NULL` instead as to eliminate the need for `#ifdef` in the calling code.

# debugfs\_create\_x8

## LINUX

Kernel Hackers Manual October 2016

## Name

`debugfs_create_x8` — create a debugfs file that is used to read and write an unsigned 8-bit value

## Synopsis

```
struct dentry * debugfs_create_x8 (const char * name, mode_t
mode, struct dentry * parent, u8 * value);
```

## Arguments

*name*

a pointer to a string containing the name of the file to create.

*mode*

the permission that the file should have

*parent*

a pointer to the parent dentry for this file. This should be a directory dentry if set. If this parameter is `NULL`, then the file will be created in the root of the debugfs filesystem.

*value*

a pointer to the variable that the file should read to and write from.

## debugfs\_create\_x16

### LINUX

Kernel Hackers Manual October 2016

### Name

`debugfs_create_x16` — create a debugfs file that is used to read and write an unsigned 16-bit value

### Synopsis

```
struct dentry * debugfs_create_x16 (const char * name, mode_t
mode, struct dentry * parent, ul6 * value);
```



## Arguments

*name*

a pointer to a string containing the name of the file to create.

*mode*

the permission that the file should have

*parent*

a pointer to the parent dentry for this file. This should be a directory dentry if set. If this parameter is `NULL`, then the file will be created in the root of the debugfs filesystem.

*value*

a pointer to the variable that the file should read to and write from.

## debugfs\_create\_x32

### LINUX

Kernel Hackers Manual October 2016

### Name

`debugfs_create_x32` — create a debugfs file that is used to read and write an unsigned 32-bit value

### Synopsis

```
struct dentry * debugfs_create_x32 (const char * name, mode_t  
mode, struct dentry * parent, u32 * value);
```

## Arguments

*name*

a pointer to a string containing the name of the file to create.

*mode*

the permission that the file should have

*parent*

a pointer to the parent dentry for this file. This should be a directory dentry if set. If this parameter is `NULL`, then the file will be created in the root of the debugfs filesystem.

*value*

a pointer to the variable that the file should read to and write from.

## debugfs\_create\_x64

### LINUX

Kernel Hackers Manual October 2016

### Name

`debugfs_create_x64` — create a debugfs file that is used to read and write an unsigned 64-bit value

### Synopsis

```
struct dentry * debugfs_create_x64 (const char * name, mode_t
mode, struct dentry * parent, u64 * value);
```

## Arguments

*name*

a pointer to a string containing the name of the file to create.

*mode*

the permission that the file should have

*parent*

a pointer to the parent dentry for this file. This should be a directory dentry if set. If this parameter is `NULL`, then the file will be created in the root of the debugfs filesystem.

*value*

a pointer to the variable that the file should read to and write from.

## debugfs\_create\_size\_t

### LINUX

Kernel Hackers Manual October 2016

### Name

`debugfs_create_size_t` — create a debugfs file that is used to read and write an `size_t` value

### Synopsis

```
struct dentry * debugfs_create_size_t (const char * name,  
mode_t mode, struct dentry * parent, size_t * value);
```

## Arguments

*name*

a pointer to a string containing the name of the file to create.

*mode*

the permission that the file should have

*parent*

a pointer to the parent dentry for this file. This should be a directory dentry if set. If this parameter is `NULL`, then the file will be created in the root of the debugfs filesystem.

*value*

a pointer to the variable that the file should read to and write from.

## debugfs\_create\_bool

### LINUX

Kernel Hackers Manual October 2016

### Name

`debugfs_create_bool` — create a debugfs file that is used to read and write a boolean value

### Synopsis

```
struct dentry * debugfs_create_bool (const char * name, mode_t
mode, struct dentry * parent, u32 * value);
```

## Arguments

*name*

a pointer to a string containing the name of the file to create.

*mode*

the permission that the file should have

*parent*

a pointer to the parent dentry for this file. This should be a directory dentry if set. If this parameter is `NULL`, then the file will be created in the root of the debugfs filesystem.

*value*

a pointer to the variable that the file should read to and write from.

## Description

This function creates a file in debugfs with the given name that contains the value of the variable *value*. If the *mode* variable is so set, it can be read from, and written to.

This function will return a pointer to a dentry if it succeeds. This pointer must be passed to the `debugfs_remove` function when the file is to be removed (no automatic cleanup happens if your module is unloaded, you are responsible here.) If an error occurs, `NULL` will be returned.

If debugfs is not enabled in the kernel, the value `-ENODEV` will be returned. It is not wise to check for this value, but rather, check for `NULL` or `!NULL` instead as to eliminate the need for `#ifdef` in the calling code.

## debugfs\_create\_blob

**LINUX**

## Name

`debugfs_create_blob` — create a debugfs file that is used to read a binary blob

## Synopsis

```
struct dentry * debugfs_create_blob (const char * name, mode_t
mode, struct dentry * parent, struct debugfs_blob_wrapper *
blob);
```

## Arguments

*name*

a pointer to a string containing the name of the file to create.

*mode*

the permission that the file should have

*parent*

a pointer to the parent dentry for this file. This should be a directory dentry if set. If this parameter is `NULL`, then the file will be created in the root of the debugfs filesystem.

*blob*

a pointer to a struct `debugfs_blob_wrapper` which contains a pointer to the blob data and the size of the data.

## Description

This function creates a file in debugfs with the given name that exports `blob->data` as a binary blob. If the `mode` variable is so set it can be read from. Writing is not supported.

This function will return a pointer to a dentry if it succeeds. This pointer must be passed to the `debugfs_remove` function when the file is to be removed (no automatic cleanup happens if your module is unloaded, you are responsible here.) If an error occurs, `NULL` will be returned.

If `debugfs` is not enabled in the kernel, the value `-ENODEV` will be returned. It is not wise to check for this value, but rather, check for `NULL` or `!NULL` instead as to eliminate the need for `#ifdef` in the calling code.





# Chapter 6. The Linux Journalling API

## 6.1. Overview

### 6.1.1. Details

The journalling layer is easy to use. You need to first of all create a `journal_t` data structure. There are two calls to do this dependent on how you decide to allocate the physical media on which the journal resides. The `journal_init_inode()` call is for journals stored in filesystem inodes, or the `journal_init_dev()` call can be use for journal stored on a raw device (in a continuous range of blocks). A `journal_t` is a typedef for a struct pointer, so when you are finally finished make sure you call `journal_destroy()` on it to free up any used kernel memory.

Once you have got your `journal_t` object you need to 'mount' or load the journal file, unless of course you haven't initialised it yet - in which case you need to call `journal_create()`.

Most of the time however your journal file will already have been created, but before you load it you must call `journal_wipe()` to empty the journal file. Hang on, you say , what if the filesystem wasn't cleanly umount()'d . Well, it is the job of the client file system to detect this and skip the call to `journal_wipe()`.

In either case the next call should be to `journal_load()` which prepares the journal file for use. Note that `journal_wipe(..,0)` calls `journal_skip_recovery()` for you if it detects any outstanding transactions in the journal and similarly `journal_load()` will call `journal_recover()` if necessary. I would advise reading `fs/ext3/super.c` for examples on this stage. [RGG: Why is the `journal_wipe()` call necessary - doesn't this needlessly complicate the API. Or isn't a good idea for the journal layer to hide dirty mounts from the client fs]

Now you can go ahead and start modifying the underlying filesystem. Almost.

You still need to actually journal your filesystem changes, this is done by wrapping them into transactions. Additionally you also need to wrap the modification of each of the buffers with calls to the journal layer, so it knows what the modifications you are actually making are. To do this use `journal_start()` which returns a transaction handle.

`journal_start()` and its counterpart `journal_stop()`, which indicates the end of a transaction are nestable calls, so you can reenter a transaction if necessary, but remember you must call `journal_stop()` the same number of times as `journal_start()` before the transaction is completed (or more accurately leaves the update phase). Ext3/VFS makes use of this feature to simplify quota support.

Inside each transaction you need to wrap the modifications to the individual buffers (blocks). Before you start to modify a buffer you need to call `journal_get_{create,write,undo}_access()` as appropriate, this allows the journalling layer to copy the unmodified data if it needs to. After all the buffer may be part of a previously uncommitted transaction. At this point you are at last ready to modify a buffer, and once you are have done so you need to call `journal_dirty_{meta,}data()`. Or if you've asked for access to a buffer you now know is now longer required to be pushed back on the device you can call `journal_forget()` in much the same way as you might have used `bforget()` in the past.

A `journal_flush()` may be called at any time to commit and checkpoint all your transactions.

Then at umount time, in your `put_super()` (2.4) or `write_super()` (2.5) you can then call `journal_destroy()` to clean up your in-core journal object.

Unfortunately there are a couple of ways the journal layer can cause a deadlock. The first thing to note is that each task can only have a single outstanding transaction at any one time, remember nothing commits until the outermost `journal_stop()`. This means you must complete the transaction at the end of each file/inode/address etc. operation you perform, so that the journalling system isn't re-entered on another journal. Since transactions can't be nested/batched across differing journals, and another filesystem other than yours (say ext3) may be modified in a later syscall.

The second case to bear in mind is that `journal_start()` can block if there isn't enough space in the journal for your transaction (based on the passed `nblocks` param) - when it blocks it merely(!) needs to wait for transactions to complete and be committed from other tasks, so essentially we are waiting for `journal_stop()`. So to avoid deadlocks you must treat `journal_start/stop()` as if they were semaphores and include them in your semaphore ordering rules to prevent deadlocks. Note that `journal_extend()` has similar blocking behaviour to `journal_start()` so you can deadlock here just as easily as on `journal_start()`.

Try to reserve the right number of blocks the first time. ;-). This will be the maximum number of blocks you are going to touch in this transaction. I advise having a look at at least `ext3_jbd.h` to see the basis on which ext3 uses to make these decisions.

Another wriggle to watch out for is your on-disk block allocation strategy. why? Because, if you undo a delete, you need to ensure you haven't reused any of the freed blocks in a later transaction. One simple way of doing this is make sure any blocks you allocate only have checkpointed transactions listed against them. Ext3 does this in `ext3_test_allocatable()`.

Lock is also providing through `journal_{un,}lock_updates()`, ext3 uses this when it wants a window with a clean and stable fs for a moment. eg.

```

journal_lock_updates() //stop new stuff happening..
journal_flush()        // checkpoint everything.
..do stuff on stable fs
journal_unlock_updates() // carry on with filesystem use.

```

The opportunities for abuse and DOS attacks with this should be obvious, if you allow unprivileged userspace to trigger codepaths containing these calls.

A new feature of jbd since 2.5.25 is commit callbacks with the new `journal_callback_set()` function you can now ask the journalling layer to call you back when the transaction is finally committed to disk, so that you can do some of your own management. The key to this is the `journal_callback` struct, this maintains the internal callback information but you can extend it like this:-

```

struct myfs_callback_s {
    //Data structure element required by jbd..
    struct journal_callback for_jbd;
    // Stuff for myfs allocated together.
    myfs_inode*      i_committed;
}

```

this would be useful if you needed to know when data was committed to a particular inode.

## 6.1.2. Summary

Using the journal is a matter of wrapping the different context changes, being each mount, each modification (transaction) and each changed buffer to tell the journalling layer about them.

Here is a some pseudo code to give you an idea of how it works, as an example.

```

journal_t* my_jnrl = journal_create();
journal_init_{dev,inode}(jnrl,...)
if (clean) journal_wipe();
journal_load();

foreach(transaction) { /*transactions must be
                        completed before
                        a syscall returns to
                        userspace*/

    handle_t * xct=journal_start(my_jnrl);
    foreach(bh) {
        journal_get_{create,write,undo}_access(xact,bh);
        if ( myfs_modify(bh) ) { /* returns true

```

```
                                if makes changes */
                                journal_dirty_{meta, }data(xact, bh);
                                } else {
                                journal_forget(bh);
                                }
                                }
                                journal_stop(xct);
                                }
                                journal_destroy(my_jrnl);
```

## 6.2. Data Types

The journalling layer uses typedefs to 'hide' the concrete definitions of the structures used. As a client of the JBD layer you can just rely on the using the pointer as a magic cookie of some sort. Obviously the hiding is not enforced as this is 'C'.

### 6.2.1. Structures

## typedef handle\_t

### LINUX

Kernel Hackers ManualOctober 2016

### Name

`typedef handle_t` — The `handle_t` type represents a single atomic update being performed by some process.

### Synopsis

```
typedef handle_t;
```

### Description

All filesystem modifications made by the process go through this handle. Recursive operations (such as quota operations) are gathered into a single update.

The buffer credits field is used to account for journaled buffers being modified by the running process. To ensure that there is enough log space for all outstanding operations, we need to limit the number of outstanding buffers possible at any time. When the operation completes, any buffer credits not used are credited back to the transaction, so that at all times we know how many buffers the outstanding updates on a transaction might possibly touch.

This is an opaque datatype.

## **typedef journal\_t**

### **LINUX**

Kernel Hackers Manual October 2016

### **Name**

`typedef journal_t` — The `journal_t` maintains all of the journaling state information for a single filesystem.

### **Synopsis**

```
typedef journal_t;
```

### **Description**

`journal_t` is linked to from the fs superblock structure.

We use the `journal_t` to keep track of all outstanding transaction activity on the filesystem, and to manage the state of the log writing process.

This is an opaque datatype.

# struct handle\_s

## LINUX

Kernel Hackers Manual October 2016

## Name

struct handle\_s — this is the concrete type associated with handle\_t.

## Synopsis

```
struct handle_s {
    transaction_t * h_transaction;
    int h_buffer_credits;
    int h_ref;
    int h_err;
    unsigned int h_sync:1;
    unsigned int h_jdata:1;
    unsigned int h_aborted:1;
#ifdef CONFIG_DEBUG_LOCK_ALLOC
    struct lockdep_map h_lockdep_map;
#endif
};
```

## Members

h\_transaction

Which compound transaction is this update a part of?

h\_buffer\_credits

Number of remaining buffers we are allowed to dirty.

h\_ref

Reference count on this handle

h\_err

Field for caller's use to track errors through large fs operations

`h_sync`

flag for sync-on-close

`h_jdata`

flag to force data journaling

`h_aborted`

flag indicating fatal error on handle

`h_lockdep_map`

lockdep info for debugging lock problems

## struct journal\_s

### LINUX

Kernel Hackers Manual October 2016

### Name

`struct journal_s` — this is the concrete type associated with `journal_t`.

### Synopsis

```
struct journal_s {
    unsigned long j_flags;
    int j_errno;
    struct buffer_head * j_sb_buffer;
    journal_superblock_t * j_superblock;
    int j_format_version;
    spinlock_t j_state_lock;
    int j_barrier_count;
    struct mutex j_barrier;
    transaction_t * j_running_transaction;
    transaction_t * j_committing_transaction;
    transaction_t * j_checkpoint_transactions;
    wait_queue_head_t j_wait_transaction_locked;
    wait_queue_head_t j_wait_logspace;
    wait_queue_head_t j_wait_done_commit;
```

```
wait_queue_head_t j_wait_checkpoint;
wait_queue_head_t j_wait_commit;
wait_queue_head_t j_wait_updates;
struct mutex j_checkpoint_mutex;
unsigned int j_head;
unsigned int j_tail;
unsigned int j_free;
unsigned int j_first;
unsigned int j_last;
struct block_device * j_dev;
int j_blocksize;
unsigned int j_blk_offset;
struct block_device * j_fs_dev;
unsigned int j_maxlen;
spinlock_t j_list_lock;
struct inode * j_inode;
tid_t j_tail_sequence;
tid_t j_transaction_sequence;
tid_t j_commit_sequence;
tid_t j_commit_request;
tid_t j_commit_waited;
__u8 j_uuid[16];
struct task_struct * j_task;
int j_max_transaction_buffers;
unsigned long j_commit_interval;
struct timer_list j_commit_timer;
spinlock_t j_revoke_lock;
struct jbd_revoke_table_s * j_revoke;
struct jbd_revoke_table_s * j_revoke_table[2];
struct buffer_head ** j_wbuf;
int j_wbufsize;
pid_t j_last_sync_writer;
u64 j_average_commit_time;
void * j_private;
};
```

## Members

**j\_flags**

General journaling state flags

**j\_errno**

Is there an outstanding uncleared error on the journal (from a prior abort)?



`j_sb_buffer`

First part of superblock buffer

`j_superblock`

Second part of superblock buffer

`j_format_version`

Version of the superblock format

`j_state_lock`

Protect the various scalars in the journal

`j_barrier_count`

Number of processes waiting to create a barrier lock

`j_barrier`

The barrier lock itself

`j_running_transaction`

The current running transaction..

`j_committing_transaction`

the transaction we are pushing to disk

`j_checkpoint_transactions`

a linked circular list of all transactions waiting for checkpointing

`j_wait_transaction_locked`

Wait queue for waiting for a locked transaction to start committing, or for a barrier lock to be released

`j_wait_logspace`

Wait queue for waiting for checkpointing to complete

`j_wait_done_commit`

Wait queue for waiting for commit to complete

`j_wait_checkpoint`

Wait queue to trigger checkpointing

`j_wait_commit`

Wait queue to trigger commit

`j_wait_updates`

Wait queue to wait for updates to complete

`j_checkpoint_mutex`

Mutex for locking against concurrent checkpoints

`j_head`

Journal head - identifies the first unused block in the journal

`j_tail`

Journal tail - identifies the oldest still-used block in the journal.

`j_free`

Journal free - how many free blocks are there in the journal?

`j_first`

The block number of the first usable block

`j_last`

The block number one beyond the last usable block

`j_dev`

Device where we store the journal

`j_blocksize`

blocksize for the location where we store the journal.

`j_blk_offset`

starting block offset for into the device where we store the journal

`j_fs_dev`

Device which holds the client fs. For internal journal this will be equal to `j_dev`

`j_maxlen`

Total maximum capacity of the journal region on disk.

`j_list_lock`

Protects the buffer lists and internal buffer state.

`j_inode`

Optional inode where we store the journal. If present, all journal block numbers are mapped into this inode via `bmap`.

`j_tail_sequence`

Sequence number of the oldest transaction in the log

`j_transaction_sequence`

Sequence number of the next transaction to grant

`j_commit_sequence`

Sequence number of the most recently committed transaction

`j_commit_request`

Sequence number of the most recent transaction wanting commit

`j_commit_waited`

Sequence number of the most recent transaction someone is waiting for to commit.

`j_uuid[16]`

Uuid of client object.

`j_task`

Pointer to the current commit thread for this journal

`j_max_transaction_buffers`

Maximum number of metadata buffers to allow in a single compound commit transaction

`j_commit_interval`

What is the maximum transaction lifetime before we begin a commit?

`j_commit_timer`

The timer used to wakeup the commit thread

`j_revoke_lock`

Protect the revoke table

`j_revoke`

The revoke table - maintains the list of revoked blocks in the current transaction.

`j_revoke_table[2]`

alternate revoke tables for `j_revoke`

`j_wbuf`

array of `buffer_heads` for `journal_commit_transaction`

`j_wbufsize`

maximum number of `buffer_heads` allowed in `j_wbuf`, the number that will fit in `j_blocksize`

`j_last_sync_writer`

most recent pid which did a synchronous write

`j_average_commit_time`

the average amount of time in nanoseconds it takes to commit a transaction to the disk.

`j_private`

An opaque pointer to fs-private information.

## 6.3. Functions

The functions here are split into two groups those that affect a journal as a whole, and those which are used to manage transactions

### 6.3.1. Journal Level

# journal\_init\_dev

**LINUX**

## Name

`journal_init_dev` — creates and initialises a journal structure

## Synopsis

```
journal_t * journal_init_dev (struct block_device * bdev,  
struct block_device * fs_dev, int start, int len, int  
blocksize);
```

## Arguments

*bdev*

Block device on which to create the journal

*fs\_dev*

Device which hold journalled filesystem for this journal.

*start*

Block nr Start of journal.

*len*

Length of the journal in blocks.

*blocksize*

blocksize of journalling device

## Returns

a newly created `journal_t *`

`journal_init_dev` creates a journal which maps a fixed contiguous range of blocks on an arbitrary block device.

# journal\_init\_inode

## LINUX

Kernel Hackers Manual October 2016

### Name

`journal_init_inode` — creates a journal which maps to a inode.

### Synopsis

```
journal_t * journal_init_inode (struct inode * inode);
```

### Arguments

*inode*

An inode to create the journal in

### Description

`journal_init_inode` creates a journal which maps an on-disk inode as the journal. The inode must exist already, must support `bmap` and must have all data blocks preallocated.

# journal\_create

## LINUX

## Name

`journal_create` — Initialise the new journal file

## Synopsis

```
int journal_create (journal_t * journal);
```

## Arguments

*journal*

Journal to create. This structure must have been initialised

## Description

Given a `journal_t` structure which tells us which disk blocks we can use, create a new journal superblock and initialise all of the journal fields from scratch.

# journal\_load

## LINUX

## Name

`journal_load` — Read journal from disk.

## Synopsis

```
int journal_load (journal_t * journal);
```

## Arguments

*journal*

Journal to act on.

## Description

Given a `journal_t` structure which tells us which disk blocks contain a journal, read the journal from disk to initialise the in-memory structures.

# journal\_destroy

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`journal_destroy` — Release a `journal_t` structure.

## Synopsis

```
int journal_destroy (journal_t * journal);
```



## Arguments

*journal*

Journal to act on.

## Description

Release a `journal_t` structure once it is no longer in use by the journaled object.

Return `<0` if we couldn't clean up the journal.

# journal\_check\_used\_features

## LINUX

Kernel Hackers Manual October 2016

## Name

`journal_check_used_features` — Check if features specified are used.

## Synopsis

```
int journal_check_used_features (journal_t * journal, unsigned
long compat, unsigned long ro, unsigned long incompat);
```

## Arguments

*journal*

Journal to check.

*compat*

bitmask of compatible features

*ro*

bitmask of features that force read-only mount

*incompat*

bitmask of incompatible features

## Description

Check whether the journal uses all of a given set of features. Return true (non-zero) if it does.

# journal\_check\_available\_features

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`journal_check_available_features` — Check feature set in journalling layer

## Synopsis

```
int journal_check_available_features (journal_t * journal,
unsigned long compat, unsigned long ro, unsigned long
incompat);
```

## Arguments

*journal*

Journal to check.

*compat*

bitmask of compatible features

*ro*

bitmask of features that force read-only mount

*incompat*

bitmask of incompatible features

## Description

Check whether the journaling code supports the use of all of a given set of features on this journal. Return true

# journal\_set\_features

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`journal_set_features` — Mark a given journal feature in the superblock

## Synopsis

```
int journal_set_features (journal_t * journal, unsigned long
compat, unsigned long ro, unsigned long incompat);
```

## Arguments

*journal*

Journal to act on.

*compat*

bitmask of compatible features

*ro*

bitmask of features that force read-only mount

*incompat*

bitmask of incompatible features

## Description

Mark a given journal feature as present on the superblock. Returns true if the requested features could be set.

# journal\_update\_format

**LINUX**

Kernel Hackers ManualOctober 2016

## Name

`journal_update_format` — Update on-disk journal structure.

## Synopsis

```
int journal_update_format (journal_t * journal);
```

## Arguments

*journal*

Journal to act on.

## Description

Given an initialised but unloaded journal struct, poke about in the on-disk structure to update it to the most recent supported version.

# journal\_flush

## LINUX

Kernel Hackers ManualOctober 2016

## Name

journal\_flush — Flush journal

## Synopsis

```
int journal_flush (journal_t * journal);
```

## Arguments

*journal*

Journal to act on.

## Description

Flush all data for a given journal to disk and empty the journal. Filesystems can use this when remounting readonly to ensure that recovery does not need to happen on remount.

# journal\_wipe

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`journal_wipe` — Wipe journal contents

## Synopsis

```
int journal_wipe (journal_t * journal, int write);
```

## Arguments

*journal*

Journal to act on.

*write*

flag (see below)

## Description

Wipe out all of the contents of a journal, safely. This will produce a warning if the journal contains any valid recovery information. Must be called between `journal_init_*`() and `journal_load`.

If 'write' is non-zero, then we wipe out the journal on disk; otherwise we merely suppress recovery.

## journal\_abort

### LINUX

Kernel Hackers Manual October 2016

### Name

`journal_abort` — Shutdown the journal immediately.

### Synopsis

```
void journal_abort (journal_t * journal, int errno);
```

### Arguments

*journal*

the journal to shutdown.

*errno*

an error number to record in the journal indicating the reason for the shutdown.

### Description

Perform a complete, immediate shutdown of the ENTIRE journal (not of a single transaction). This operation cannot be undone without closing and reopening the journal.

The `journal_abort` function is intended to support higher level error recovery mechanisms such as the ext2/ext3 remount-readonly error mode.

Journal abort has very specific semantics. Any existing dirty, unjournalized buffers in the main filesystem will still be written to disk by `bdflush`, but the journaling mechanism will be suspended immediately and no further transaction commits will be honoured.

Any dirty, journaled buffers will be written back to disk without hitting the journal. Atomicity cannot be guaranteed on an aborted filesystem, but we `_do_` attempt to leave as much data as possible behind for `fsck` to use for cleanup.

Any attempt to get a new transaction handle on a journal which is in ABORT state will just result in an `-EROFS` error return. A `journal_stop` on an existing handle will return `-EIO` if we have entered abort state during the update.

Recursive transactions are not disturbed by journal abort until the final `journal_stop`, which will receive the `-EIO` error.

Finally, the `journal_abort` call allows the caller to supply an `errno` which will be recorded (if possible) in the journal superblock. This allows a client to record failure conditions in the middle of a transaction without having to complete the transaction to record the failure to disk. `ext3_error`, for example, now uses this functionality.

Errors which originate from within the journaling layer will NOT supply an `errno`; a null `errno` implies that absolutely no further writes are done to the journal (unless there are any already in progress).

## journal\_errno

### LINUX

Kernel Hackers Manual October 2016

### Name

`journal_errno` — returns the journal's error state.

### Synopsis

```
int journal_errno (journal_t * journal);
```



## Arguments

*journal*

journal to examine.

## Description

This is the errno numbet set with `journal_abort`, the last time the journal was mounted - if the journal was stopped without calling abort this will be 0.

If the journal has been aborted on this mount time -EROFS will be returned.

# journal\_clear\_err

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`journal_clear_err` — clears the journal's error state

## Synopsis

```
int journal_clear_err (journal_t * journal);
```

## Arguments

*journal*

journal to act on.

## Description

An error must be cleared or Acked to take a FS out of readonly mode.

# journal\_ack\_err

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`journal_ack_err` — Ack journal err.

## Synopsis

```
void journal_ack_err (journal_t * journal);
```

## Arguments

*journal*

journal to act on.

## Description

An error must be cleared or Acked to take a FS out of readonly mode.

# journal\_recover

## LINUX

Kernel Hackers Manual October 2016

### Name

`journal_recover` — recovers a on-disk journal

### Synopsis

```
int journal_recover (journal_t * journal);
```

### Arguments

*journal*

the journal to recover

### Description

The primary function for recovering the log contents when mounting a journaled device.

Recovery is done in three passes. In the first pass, we look for the end of the log. In the second, we assemble the list of revoke blocks. In the third and final pass, we replay any un-revoked blocks in the log.

# journal\_skip\_recovery

## LINUX

## Name

`journal_skip_recovery` — Start journal and wipe exiting records

## Synopsis

```
int journal_skip_recovery (journal_t * journal);
```

## Arguments

*journal*

journal to startup

## Description

Locate any valid recovery information from the journal and set up the journal structures in memory to ignore it (presumably because the caller has evidence that it is out of date). This function does'nt appear to be exorted..

We perform one pass over the journal to allow us to tell the user how much recovery information is being erased, and to let us initialise the journal transaction sequence numbers to the next unused ID.

### 6.3.2. Transasction Level

## `journal_start`

**LINUX**

## Name

`journal_start` — Obtain a new handle.

## Synopsis

```
handle_t * journal_start (journal_t * journal, int nblocks);
```

## Arguments

*journal*

Journal to start transaction on.

*nblocks*

number of block buffer we might modify

## Description

We make sure that the transaction can guarantee at least `nblocks` of modified buffers in the log. We block until the log can guarantee that much space.

This function is visible to journal users (like `ext3fs`), so is not called with the journal already locked.

Return a pointer to a newly allocated handle, or an `ERR_PTR` value on failure.

## `journal_extend`

**LINUX**

## Name

`journal_extend` — extend buffer credits.

## Synopsis

```
int journal_extend (handle_t * handle, int nblocks);
```

## Arguments

*handle*

handle to 'extend'

*nblocks*

nr blocks to try to extend by.

## Description

Some transactions, such as large extends and truncates, can be done atomically all at once or in several stages. The operation requests a credit for a number of buffer modifications in advance, but can extend its credit if it needs more.

`journal_extend` tries to give the running handle more buffer credits. It does not guarantee that allocation - this is a best-effort only. The calling process **MUST** be able to deal cleanly with a failure to extend here.

Return 0 on success, non-zero on failure.

return code < 0 implies an error return code > 0 implies normal transaction-full status.

# journal\_restart

## LINUX

Kernel Hackers Manual October 2016

### Name

`journal_restart` — restart a handle.

### Synopsis

```
int journal_restart (handle_t * handle, int nblocks);
```

### Arguments

*handle*

handle to restart

*nblocks*

nr credits requested

### Description

Restart a handle for a multi-transaction filesystem operation.

If the `journal_extend` call above fails to grant new buffer credits to a running handle, a call to `journal_restart` will commit the handle's transaction so far and reattach the handle to a new transaction capable of guaranteeing the requested number of credits.

# journal\_lock\_updates

**LINUX**

Kernel Hackers Manual October 2016

## Name

`journal_lock_updates` — establish a transaction barrier.

## Synopsis

```
void journal_lock_updates (journal_t * journal);
```

## Arguments

*journal*

Journal to establish a barrier on.

## Description

This locks out any further updates from being started, and blocks until all existing updates have completed, returning only once the journal is in a quiescent state with no updates running.

The journal lock should not be held on entry.

# journal\_unlock\_updates

**LINUX**



## Name

`journal_unlock_updates` — release barrier

## Synopsis

```
void journal_unlock_updates (journal_t * journal);
```

## Arguments

*journal*

Journal to release the barrier on.

## Description

Release a transaction barrier obtained with `journal_lock_updates`.

Should be called without the journal lock held.

# journal\_get\_write\_access

## LINUX

## Name

`journal_get_write_access` — notify intent to modify a buffer for metadata (not data) update.

## Synopsis

```
int journal_get_write_access (handle_t * handle, struct
buffer_head * bh);
```

## Arguments

*handle*

transaction to add buffer modifications to

*bh*

bh to be used for metadata writes

## Description

Returns an error code or 0 on success.

In full data journalling mode the buffer may be of type BJ\_AsyncData, because we're writing a buffer which is also part of a shared mapping.

## journal\_get\_create\_access

### LINUX

Kernel Hackers Manual October 2016

## Name

journal\_get\_create\_access — notify intent to use newly created bh

## Synopsis

```
int journal_get_create_access (handle_t * handle, struct
buffer_head * bh);
```

## Arguments

*handle*

transaction to new buffer to

*bh*

new buffer.

## Description

Call this if you create a new bh.

# journal\_get\_undo\_access

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`journal_get_undo_access` — Notify intent to modify metadata with non-rewindable consequences

## Synopsis

```
int journal_get_undo_access (handle_t * handle, struct
buffer_head * bh);
```

## Arguments

*handle*

transaction

*bh*

buffer to undo

## Description

Sometimes there is a need to distinguish between metadata which has been committed to disk and that which has not. The ext3fs code uses this for freeing and allocating space, we have to make sure that we do not reuse freed space until the deallocation has been committed, since if we overwrote that space we would make the delete un-rewindable in case of a crash.

To deal with that, `journal_get_undo_access` requests write access to a buffer for parts of non-rewindable operations such as delete operations on the bitmaps. The journaling code must keep a copy of the buffer's contents prior to the `undo_access` call until such time as we know that the buffer has definitely been committed to disk.

We never need to know which transaction the committed data is part of, buffers touched here are guaranteed to be dirtied later and so will be committed to a new transaction in due course, at which point we can discard the old committed data pointer.

Returns error number or 0 on success.

## journal\_dirty\_data

**LINUX**

## Name

`journal_dirty_data` — mark a buffer as containing dirty data to be flushed

## Synopsis

```
int journal_dirty_data (handle_t * handle, struct buffer_head  
* bh);
```

## Arguments

*handle*

transaction

*bh*

bufferhead to mark

## Description

Mark a buffer as containing dirty data which needs to be flushed before we can commit the current transaction.

The buffer is placed on the transaction's data list and is marked as belonging to the transaction.

Returns error number or 0 on success.

`journal_dirty_data` can be called via `page_launder->ext3_writepage` by `kswapd`.

# journal\_dirty\_metadata

## LINUX

Kernel Hackers Manual October 2016

### Name

`journal_dirty_metadata` — mark a buffer as containing dirty metadata

### Synopsis

```
int journal_dirty_metadata (handle_t * handle, struct
buffer_head * bh);
```

### Arguments

*handle*

transaction to add buffer to.

*bh*

buffer to mark

### Description

Mark dirty metadata which needs to be journaled as part of the current transaction.

The buffer is placed on the transaction's metadata list and is marked as belonging to the transaction.

Returns error number or 0 on success.

Special care needs to be taken if the buffer already belongs to the current committing transaction (in which case we should have frozen data present for that commit). In that case, we don't relink the

## buffer

that only gets done when the old transaction finally completes its commit.

## journal\_forget

### LINUX

Kernel Hackers Manual October 2016

## Name

`journal_forget` — `bforget` for potentially-journaled buffers.

## Synopsis

```
int journal_forget (handle_t * handle, struct buffer_head *  
bh);
```

## Arguments

*handle*

transaction handle

*bh*

bh to 'forget'

## Description

We can only do the `bforget` if there are no commits pending against the buffer. If the buffer is dirty in the current running transaction we can safely unlink it.

`bh` may not be a journalled buffer at all - it may be a non-JBD buffer which came off the hashtable. Check for this.

Decrements `bh->b_count` by one.

Allow this call even if the handle has aborted --- it may be part of the caller's cleanup after an abort.

## journal\_stop

### LINUX

Kernel Hackers Manual October 2016

### Name

`journal_stop` — complete a transaction

### Synopsis

```
int journal_stop (handle_t * handle);
```

### Arguments

*handle*

transaction to complete.

### Description

All done for a particular handle.

There is not much action needed here. We just return any remaining buffer credits to the transaction and remove the handle. The only complication is that we need to start a commit operation if the filesystem is marked for synchronous update.

`journal_stop` itself will not usually return an error, but it may do so in unusual circumstances. In particular, expect it to return `-EIO` if a `journal_abort` has been executed since the transaction began.



# journal\_force\_commit

## LINUX

Kernel Hackers Manual October 2016

### Name

`journal_force_commit` — force any uncommitted transactions

### Synopsis

```
int journal_force_commit (journal_t * journal);
```

### Arguments

*journal*

journal to force

### For synchronous operations

force any uncommitted transactions to disk. May seem kludgy, but it reuses all the handle batching code in a very simple manner.

# journal\_try\_to\_free\_buffers

## LINUX

## Name

`journal_try_to_free_buffers` — try to free page buffers.

## Synopsis

```
int journal_try_to_free_buffers (journal_t * journal, struct
page * page, gfp_t gfp_mask);
```

## Arguments

*journal*

journal for operation

*page*

to try and free

*gfp\_mask*

we use the mask to detect how hard should we try to release buffers. If `__GFP_WAIT` and `__GFP_FS` is set, we wait for commit code to release the buffers.

## Description

For all the buffers on this page, if they are fully written out ordered data, move them onto `BUF_CLEAN` so `try_to_free_buffers` can reap them.

This function returns non-zero if we wish `try_to_free_buffers` to be called. We do this if the page is releasable by `try_to_free_buffers`. We also do it if the page has locked or dirty buffers and the caller wants us to perform sync or async writeout.

This complicates JBD locking somewhat. We aren't protected by the BKL here. We wish to remove the buffer from its committing or running transaction's `->t_datalist` via `__journal_unfile_buffer`.

This may *\*change\** the value of `transaction_t->t_datalist`, so anyone who looks at `t_datalist` needs to lock against this function.

Even worse, someone may be doing a `journal_dirty_data` on this buffer. So we need to lock against that. `journal_dirty_data` will come out of the lock with the buffer dirty, which makes it ineligible for release here.

Who else is affected by this? hmm... Really the only contender is `do_get_write_access` - it could be looking at the buffer while `journal_try_to_free_buffer` is changing its state. But that cannot happen because we never reallocate freed data as metadata while the data is part of a transaction. Yes?

Return 0 on failure, 1 on success

## journal\_invalidatepage

### LINUX

Kernel Hackers Manual October 2016

### Name

`journal_invalidatepage` — invalidate a journal page

### Synopsis

```
void journal_invalidatepage (journal_t * journal, struct page  
* page, unsigned long offset);
```

### Arguments

*journal*

journal to use for flush

*page*

page to flush

*offset*

length of page to invalidate.

## Description

Reap page buffers containing data after offset in page.

## 6.4. See also

[ Journaling the Linux ext2fs Filesystem, LinuxExpo 98, Stephen Tweedie  
(<ftp://ftp.uk.linux.org/pub/linux/sct/fs/jfs/journal-design.ps.gz>) ]

[ Ext3 Journalling FileSystem, OLS 2000, Dr. Stephen Tweedie  
(<http://olstrans.sourceforge.net/release/OLS2000-ext3/OLS2000-ext3.html>) ]

# Chapter 7. splice API

splice is a method for moving blocks of data around inside the kernel, without continually transferring them between the kernel and user space.

## splice\_to\_pipe

### LINUX

Kernel Hackers ManualOctober 2016

### Name

`splice_to_pipe` — fill passed data into a pipe

### Synopsis

```
ssize_t splice_to_pipe (struct pipe_inode_info * pipe, struct  
splice_pipe_desc * spd);
```

### Arguments

*pipe*

pipe to fill

*spd*

data to fill

### Description

*spd* contains a map of pages and len/offset tuples, along with the struct `pipe_buf_operations` associated with these pages. This function will link that data to the pipe.

# generic\_file\_splice\_read

## LINUX

Kernel Hackers Manual October 2016

## Name

`generic_file_splice_read` — splice data from file to a pipe

## Synopsis

```
ssize_t generic_file_splice_read (struct file * in, loff_t *  
ppos, struct pipe_inode_info * pipe, size_t len, unsigned int  
flags);
```

## Arguments

*in*

file to splice from

*ppos*

position in *in*

*pipe*

pipe to splice to

*len*

number of bytes to splice

*flags*

splice modifier flags

## Description

Will read pages from given file and fill them into a pipe. Can be used as long as the `address_space` operations for the source implements a `readpage` hook.

# splice\_from\_pipe\_feed

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`splice_from_pipe_feed` — feed available data from a pipe to a file

## Synopsis

```
int splice_from_pipe_feed (struct pipe_inode_info * pipe,
struct splice_desc * sd, splice_actor * actor);
```

## Arguments

*pipe*

pipe to splice from

*sd*

information to *actor*

*actor*

handler that splices the data

## Description

This function loops over the pipe and calls *actor* to do the actual moving of a single struct `pipe_buffer` to the desired destination. It returns when there's no more buffers left in the pipe or if the requested number of bytes (`sd->total_len`) have been copied. It returns a positive number (one) if the pipe needs to be filled with more data, zero if the required number of bytes have been copied and `-errno` on error.

This, together with `splice_from_pipe_{begin,end,next}`, may be used to implement the functionality of `__splice_from_pipe` when locking is required around copying the pipe buffers to the destination.

## `splice_from_pipe_next`

### LINUX

Kernel Hackers Manual October 2016

## Name

`splice_from_pipe_next` — wait for some data to splice from

## Synopsis

```
int splice_from_pipe_next (struct pipe_inode_info * pipe,
struct splice_desc * sd);
```

## Arguments

*pipe*

pipe to splice from

*sd*

information about the splice operation



## Description

This function will wait for some data and return a positive value (one) if pipe buffers are available. It will return zero or -errno if no more data needs to be spliced.

# splice\_from\_pipe\_begin

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`splice_from_pipe_begin` — start splicing from pipe

## Synopsis

```
void splice_from_pipe_begin (struct splice_desc * sd);
```

## Arguments

*sd*

information about the splice operation

## Description

This function should be called before a loop containing `splice_from_pipe_next` and `splice_from_pipe_feed` to initialize the necessary fields of *sd*.

# splice\_from\_pipe\_end

## LINUX

Kernel Hackers ManualOctober 2016

### Name

`splice_from_pipe_end` — finish splicing from pipe

### Synopsis

```
void splice_from_pipe_end (struct pipe_inode_info * pipe,  
struct splice_desc * sd);
```

### Arguments

*pipe*

pipe to splice from

*sd*

information about the splice operation

### Description

This function will wake up pipe writers if necessary. It should be called after a loop containing `splice_from_pipe_next` and `splice_from_pipe_feed`.

# \_\_splice\_from\_pipe

## LINUX

## Name

`__splice_from_pipe` — splice data from a pipe to given actor

## Synopsis

```
ssize_t __splice_from_pipe (struct pipe_inode_info * pipe,  
struct splice_desc * sd, splice_actor * actor);
```

## Arguments

*pipe*

pipe to splice from

*sd*

information to *actor*

*actor*

handler that splices the data

## Description

This function does little more than loop over the pipe and call *actor* to do the actual moving of a single struct `pipe_buffer` to the desired destination. See `pipe_to_file`, `pipe_to_sendpage`, or `pipe_to_user`.

# splice\_from\_pipe

**LINUX**

## Name

`splice_from_pipe` — splice data from a pipe to a file

## Synopsis

```
ssize_t splice_from_pipe (struct pipe_inode_info * pipe,  
struct file * out, loff_t * ppos, size_t len, unsigned int  
flags, splice_actor * actor);
```

## Arguments

*pipe*

pipe to splice from

*out*

file to splice to

*ppos*

position in *out*

*len*

how many bytes to splice

*flags*

splice modifier flags

*actor*

handler that splices the data

## Description

See `__splice_from_pipe`. This function locks the pipe inode, otherwise it's identical to `__splice_from_pipe`.

# generic\_file\_splice\_write

## LINUX

Kernel Hackers Manual October 2016

## Name

`generic_file_splice_write` — splice data from a pipe to a file

## Synopsis

```
ssize_t generic_file_splice_write (struct pipe_inode_info *  
pipe, struct file * out, loff_t * ppos, size_t len, unsigned  
int flags);
```

## Arguments

*pipe*

pipe info

*out*

file to write to

*ppos*

position in *out*

*len*

number of bytes to splice

*flags*

splice modifier flags

## Description

Will either move or copy pages (determined by *flags* options) from the given pipe inode to the given file.

# generic\_splice\_sendpage

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`generic_splice_sendpage` — splice data from a pipe to a socket

## Synopsis

```
ssize_t generic_splice_sendpage (struct pipe_inode_info *  
pipe, struct file * out, loff_t * ppos, size_t len, unsigned  
int flags);
```

## Arguments

*pipe*

pipe to splice from

*out*

socket to write to

*ppos*

position in *out*

*len*

number of bytes to splice

*flags*

splice modifier flags

## Description

Will send *len* bytes from the pipe to a network socket. No data copying is involved.

# splice\_direct\_to\_actor

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`splice_direct_to_actor` — splices data directly between two non-pipes

## Synopsis

```
ssize_t splice_direct_to_actor (struct file * in, struct
splice_desc * sd, splice_direct_actor * actor);
```

## Arguments

*in*

file to splice from

*sd*

actor information on where to splice to

*actor*

handles the data splicing

## Description

This is a special case helper to splice directly between two points, without requiring an explicit pipe. Internally an allocated pipe is cached in the process, and reused during the lifetime of that process.

## do\_splice\_direct

### LINUX

Kernel Hackers Manual October 2016

### Name

`do_splice_direct` — splices data directly between two files

### Synopsis

```
long do_splice_direct (struct file * in, loff_t * ppos, struct  
file * out, size_t len, unsigned int flags);
```

### Arguments

*in*

file to splice from

*ppos*

input file offset

*out*

file to splice to

*len*

number of bytes to splice



*flags*

splice modifier flags

## Description

For use by `do_sendfile`. `splice` can easily emulate `sendfile`, but doing it in the application would incur an extra system call (`splice in` + `splice out`, as compared to just `sendfile`). So this helper can `splice` directly through a process-private pipe.



# Chapter 8. pipes API

Pipe interfaces are all for in-kernel (builtin image) use. They are not exported for use by modules.

## struct pipe\_buffer

### LINUX

Kernel Hackers Manual October 2016

### Name

struct pipe\_buffer — a linux kernel pipe buffer

### Synopsis

```
struct pipe_buffer {
    struct page * page;
    unsigned int offset;
    unsigned int len;
    const struct pipe_buf_operations * ops;
    unsigned int flags;
    unsigned long private;
};
```

### Members

page

the page containing the data for the pipe buffer

offset

offset of data inside the *page*

len

length of data inside the *page*

ops

operations associated with this buffer. See *pipe\_buf\_operations*.

flags

pipe buffer flags. See above.

private

private data owned by the ops.

## struct pipe\_inode\_info

### LINUX

Kernel Hackers Manual October 2016

### Name

struct pipe\_inode\_info — a linux kernel pipe

### Synopsis

```
struct pipe_inode_info {
    wait_queue_head_t wait;
    unsigned int nrbufs;
    unsigned int curbuf;
    unsigned int buffers;
    unsigned int readers;
    unsigned int writers;
    unsigned int waiting_writers;
    unsigned int r_counter;
    unsigned int w_counter;
    struct page * tmp_page;
    struct fasync_struct * fasync_readers;
    struct fasync_struct * fasync_writers;
    struct inode * inode;
    struct pipe_buffer * bufs;
#ifdef __GENKSYMS__
    struct user_struct * user;
#endif
}
```

```
};
```

## Members

wait

reader/writer wait point in case of empty/full pipe

nrbufs

the number of non-empty pipe buffers in this pipe

curbuf

the current pipe buffer entry

buffers

total number of buffers (should be a power of 2)

readers

number of current readers of this pipe

writers

number of current writers of this pipe

waiting\_writers

number of writers blocked waiting for room

r\_counter

reader counter

w\_counter

writer counter

tmp\_page

cached released page

fasync\_readers

reader side fasync

fasync\_writers

writer side fasync

*inode*

inode this pipe is attached to

*bufs*

the circular array of pipe buffers

*user*

the user who created this pipe

## generic\_pipe\_buf\_map

### LINUX

Kernel Hackers Manual October 2016

### Name

`generic_pipe_buf_map` — virtually map a pipe buffer

### Synopsis

```
void * generic_pipe_buf_map (struct pipe_inode_info * pipe,  
struct pipe_buffer * buf, int atomic);
```

### Arguments

*pipe*

the pipe that the buffer belongs to

*buf*

the buffer that should be mapped

*atomic*

whether to use an atomic map

## Description

This function returns a kernel virtual address mapping for the `pipe_buffer` passed in *buf*. If *atomic* is set, an atomic map is provided and the caller has to be careful not to fault before calling the unmap function.

Note that this function occupies `KM_USER0` if *atomic* != 0.

# generic\_pipe\_buf\_unmap

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`generic_pipe_buf_unmap` — unmap a previously mapped pipe buffer

## Synopsis

```
void generic_pipe_buf_unmap (struct pipe_inode_info * pipe,
struct pipe_buffer * buf, void * map_data);
```

## Arguments

*pipe*

the pipe that the buffer belongs to

*buf*

the buffer that should be unmapped

*map\_data*

the data that the mapping function returned

## Description

This function undoes the mapping that `->map` provided.

# generic\_pipe\_buf\_steal

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`generic_pipe_buf_steal` — attempt to take ownership of a `pipe_buffer`

## Synopsis

```
int generic_pipe_buf_steal (struct pipe_inode_info * pipe,  
struct pipe_buffer * buf);
```

## Arguments

*pipe*

the pipe that the buffer belongs to

*buf*

the buffer to attempt to steal



## Description

This function attempts to steal the struct page attached to *buf*. If successful, this function returns 0 and returns with the page locked. The caller may then reuse the page for whatever he wishes; the typical use is insertion into a different file page cache.

# generic\_pipe\_buf\_get

## LINUX

Kernel Hackers Manual October 2016

## Name

`generic_pipe_buf_get` — get a reference to a struct `pipe_buffer`

## Synopsis

```
void generic_pipe_buf_get (struct pipe_inode_info * pipe,
struct pipe_buffer * buf);
```

## Arguments

*pipe*

the pipe that the buffer belongs to

*buf*

the buffer to get a reference to

## Description

This function grabs an extra reference to *buf*. It's used in in the `tee` system call, when we duplicate the buffers in one pipe into another.

# generic\_pipe\_buf\_confirm

## LINUX

Kernel Hackers ManualOctober 2016

## Name

`generic_pipe_buf_confirm` — verify contents of the pipe buffer

## Synopsis

```
int generic_pipe_buf_confirm (struct pipe_inode_info * info,  
struct pipe_buffer * buf);
```

## Arguments

*info*

the pipe that the buffer belongs to

*buf*

the buffer to confirm

## Description

This function does nothing, because the generic pipe code uses pages that are always good when inserted into the pipe.

# generic\_pipe\_buf\_release

## LINUX

Kernel Hackers Manual October 2016

### Name

`generic_pipe_buf_release` — put a reference to a struct `pipe_buffer`

### Synopsis

```
void generic_pipe_buf_release (struct pipe_inode_info * pipe,  
struct pipe_buffer * buf);
```

### Arguments

*pipe*

the pipe that the buffer belongs to

*buf*

the buffer to put a reference to

### Description

This function releases a reference to *buf*.

