

The Linux Kernel API

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Table of Contents

1. Data Types	1
1.1. Doubly Linked Lists	1
list_add.....	1
list_add_tail.....	2
__list_del_entry.....	2
list_replace	3
list_del_init	4
list_move.....	5
list_move_tail.....	5
list_is_last	6
list_empty.....	7
list_empty_careful.....	8
list_rotate_left	9
list_is_singular	9
list_cut_position.....	10
list_splice	11
list_splice_tail	12
list_splice_init.....	12
list_splice_tail_init.....	13
list_entry	14
list_first_entry	15
list_last_entry	16
list_first_entry_or_null.....	17
list_next_entry.....	18
list_prev_entry	19
list_for_each.....	19
list_for_each_prev.....	20
list_for_each_safe	21
list_for_each_prev_safe	22
list_for_each_entry	23
list_for_each_entry_reverse	23
list_prepare_entry	24
list_for_each_entry_continue.....	25
list_for_each_entry_continue_reverse	26
list_for_each_entry_from.....	27
list_for_each_entry_safe	28
list_for_each_entry_safe_continue	29
list_for_each_entry_safe_from	30
list_for_each_entry_safe_reverse.....	31
list_safe_reset_next.....	32
hlist_for_each_entry	33

hlist_for_each_entry_continue.....	34
hlist_for_each_entry_from.....	35
hlist_for_each_entry_safe.....	36
2. Basic C Library Functions	39
2.1. String Conversions	39
simple_strtoul	39
simple_strtoul.....	40
simple_strtol.....	41
simple_strtoll	42
vsnprintf	42
vscnprintf	44
snprintf	45
scnprintf	46
vsprintf	47
sprintf	48
vbin_printf.....	49
bstr_printf.....	51
bprintf.....	52
vsscanf.....	53
sscanf.....	54
kstrtol	54
kstrtoul	56
kstrtoull	57
kstrtoll	58
kstrtouint	59
kstrtoint	60
2.2. String Manipulation	61
strnicmp.....	61
strcpy	62
strncpy	63
strlcpy.....	64
strcat.....	65
strncat.....	66
strlcat.....	67
strcmp.....	67
strncmp.....	68
strchr	69
strchrnul	70
strrchr	71
strnchr	71
skip_spaces	72
strim	73
strlen.....	74

strnlen.....	75
strspn.....	75
strcspn.....	76
strpbrk.....	77
strsep.....	78
sysfs_streq.....	79
strtobool.....	80
memset.....	80
memcpy.....	81
memmove.....	82
memcmp.....	83
memscan.....	84
strstr.....	85
strnstr.....	86
memchr.....	87
memchr_inv.....	88
2.3. Bit Operations.....	89
set_bit.....	89
__set_bit.....	90
clear_bit.....	91
__change_bit.....	92
change_bit.....	93
test_and_set_bit.....	94
test_and_set_bit_lock.....	94
__test_and_set_bit.....	95
test_and_clear_bit.....	96
__test_and_clear_bit.....	97
test_and_change_bit.....	98
test_bit.....	99
__ffs.....	100
ffz.....	101
ffs.....	102
fls.....	102
fls64.....	103
3. Basic Kernel Library Functions	105
3.1. Bitmap Operations.....	105
__bitmap_shift_right.....	105
__bitmap_shift_left.....	106
bitmap_scnprintf.....	107
__bitmap_parse.....	108
bitmap_parse_user.....	109
bitmap_scnlistprintf.....	110
bitmap_parselist_user.....	111

bitmap_remap	113
bitmap_bitremap	114
bitmap_onto	115
bitmap_fold	118
bitmap_find_free_region	119
bitmap_release_region	120
bitmap_allocate_region	121
bitmap_copy_le	122
__bitmap_parselist	123
bitmap_pos_to_ord	124
bitmap_ord_to_pos	125
3.2. Command-line Parsing	126
get_option	127
get_options	128
memparse	129
3.3. CRC Functions	130
crc7_be	130
crc16	131
crc_itu_t	132
/usr/src/linux-3.16.3-4.2.gd2bbe7f/lib/crc32.c	132
crc_ccitt	133
3.4. idr/ida Functions	134
idr_preload	134
idr_alloc	135
idr_alloc_cyclic	137
idr_remove	138
idr_destroy	139
idr_for_each	140
idr_get_next	141
idr_replace	142
idr_init	143
ida_pre_get	143
ida_get_new_above	144
ida_remove	145
ida_destroy	146
ida_simple_get	147
ida_simple_remove	148
ida_init	149
4. Memory Management in Linux	151
4.1. The Slab Cache	151
kmalloc	151
kmalloc_array	152
kcalloc	153

kzalloc	154
kzalloc_node	155
kmem_cache_alloc	156
kmem_cache_alloc_node	156
kmem_cache_free	157
kfree	158
ksize	159
kstrdup	160
kstrndup	161
kmemdup	162
memdup_user	162
__krealloc	163
krealloc	164
kzfree	165
get_user_pages_fast	166
4.2. User Space Memory Access	168
__copy_to_user_inatomic	168
__copy_to_user	169
__copy_from_user	170
clear_user	171
__clear_user	172
_copy_to_user	173
_copy_from_user	174
4.3. More Memory Management Functions	176
read_cache_pages	176
page_cache_sync_readahead	177
page_cache_async_readahead	178
delete_from_page_cache	179
filemap_flush	180
filemap_fdatawait_range	181
filemap_fdatawait	182
filemap_write_and_wait_range	183
replace_page_cache_page	184
add_to_page_cache_locked	185
add_page_wait_queue	186
unlock_page	187
end_page_writeback	187
__lock_page	188
page_cache_next_hole	189
page_cache_prev_hole	190
find_get_entry	191
find_lock_entry	192
pagecache_get_page	193

find_get_pages_contig	195
find_get_pages_tag	196
generic_file_read_iter	197
filemap_fault	198
read_cache_page	199
read_cache_page_gfp	200
__generic_file_write_iter	201
generic_file_write_iter	202
try_to_release_page	203
zap_page_range	204
zap_vma_ptes	205
vm_insert_page	206
vm_insert_pfn	207
remap_pfn_range	208
vm_iomap_memory	210
unmap_mapping_range	211
follow_pfn	212
vm_unmap_aliases	213
vm_unmap_ram	214
vm_map_ram	214
unmap_kernel_range_noflush	216
unmap_kernel_range	217
vfree	218
vunmap	219
vmap	219
vmalloc	220
vzalloc	221
vmalloc_user	222
vmalloc_node	223
vzalloc_node	224
vmalloc_32	225
vmalloc_32_user	225
remap_vmalloc_range_partial	226
remap_vmalloc_range	227
alloc_vm_area	228
nr_free_zone_pages	229
nr_free_pagecache_pages	230
find_next_best_node	231
free_bootmem_with_active_regions	232
sparse_memory_present_with_active_regions	233
get_pfn_range_for_nid	234
absent_pages_in_range	235
node_map_pfn_alignment	236

find_min_pfn_with_active_regions.....	237
free_area_init_nodes.....	238
set_dma_reserve.....	239
setup_per_zone_wmarks.....	239
get_pfnblock_flags_mask.....	240
set_pfnblock_flags_mask.....	241
alloc_contig_range.....	242
mempool_destroy.....	244
mempool_create.....	244
mempool_resize.....	246
mempool_alloc.....	247
mempool_free.....	248
dma_pool_create.....	248
dma_pool_destroy.....	250
dma_pool_alloc.....	251
dma_pool_free.....	252
dmam_pool_create.....	253
dmam_pool_destroy.....	254
balance_dirty_pages_ratelimited.....	255
tag_pages_for_writeback.....	255
write_cache_pages.....	257
generic_writepages.....	258
write_one_page.....	259
wait_for_stable_page.....	260
truncate_inode_pages_range.....	261
truncate_inode_pages.....	262
truncate_inode_pages_final.....	263
invalidate_mapping_pages.....	264
invalidate_inode_pages2_range.....	265
invalidate_inode_pages2.....	266
truncate_pagecache.....	267
truncate_setsize.....	268
truncate_pagecache_range.....	269
5. Kernel IPC facilities.....	271
5.1. IPC utilities.....	271
ipc_init.....	271
ipc_init_ids.....	272
ipc_init_proc_interface.....	272
ipc_findkey.....	273
ipc_get_maxid.....	274
ipc_addid.....	275
ipcget_new.....	276
ipc_check_perms.....	277

ipcget_public.....	278
ipc_rmid.....	279
ipc_alloc.....	280
ipc_free.....	281
ipc_rcu_alloc.....	282
ipcperms.....	283
kernel_to_ipc64_perm.....	284
ipc64_perm_to_ipc_perm.....	285
ipc_obtain_object.....	286
ipc_lock.....	286
ipc_obtain_object_check.....	287
ipcget.....	288
ipc_update_perm.....	289
ipcctl_pre_down_nolock.....	290
ipc_parse_version.....	291
6. FIFO Buffer.....	293
6.1. kfifo interface.....	293
DECLARE_KFIFO_PTR.....	293
DECLARE_KFIFO.....	293
INIT_KFIFO.....	294
DEFINE_KFIFO.....	295
kfifo_initialized.....	296
kfifo_esize.....	297
kfifo_recsz.....	297
kfifo_size.....	298
kfifo_reset.....	299
kfifo_reset_out.....	299
kfifo_len.....	300
kfifo_is_empty.....	301
kfifo_is_full.....	302
kfifo_avail.....	302
kfifo_skip.....	303
kfifo_peek_len.....	304
kfifo_alloc.....	304
kfifo_free.....	305
kfifo_init.....	306
kfifo_put.....	307
kfifo_get.....	308
kfifo_peek.....	309
kfifo_in.....	310
kfifo_in_spinlocked.....	311
kfifo_out.....	312
kfifo_out_spinlocked.....	313

kfifo_from_user.....	314
kfifo_to_user	315
kfifo_dma_in_prepare	316
kfifo_dma_in_finish	318
kfifo_dma_out_prepare	318
kfifo_dma_out_finish	320
kfifo_out_peek	320
7. relay interface support	323
7.1. relay interface.....	323
relay_buf_full.....	323
relay_reset.....	323
relay_open.....	324
relay_switch_subbuf	326
relay_subbufs_consumed	327
relay_close	328
relay_flush.....	328
relay_mmap_buf	329
relay_alloc_buf	330
relay_create_buf.....	331
relay_destroy_channel	332
relay_destroy_buf.....	333
relay_remove_buf	333
relay_buf_empty	334
wakeup_readers.....	335
__relay_reset.....	336
relay_close_buf	337
relay_hotcpu_callback	337
relay_late_setup_files.....	338
relay_file_open.....	339
relay_file_mmap	340
relay_file_poll	341
relay_file_release	342
relay_file_read_subbuf_avail	343
relay_file_read_start_pos	344
relay_file_read_end_pos	345
8. Module Support	347
8.1. Module Loading.....	347
__request_module	347
call_usermodehelper_setup.....	348
call_usermodehelper_exec	349
call_usermodehelper	350
8.2. Inter Module support.....	351

9. Hardware Interfaces	353
9.1. Interrupt Handling.....	353
synchronize_hardirq.....	353
synchronize_irq.....	354
irq_set_affinity_notifier.....	354
disable_irq_nosync	355
disable_irq.....	356
enable_irq.....	357
irq_set_irq_wake.....	358
irq_wake_thread.....	359
setup_irq.....	360
remove_irq	361
free_irq.....	361
request_threaded_irq.....	362
request_any_context_irq	364
9.2. DMA Channels	365
request_dma	366
free_dma	366
9.3. Resources Management	367
request_resource_conflict	367
reallocate_resource	368
lookup_resource.....	369
insert_resource_conflict	370
insert_resource	371
insert_resource_expand_to_fit	372
resource_alignment.....	373
release_mem_region_adjustable	374
request_resource	375
release_resource.....	376
allocate_resource.....	376
adjust_resource	378
__request_region.....	379
__check_region	380
__release_region	381
9.4. MTRR Handling	382
mtrr_add.....	382
mtrr_del.....	383
arch_phys_wc_add.....	384
9.5. PCI Support Library.....	385
pci_bus_max_busnr	386
pci_find_capability.....	386
pci_bus_find_capability	387
pci_find_next_ext_capability	388

pci_find_ext_capability	389
pci_find_next_ht_capability	390
pci_find_ht_capability	391
pci_find_parent_resource	392
__pci_complete_power_transition	393
pci_set_power_state	394
pci_choose_state	395
pci_save_state	396
pci_restore_state	397
pci_store_saved_state	398
pci_load_and_free_saved_state	398
pci_reenable_device	399
pci_enable_device_io	400
pci_enable_device_mem	401
pci_enable_device	402
pcim_enable_device	402
pcim_pin_device	403
pci_disable_device	404
pci_set_pcie_reset_state	405
pci_pme_capable	406
pci_pme_active	406
__pci_enable_wake	407
pci_wake_from_d3	409
pci_prepare_to_sleep	410
pci_back_from_sleep	411
pci_dev_run_wake	411
pci_release_region	412
pci_request_region	413
pci_request_region_exclusive	414
pci_release_selected_regions	415
pci_request_selected_regions	416
pci_release_regions	417
pci_request_regions	418
pci_request_regions_exclusive	419
pci_set_master	420
pci_clear_master	421
pci_set_cacheline_size	421
pci_set_mwi	422
pci_try_set_mwi	423
pci_clear_mwi	424
pci_intx	425
pci_intx_mask_supported	426
pci_check_and_mask_intx	427

pci_check_and_unmask_intx	428
pci_msi_off	428
pci_wait_for_pending_transaction	429
pci_reset_bridge_secondary_bus	430
__pci_reset_function	431
__pci_reset_function_locked	432
pci_reset_function	433
pci_try_reset_function	434
pci_probe_reset_slot	435
pci_reset_slot	436
pci_try_reset_slot	436
pci_probe_reset_bus	437
pci_reset_bus	438
pci_try_reset_bus	439
pcix_get_max_mmrbc	440
pcix_get_mmrbc	440
pcix_set_mmrbc	441
pcie_get_readrq	442
pcie_set_readrq	443
pcie_get_mps	444
pcie_set_mps	444
pcie_get_minimum_link	445
pci_selectBars	446
pci_add_dynid	447
pci_match_id	449
__pci_register_driver	450
pci_unregister_driver	451
pci_dev_driver	451
pci_dev_get	452
pci_dev_put	453
pci_stop_and_remove_bus_device	454
pci_find_bus	455
pci_find_next_bus	456
pci_get_slot	457
pci_get_domain_bus_and_slot	458
pci_get_subsys	459
pci_get_device	460
pci_get_class	461
pci_dev_present	462
pci_msi_vec_count	463
pci_msix_vec_count	464
pci_enable_msix	464
pci_msi_enabled	466

pci_enable_msi_range.....	466
pci_enable_msix_range.....	467
pci_bus_alloc_resource.....	469
pci_bus_add_device.....	470
pci_bus_add_devices.....	471
pci_bus_set_ops.....	472
pci_read_vpd.....	472
pci_write_vpd.....	473
pci_cfg_access_lock.....	474
pci_cfg_access_trylock.....	475
pci_cfg_access_unlock.....	476
pci_lost_interrupt.....	477
__ht_create_irq.....	478
ht_create_irq.....	479
ht_destroy_irq.....	480
pci_scan_slot.....	480
pci_rescan_bus.....	481
pci_create_slot.....	482
pci_destroy_slot.....	484
pci_hp_create_module_link.....	485
pci_hp_remove_module_link.....	486
pci_enable_rom.....	486
pci_disable_rom.....	487
pci_map_rom.....	488
pci_unmap_rom.....	489
pci_platform_rom.....	490
pci_enable_sriov.....	491
pci_disable_sriov.....	492
pci_num_vf.....	492
pci_vfs_assigned.....	493
pci_sriov_set_totalvfs.....	494
pci_sriov_get_totalvfs.....	495
pci_read_legacy_io.....	496
pci_write_legacy_io.....	497
pci_mmap_legacy_mem.....	498
pci_mmap_legacy_io.....	499
pci_adjust_legacy_attr.....	500
pci_create_legacy_files.....	501
pci_mmap_resource.....	502
pci_remove_resource_files.....	503
pci_create_resource_files.....	504
pci_write_rom.....	505
pci_read_rom.....	506

pci_remove_sysfs_dev_files	507
9.6. PCI Hotplug Support Library.....	508
__pci_hp_register.....	508
pci_hp_deregister	509
pci_hp_change_slot_info	510
10. Firmware Interfaces	513
10.1. DMI Interfaces	513
dmi_check_system.....	513
dmi_first_match	514
dmi_get_system_info	514
dmi_name_in_vendors	515
dmi_find_device.....	516
dmi_get_date.....	517
dmi_walk.....	518
dmi_match.....	519
10.2. EDD Interfaces.....	520
edd_show_raw_data.....	520
edd_release.....	521
edd_dev_is_type	522
edd_get_pci_dev	523
edd_init	523
11. Security Framework	525
security_init.....	525
security_module_enable	525
register_security	526
securityfs_create_file	527
securityfs_create_dir.....	529
securityfs_remove	530
12. Audit Interfaces.....	533
audit_log_start.....	533
audit_log_format.....	534
audit_log_end.....	535
audit_log	535
audit_log_secctx	537
audit_alloc.....	538
__audit_free	538
__audit_syscall_entry	539
__audit_syscall_exit.....	540
__audit_reusename	541
__audit_getname	542
__audit_inode.....	543
auditsc_get_stamp.....	544

audit_set_loginuid.....	545
__audit_mq_open.....	546
__audit_mq_sendrecv	546
__audit_mq_notify	547
__audit_mq_getsetattr.....	548
__audit_ipc_obj.....	549
__audit_ipc_set_perm.....	550
__audit_socketcall.....	551
__audit_fd_pair.....	551
__audit_sockaddr	552
__audit_signal_info.....	553
__audit_log_bprm_fcaps.....	554
__audit_log_capset	555
audit_core_dumps.....	556
audit_rule_change.....	557
audit_list_rules_send.....	558
parent_len.....	558
audit_compare_dname_path	559
13. Accounting Framework.....	561
sys_acct.....	561
acct_auto_close_mnt.....	561
acct_auto_close	562
acct_collect	563
acct_process	564
14. Block Devices.....	567
blk_get_backing_dev_info.....	567
blk_delay_queue	567
blk_start_queue	568
blk_stop_queue	569
blk_sync_queue.....	570
__blk_run_queue.....	571
blk_run_queue_async	572
blk_run_queue.....	573
blk_queue_bypass_start	573
blk_queue_bypass_end	574
blk_cleanup_queue	575
blk_init_queue.....	576
blk_make_request	577
blk_rq_set_block_pc.....	579
blk_requeue_request	579
part_round_stats.....	580
blk_add_request_payload	581

generic_make_request.....	582
submit_bio	583
blk_rq_check_limits.....	584
blk_insert_cloned_request	585
blk_rq_err_bytes	586
blk_peek_request	587
blk_start_request.....	588
blk_fetch_request.....	589
blk_update_request	590
blk_unprep_request.....	591
blk_end_request	592
blk_end_request_all	593
blk_end_request_cur.....	594
blk_end_request_err.....	595
__blk_end_request	596
__blk_end_request_all	597
__blk_end_request_cur.....	598
__blk_end_request_err.....	599
rq_flush_dcache_pages	600
blk_lld_busy.....	601
blk_rq_unprep_clone	602
blk_rq_prep_clone	603
blk_start_plug	604
blk_pm_runtime_init	605
blk_pre_runtime_suspend.....	606
blk_post_runtime_suspend	608
blk_pre_runtime_resume	609
blk_post_runtime_resume.....	609
__blk_run_queue_uncond.....	610
__blk_drain_queue.....	611
rq_ioc	612
__get_request	613
get_request	614
blk_attempt_plug_merge	615
blk_end_bidi_request.....	616
__blk_end_bidi_request.....	617
blk_rq_map_user.....	619
blk_rq_map_user_iov	620
blk_rq_unmap_user.....	621
blk_rq_map_kern	622
blk_release_queue.....	623
blk_queue_prep_rq	624
blk_queue_unprep_rq	625

blk_queue_merge_bvec	626
blk_set_default_limits.....	627
blk_set_stacking_limits	628
blk_queue_make_request.....	629
blk_queue_bounce_limit.....	630
blk_limits_max_hw_sectors	631
blk_queue_max_hw_sectors	632
blk_queue_chunk_sectors	633
blk_queue_max_discard_sectors	634
blk_queue_max_write_same_sectors	635
blk_queue_max_segments	636
blk_queue_max_segment_size	636
blk_queue_logical_block_size	637
blk_queue_physical_block_size	638
blk_queue_alignment_offset.....	639
blk_limits_io_min.....	640
blk_queue_io_min.....	641
blk_limits_io_opt.....	642
blk_queue_io_opt.....	643
blk_queue_stack_limits.....	644
blk_stack_limits	645
bdev_stack_limits	646
disk_stack_limits	647
blk_queue_dma_pad	648
blk_queue_update_dma_pad.....	649
blk_queue_dma_drain.....	650
blk_queue_segment_boundary	652
blk_queue_dma_alignment.....	652
blk_queue_update_dma_alignment	653
blk_queue_flush	654
blk_execute_rq_nowait	655
blk_execute_rq.....	657
blkdev_issue_flush.....	658
blkdev_issue_discard	659
blkdev_issue_write_same	660
blkdev_issue_zeroout.....	661
blk_queue_find_tag.....	662
blk_free_tags.....	663
blk_queue_free_tags	664
blk_init_tags.....	664
blk_queue_init_tags	665
blk_queue_resize_tags	666
blk_queue_end_tag	667

blk_queue_start_tag	668
blk_queue_invalidate_tags	669
__blk_queue_free_tags	670
blk_rq_count_integrity_sg	671
blk_rq_map_integrity_sg	672
blk_integrity_compare	673
blk_integrity_register	674
blk_integrity_unregister	675
blk_trace_ioctl	676
blk_trace_shutdown	677
blk_add_trace_rq	677
blk_add_trace_bio	678
blk_add_trace_bio_remap	679
blk_add_trace_rq_remap	680
blk_mangle_minor	682
blk_alloc_devt	683
blk_free_devt	684
disk_replace_part_tbl	685
disk_expand_part_tbl	685
disk_block_events	687
disk_unblock_events	688
disk_flush_events	688
disk_clear_events	689
disk_get_part	690
disk_part_iter_init	692
disk_part_iter_next	693
disk_part_iter_exit	694
disk_map_sector_rcu	694
register_blkdev	696
add_disk	697
get_gendisk	698
bdget_disk	698
15. Char devices	701
register_chrdev_region	701
alloc_chrdev_region	702
__register_chrdev	703
unregister_chrdev_region	704
__unregister_chrdev	705
cdev_add	706
cdev_del	707
cdev_alloc	708
cdev_init	709

16. Miscellaneous Devices.....	711
misc_register	711
misc_deregister	711
17. Clock Framework	713
struct clk_notifier	713
struct clk_notifier_data.....	714
clk_notifier_register	715
clk_notifier_unregister	716
clk_get_accuracy.....	717
clk_prepare.....	718
clk_unprepare.....	718
clk_get.....	719
devm_clk_get.....	720
clk_enable	721
clk_disable	722
clk_get_rate.....	723
clk_put.....	724
devm_clk_put.....	725
clk_round_rate	726
clk_set_rate	727
clk_set_parent	727
clk_get_parent.....	728
clk_get_sys.....	729
clk_add_alias.....	730

Chapter 1. Data Types

1.1. Doubly Linked Lists

list_add

LINUX

Kernel Hackers ManualSeptember 2014

Name

`list_add` — add a new entry

Synopsis

```
void list_add (struct list_head * new, struct list_head *  
head);
```

Arguments

new

new entry to be added

head

list head to add it after

Description

Insert a new entry after the specified head. This is good for implementing stacks.

list_add_tail

LINUX

Kernel Hackers ManualSeptember 2014

Name

`list_add_tail` — add a new entry

Synopsis

```
void list_add_tail (struct list_head * new, struct list_head *  
head);
```

Arguments

new

new entry to be added

head

list head to add it before

Description

Insert a new entry before the specified head. This is useful for implementing queues.

__list_del_entry

LINUX

Name

`__list_del_entry` — deletes entry from list.

Synopsis

```
void __list_del_entry (struct list_head * entry);
```

Arguments

entry

the element to delete from the list.

Note

`list_empty` on `entry` does not return true after this, the entry is in an undefined state.

list_replace

LINUX

Name

`list_replace` — replace old entry by new one

Synopsis

```
void list_replace (struct list_head * old, struct list_head *  
new);
```

Arguments

old

the element to be replaced

new

the new element to insert

Description

If *old* was empty, it will be overwritten.

list_del_init

LINUX

Kernel Hackers ManualSeptember 2014

Name

`list_del_init` — deletes entry from list and reinitialize it.

Synopsis

```
void list_del_init (struct list_head * entry);
```

Arguments

entry

the element to delete from the list.

list_move

LINUX

Kernel Hackers ManualSeptember 2014

Name

`list_move` — delete from one list and add as another's head

Synopsis

```
void list_move (struct list_head * list, struct list_head *  
head);
```

Arguments

list

the entry to move

head

the head that will precede our entry

list_move_tail

LINUX

Kernel Hackers ManualSeptember 2014

Name

`list_move_tail` — delete from one list and add as another's tail

Synopsis

```
void list_move_tail (struct list_head * list, struct list_head  
* head);
```

Arguments

list

the entry to move

head

the head that will follow our entry

list_is_last

LINUX

Kernel Hackers ManualSeptember 2014

Name

`list_is_last` — tests whether *list* is the last entry in list *head*

Synopsis

```
int list_is_last (const struct list_head * list, const struct  
list_head * head);
```

Arguments

list

the entry to test

head

the head of the list

list_empty

LINUX

Kernel Hackers ManualSeptember 2014

Name

`list_empty` — tests whether a list is empty

Synopsis

```
int list_empty (const struct list_head * head);
```

Arguments

head

the list to test.

list_empty_careful

LINUX

Kernel Hackers ManualSeptember 2014

Name

`list_empty_careful` — tests whether a list is empty and not being modified

Synopsis

```
int list_empty_careful (const struct list_head * head);
```

Arguments

head

the list to test

Description

tests whether a list is empty _and_ checks that no other CPU might be in the process of modifying either member (next or prev)

NOTE

using `list_empty_careful` without synchronization can only be safe if the only activity that can happen to the list entry is `list_del_init`. Eg. it cannot be used if another CPU could `re-list_add` it.

list_rotate_left

LINUX

Kernel Hackers Manual September 2014

Name

`list_rotate_left` — rotate the list to the left

Synopsis

```
void list_rotate_left (struct list_head * head);
```

Arguments

head

the head of the list

list_is_singular

LINUX

Name

`list_is_singular` — tests whether a list has just one entry.

Synopsis

```
int list_is_singular (const struct list_head * head);
```

Arguments

head

the list to test.

list_cut_position

LINUX

Name

`list_cut_position` — cut a list into two

Synopsis

```
void list_cut_position (struct list_head * list, struct  
list_head * head, struct list_head * entry);
```


Arguments

list

a new list to add all removed entries

head

a list with entries

entry

an entry within head, could be the head itself and if so we won't cut the list

Description

This helper moves the initial part of *head*, up to and including *entry*, from *head* to *list*. You should pass on *entry* an element you know is on *head*. *list* should be an empty list or a list you do not care about losing its data.

list_splice

LINUX

Kernel Hackers Manual September 2014

Name

`list_splice` — join two lists, this is designed for stacks

Synopsis

```
void list_splice (const struct list_head * list, struct
list_head * head);
```

Arguments

list

the new list to add.

head

the place to add it in the first list.

list_splice_tail

LINUX

Kernel Hackers ManualSeptember 2014

Name

`list_splice_tail` — join two lists, each list being a queue

Synopsis

```
void list_splice_tail (struct list_head * list, struct  
list_head * head);
```

Arguments

list

the new list to add.

head

the place to add it in the first list.

list_splice_init

LINUX

Kernel Hackers ManualSeptember 2014

Name

`list_splice_init` — join two lists and reinitialise the emptied list.

Synopsis

```
void list_splice_init (struct list_head * list, struct  
list_head * head);
```

Arguments

list

the new list to add.

head

the place to add it in the first list.

Description

The list at *list* is reinitialised

list_splice_tail_init

LINUX

Name

`list_splice_tail_init` — join two lists and reinitialise the emptied list

Synopsis

```
void list_splice_tail_init (struct list_head * list, struct  
list_head * head);
```

Arguments

list

the new list to add.

head

the place to add it in the first list.

Description

Each of the lists is a queue. The list at *list* is reinitialised

list_entry

LINUX

Name

`list_entry` — get the struct for this entry

Synopsis

```
list_entry ( ptr,  type,  member);
```

Arguments

ptr

the struct list_head pointer.

type

the type of the struct this is embedded in.

member

the name of the list_struct within the struct.

list_first_entry

LINUX

Kernel Hackers ManualSeptember 2014

Name

list_first_entry — get the first element from a list

Synopsis

```
list_first_entry ( ptr,  type,  member);
```

Arguments

ptr

the list head to take the element from.

type

the type of the struct this is embedded in.

member

the name of the list_struct within the struct.

Description

Note, that list is expected to be not empty.

list_last_entry

LINUX

Kernel Hackers ManualSeptember 2014

Name

`list_last_entry` — get the last element from a list

Synopsis

```
list_last_entry ( ptr,  type,  member);
```

Arguments

ptr

the list head to take the element from.

type

the type of the struct this is embedded in.

member

the name of the list_struct within the struct.

Description

Note, that list is expected to be not empty.

list_first_entry_or_null

LINUX

Kernel Hackers ManualSeptember 2014

Name

`list_first_entry_or_null` — get the first element from a list

Synopsis

```
list_first_entry_or_null ( ptr,  type,  member);
```

Arguments

ptr

the list head to take the element from.

type

the type of the struct this is embedded in.

member

the name of the list_struct within the struct.

Description

Note that if the list is empty, it returns NULL.

list_next_entry

LINUX

Kernel Hackers ManualSeptember 2014

Name

`list_next_entry` — get the next element in list

Synopsis

```
list_next_entry ( pos, member );
```


Arguments

pos

the type * to cursor

member

the name of the list_struct within the struct.

list_prev_entry

LINUX

Kernel Hackers ManualSeptember 2014

Name

list_prev_entry — get the prev element in list

Synopsis

```
list_prev_entry ( pos, member );
```

Arguments

pos

the type * to cursor

member

the name of the list_struct within the struct.

list_for_each

LINUX

Kernel Hackers ManualSeptember 2014

Name

`list_for_each` — iterate over a list

Synopsis

```
list_for_each ( pos, head );
```

Arguments

pos

the struct `list_head` to use as a loop cursor.

head

the head for your list.

list_for_each_prev

LINUX

Kernel Hackers ManualSeptember 2014

Name

`list_for_each_prev` — iterate over a list backwards

Synopsis

```
list_for_each_prev ( pos, head );
```

Arguments

pos

the struct list_head to use as a loop cursor.

head

the head for your list.

list_for_each_safe

LINUX

Kernel Hackers Manual September 2014

Name

list_for_each_safe — iterate over a list safe against removal of list entry

Synopsis

```
list_for_each_safe ( pos, n, head );
```

Arguments

pos

the struct `list_head` to use as a loop cursor.

n

another struct `list_head` to use as temporary storage

head

the head for your list.

list_for_each_prev_safe

LINUX

Kernel Hackers ManualSeptember 2014

Name

`list_for_each_prev_safe` — iterate over a list backwards safe against removal of list entry

Synopsis

```
list_for_each_prev_safe ( pos, n, head );
```

Arguments

pos

the struct `list_head` to use as a loop cursor.

n

another struct list_head to use as temporary storage

head

the head for your list.

list_for_each_entry

LINUX

Kernel Hackers ManualSeptember 2014

Name

list_for_each_entry — iterate over list of given type

Synopsis

```
list_for_each_entry ( pos, head, member );
```

Arguments

pos

the type * to use as a loop cursor.

head

the head for your list.

member

the name of the list_struct within the struct.

list_for_each_entry_reverse

LINUX

Kernel Hackers Manual September 2014

Name

`list_for_each_entry_reverse` — iterate backwards over list of given type.

Synopsis

```
list_for_each_entry_reverse ( pos, head, member );
```

Arguments

pos

the type * to use as a loop cursor.

head

the head for your list.

member

the name of the `list_struct` within the struct.

list_prepare_entry

LINUX

Name

`list_prepare_entry` — prepare a pos entry for use in
`list_for_each_entry_continue`

Synopsis

```
list_prepare_entry ( pos,  head,  member );
```

Arguments

pos

the type * to use as a start point

head

the head of the list

member

the name of the list_struct within the struct.

Description

Prepares a pos entry for use as a start point in `list_for_each_entry_continue`.

list_for_each_entry_continue

LINUX

Name

`list_for_each_entry_continue` — continue iteration over list of given type

Synopsis

```
list_for_each_entry_continue ( pos, head, member );
```

Arguments

pos

the type * to use as a loop cursor.

head

the head for your list.

member

the name of the list_struct within the struct.

Description

Continue to iterate over list of given type, continuing after the current position.

`list_for_each_entry_continue_reverse`

LINUX

Name

`list_for_each_entry_continue_reverse` — iterate backwards from the given point

Synopsis

```
list_for_each_entry_continue_reverse ( pos, head, member );
```

Arguments

pos

the type * to use as a loop cursor.

head

the head for your list.

member

the name of the list_struct within the struct.

Description

Start to iterate over list of given type backwards, continuing after the current position.

`list_for_each_entry_from`

LINUX

Name

`list_for_each_entry_from` — iterate over list of given type from the current point

Synopsis

```
list_for_each_entry_from ( pos, head, member );
```

Arguments

pos

the type * to use as a loop cursor.

head

the head for your list.

member

the name of the list_struct within the struct.

Description

Iterate over list of given type, continuing from current position.

`list_for_each_entry_safe`

LINUX

Name

`list_for_each_entry_safe` — iterate over list of given type safe against removal of list entry

Synopsis

```
list_for_each_entry_safe ( pos, n, head, member );
```

Arguments

pos

the type * to use as a loop cursor.

n

another type * to use as temporary storage

head

the head for your list.

member

the name of the list_struct within the struct.

`list_for_each_entry_safe_continue`

LINUX

Name

`list_for_each_entry_safe_continue` — continue list iteration safe against removal

Synopsis

```
list_for_each_entry_safe_continue ( pos,  n,  head,  member );
```

Arguments

pos

the type * to use as a loop cursor.

n

another type * to use as temporary storage

head

the head for your list.

member

the name of the list_struct within the struct.

Description

Iterate over list of given type, continuing after current point, safe against removal of list entry.

list_for_each_entry_safe_from

LINUX

Kernel Hackers Manual September 2014

Name

`list_for_each_entry_safe_from` — iterate over list from current point safe against removal

Synopsis

```
list_for_each_entry_safe_from ( pos,  n,  head,  member );
```

Arguments

pos

the type * to use as a loop cursor.

n

another type * to use as temporary storage

head

the head for your list.

member

the name of the list_struct within the struct.

Description

Iterate over list of given type from current point, safe against removal of list entry.

list_for_each_entry_safe_reverse

LINUX

Kernel Hackers ManualSeptember 2014

Name

`list_for_each_entry_safe_reverse` — iterate backwards over list safe against removal

Synopsis

```
list_for_each_entry_safe_reverse ( pos,  n,  head,  member );
```

Arguments

pos

the type * to use as a loop cursor.

n

another type * to use as temporary storage

head

the head for your list.

member

the name of the list_struct within the struct.

Description

Iterate backwards over list of given type, safe against removal of list entry.

list_safe_reset_next

LINUX

Kernel Hackers Manual September 2014

Name

`list_safe_reset_next` — reset a stale `list_for_each_entry_safe` loop

Synopsis

```
list_safe_reset_next ( pos, n, member );
```

Arguments

pos

the loop cursor used in the `list_for_each_entry_safe` loop

n

temporary storage used in `list_for_each_entry_safe`

member

the name of the `list_struct` within the struct.

Description

`list_safe_reset_next` is not safe to use in general if the list may be modified concurrently (eg. the lock is dropped in the loop body). An exception to this is if the cursor element (`pos`) is pinned in the list, and `list_safe_reset_next` is called after re-taking the lock and before completing the current iteration of the loop body.

hlist_for_each_entry

LINUX

Kernel Hackers ManualSeptember 2014

Name

`hlist_for_each_entry` — iterate over list of given type

Synopsis

```
hlist_for_each_entry ( pos, head, member );
```

Arguments

pos

the type `*` to use as a loop cursor.

head

the head for your list.

member

the name of the `hlist_node` within the struct.

hlist_for_each_entry_continue

LINUX

Name

`hlist_for_each_entry_continue` — iterate over a hlist continuing after current point

Synopsis

```
hlist_for_each_entry_continue ( pos, member );
```

Arguments

pos

the type * to use as a loop cursor.

member

the name of the hlist_node within the struct.

hlist_for_each_entry_from

LINUX

Name

`hlist_for_each_entry_from` — iterate over a hlist continuing from current point

Synopsis

```
hlist_for_each_entry_from ( pos, member );
```

Arguments

pos

the type * to use as a loop cursor.

member

the name of the hlist_node within the struct.

hlist_for_each_entry_safe

LINUX

Kernel Hackers ManualSeptember 2014

Name

hlist_for_each_entry_safe — iterate over list of given type safe against removal of list entry

Synopsis

```
hlist_for_each_entry_safe ( pos, n, head, member );
```

Arguments

pos

the type * to use as a loop cursor.

n

another struct hlist_node to use as temporary storage

head

the head for your list.

member

the name of the hlist_node within the struct.

Chapter 2. Basic C Library Functions

When writing drivers, you cannot in general use routines which are from the C Library. Some of the functions have been found generally useful and they are listed below. The behaviour of these functions may vary slightly from those defined by ANSI, and these deviations are noted in the text.

2.1. String Conversions

simple_strtoul

LINUX

Kernel Hackers Manual September 2014

Name

`simple_strtoul` — convert a string to an unsigned long long

Synopsis

```
unsigned long long simple_strtoul (const char * cp, char **  
endp, unsigned int base);
```

Arguments

cp

The start of the string

endp

A pointer to the end of the parsed string will be placed here

base

The number base to use

Description

This function is obsolete. Please use `kstrtoull` instead.

simple_strtoul

LINUX

Kernel Hackers ManualSeptember 2014

Name

`simple_strtoul` — convert a string to an unsigned long

Synopsis

```
unsigned long simple_strtoul (const char * cp, char ** endp,  
unsigned int base);
```

Arguments

cp

The start of the string

endp

A pointer to the end of the parsed string will be placed here

base

The number base to use

Description

This function is obsolete. Please use `kstrtol` instead.

simple_strtol

LINUX

Kernel Hackers ManualSeptember 2014

Name

`simple_strtol` — convert a string to a signed long

Synopsis

```
long simple_strtol (const char * cp, char ** endp, unsigned  
int base);
```

Arguments

cp

The start of the string

endp

A pointer to the end of the parsed string will be placed here

base

The number base to use

Description

This function is obsolete. Please use `kstrtol` instead.

simple_strtoll

LINUX

Kernel Hackers ManualSeptember 2014

Name

`simple_strtoll` — convert a string to a signed long long

Synopsis

```
long long simple_strtoll (const char * cp, char ** endp,  
unsigned int base);
```

Arguments

cp

The start of the string

endp

A pointer to the end of the parsed string will be placed here

base

The number base to use

Description

This function is obsolete. Please use `kstrtoll` instead.

vsnprintf

LINUX

Kernel Hackers Manual September 2014

Name

`vsnprintf` — Format a string and place it in a buffer

Synopsis

```
int vsnprintf (char * buf, size_t size, const char * fmt,
va_list args);
```

Arguments

buf

The buffer to place the result into

size

The size of the buffer, including the trailing null space

fmt

The format string to use

args

Arguments for the format string

Description

This function follows C99 `vsnprintf`, but has some extensions: `pS` output the name of a text symbol with offset `pS` output the name of a text symbol without offset `pF` output the name of a function pointer with its offset `pf` output the name of a function pointer without its offset `pB` output the name of a backtrace symbol with its offset `pR` output the address range in a struct resource with decoded flags `pr` output

the address range in a struct resource with raw flags `pM` output a 6-byte MAC address with colons `pMR` output a 6-byte MAC address with colons in reversed order `pMF` output a 6-byte MAC address with dashes `pm` output a 6-byte MAC address without colons `pmR` output a 6-byte MAC address without colons in reversed order `pI4` print an IPv4 address without leading zeros `pi4` print an IPv4 address with leading zeros `pI6` print an IPv6 address with colons `pi6` print an IPv6 address without colons `pI6c` print an IPv6 address as specified by RFC 5952 `pIS` depending on `sa_family` of 'struct sockaddr *' print IPv4/IPv6 address `piS` depending on `sa_family` of 'struct sockaddr *' print IPv4/IPv6 address `pU[bBIL]` print a UUID/GUID in big or little endian using lower or upper case. `%*ph[CDN]` a variable-length hex string with a separator (supports up to 64 bytes of the input) `n` is ignored

**** Please update Documentation/printk-formats.txt when making changes ****

The return value is the number of characters which would be generated for the given input, excluding the trailing `'\0'`, as per ISO C99. If you want to have the exact number of characters written into `buf` as return value (not including the trailing `'\0'`), use `vsnprintf`. If the return is greater than or equal to `size`, the resulting string is truncated.

If you're not already dealing with a `va_list` consider using `snprintf`.

vsnprintf

LINUX

Kernel Hackers Manual September 2014

Name

`vsnprintf` — Format a string and place it in a buffer

Synopsis

```
int vsnprintf (char * buf, size_t size, const char * fmt,
va_list args);
```

Arguments

buf

The buffer to place the result into

size

The size of the buffer, including the trailing null space

fmt

The format string to use

args

Arguments for the format string

Description

The return value is the number of characters which have been written into the *buf* not including the trailing `'\0'`. If *size* is `== 0` the function returns 0.

If you're not already dealing with a `va_list` consider using `snprintf`.

See the `vsnprintf` documentation for format string extensions over C99.

snprintf

LINUX

Kernel Hackers Manual September 2014

Name

`snprintf` — Format a string and place it in a buffer

Synopsis

```
int snprintf (char * buf, size_t size, const char * fmt,  
...);
```

Arguments

buf

The buffer to place the result into

size

The size of the buffer, including the trailing null space

fmt

The format string to use @...: Arguments for the format string

...

variable arguments

Description

The return value is the number of characters which would be generated for the given input, excluding the trailing null, as per ISO C99. If the return is greater than or equal to *size*, the resulting string is truncated.

See the `vsnprintf` documentation for format string extensions over C99.

scanf

LINUX

Name

`scnprintf` — Format a string and place it in a buffer

Synopsis

```
int scnprintf (char * buf, size_t size, const char * fmt,  
...);
```

Arguments

buf

The buffer to place the result into

size

The size of the buffer, including the trailing null space

fmt

The format string to use @...: Arguments for the format string

...

variable arguments

Description

The return value is the number of characters written into *buf* not including the trailing `'\0'`. If *size* is `== 0` the function returns 0.

vsprintf

LINUX

Kernel Hackers Manual September 2014

Name

`vsprintf` — Format a string and place it in a buffer

Synopsis

```
int vsprintf (char * buf, const char * fmt, va_list args);
```

Arguments

buf

The buffer to place the result into

fmt

The format string to use

args

Arguments for the format string

Description

The function returns the number of characters written into *buf*. Use `vsnprintf` or `vsnprintf` in order to avoid buffer overflows.

If you're not already dealing with a `va_list` consider using `sprintf`.

See the `vsnprintf` documentation for format string extensions over C99.

sprintf

LINUX

Kernel Hackers Manual September 2014

Name

`sprintf` — Format a string and place it in a buffer

Synopsis

```
int sprintf (char * buf, const char * fmt, ...);
```

Arguments

buf

The buffer to place the result into

fmt

The format string to use @...: Arguments for the format string

...

variable arguments

Description

The function returns the number of characters written into *buf*. Use `snprintf` or `scnprintf` in order to avoid buffer overflows.

See the `vsnprintf` documentation for format string extensions over C99.

vbin_printf

LINUX

Kernel Hackers Manual September 2014

Name

`vbin_printf` — Parse a format string and place args' binary value in a buffer

Synopsis

```
int vbin_printf (u32 * bin_buf, size_t size, const char * fmt,  
va_list args);
```

Arguments

bin_buf

The buffer to place args' binary value

size

The size of the buffer(by words(32bits), not characters)

fmt

The format string to use

args

Arguments for the format string

Description

The format follows C99 `vsnprintf`, except `n` is ignored, and its argument is skipped.

The return value is the number of words(32bits) which would be generated for the given input.

NOTE

If the return value is greater than *size*, the resulting *bin_buf* is NOT valid for *bstr_printf*.

bstr_printf

LINUX

Kernel Hackers Manual September 2014

Name

bstr_printf — Format a string from binary arguments and place it in a buffer

Synopsis

```
int bstr_printf (char * buf, size_t size, const char * fmt,
const u32 * bin_buf);
```

Arguments

buf

The buffer to place the result into

size

The size of the buffer, including the trailing null space

fmt

The format string to use

bin_buf

Binary arguments for the format string

Description

This function like C99 `vsnprintf`, but the difference is that `vsnprintf` gets arguments from stack, and `bstr_printf` gets arguments from `bin_buf` which is a binary buffer that generated by `vbin_printf`.

The format follows C99 `vsnprintf`, but has some extensions: see `vsnprintf` comment for details.

The return value is the number of characters which would be generated for the given input, excluding the trailing `'\0'`, as per ISO C99. If you want to have the exact number of characters written into `buf` as return value (not including the trailing `'\0'`), use `vscnprintf`. If the return is greater than or equal to `size`, the resulting string is truncated.

bprintf

LINUX

Kernel Hackers Manual September 2014

Name

`bprintf` — Parse a format string and place args' binary value in a buffer

Synopsis

```
int bprintf (u32 * bin_buf, size_t size, const char * fmt,
...);
```

Arguments

bin_buf

The buffer to place args' binary value

size

The size of the buffer (by words (32 bits), not characters)

fmt

The format string to use @...: Arguments for the format string

...

variable arguments

Description

The function returns the number of words (u32) written into *bin_buf*.

vsscanf

LINUX

Kernel Hackers Manual September 2014

Name

`vsscanf` — Unformat a buffer into a list of arguments

Synopsis

```
int vsscanf (const char * buf, const char * fmt, va_list  
args);
```

Arguments

buf

input buffer

fmt

format of buffer

args

arguments

sscanf

LINUX

Kernel Hackers ManualSeptember 2014

Name

`sscanf` — Unformat a buffer into a list of arguments

Synopsis

```
int sscanf (const char * buf, const char * fmt, ...);
```

Arguments

buf

input buffer

fmt

formatting of buffer @...: resulting arguments

...

variable arguments

kstrtol

LINUX

Kernel Hackers Manual September 2014

Name

`kstrtol` — convert a string to a long

Synopsis

```
int kstrtol (const char * s, unsigned int base, long * res);
```

Arguments

s

The start of the string. The string must be null-terminated, and may also include a single newline before its terminating null. The first character may also be a plus sign or a minus sign.

base

The number base to use. The maximum supported base is 16. If base is given as 0, then the base of the string is automatically detected with the conventional semantics - If it begins with 0x the number will be parsed as a hexadecimal (case insensitive), if it otherwise begins with 0, it will be parsed as an octal number. Otherwise it will be parsed as a decimal.

res

Where to write the result of the conversion on success.

Description

Returns 0 on success, -ERANGE on overflow and -EINVAL on parsing error. Used as a replacement for the obsolete `simple_strtoul`. Return code must be checked.

kstrtoul

LINUX

Kernel Hackers Manual September 2014

Name

`kstrtoul` — convert a string to an unsigned long

Synopsis

```
int kstrtoul (const char * s, unsigned int base, unsigned long  
* res);
```

Arguments

s

The start of the string. The string must be null-terminated, and may also include a single newline before its terminating null. The first character may also be a plus sign, but not a minus sign.

base

The number base to use. The maximum supported base is 16. If base is given as 0, then the base of the string is automatically detected with the conventional semantics - If it begins with 0x the number will be parsed as a hexadecimal (case insensitive), if it otherwise begins with 0, it will be parsed as an octal number. Otherwise it will be parsed as a decimal.

res

Where to write the result of the conversion on success.

Description

Returns 0 on success, -ERANGE on overflow and -EINVAL on parsing error. Used as a replacement for the obsolete `simple_strtoull`. Return code must be checked.

kstrtoull

LINUX

Kernel Hackers Manual September 2014

Name

`kstrtoull` — convert a string to an unsigned long long

Synopsis

```
int kstrtoull (const char * s, unsigned int base, unsigned
long long * res);
```

Arguments

s

The start of the string. The string must be null-terminated, and may also include a single newline before its terminating null. The first character may also be a plus sign, but not a minus sign.

base

The number base to use. The maximum supported base is 16. If base is given as 0, then the base of the string is automatically detected with the conventional semantics - If it begins with 0x the number will be parsed as a hexadecimal (case insensitive), if it otherwise begins with 0, it will be parsed as an octal number. Otherwise it will be parsed as a decimal.

res

Where to write the result of the conversion on success.

Description

Returns 0 on success, -ERANGE on overflow and -EINVAL on parsing error. Used as a replacement for the obsolete `simple_strtoul`. Return code must be checked.

kstrtoll

LINUX

Kernel Hackers ManualSeptember 2014

Name

`kstrtoll` — convert a string to a long long

Synopsis

```
int kstrtoll (const char * s, unsigned int base, long long *  
res);
```

Arguments

s

The start of the string. The string must be null-terminated, and may also include a single newline before its terminating null. The first character may also be a plus sign or a minus sign.

base

The number base to use. The maximum supported base is 16. If base is given as 0, then the base of the string is automatically detected with the conventional semantics - If it begins with 0x the number will be parsed as a hexadecimal (case insensitive), if it otherwise begins with 0, it will be parsed as an octal number. Otherwise it will be parsed as a decimal.

res

Where to write the result of the conversion on success.

Description

Returns 0 on success, -ERANGE on overflow and -EINVAL on parsing error. Used as a replacement for the obsolete `simple_strtoul`. Return code must be checked.

kstrtouint

LINUX

Kernel Hackers ManualSeptember 2014

Name

`kstrtouint` — convert a string to an unsigned int

Synopsis

```
int kstrtouint (const char * s, unsigned int base, unsigned
int * res);
```

Arguments

s

The start of the string. The string must be null-terminated, and may also include a single newline before its terminating null. The first character may also be a plus sign, but not a minus sign.

base

The number base to use. The maximum supported base is 16. If base is given as 0, then the base of the string is automatically detected with the conventional semantics - If it begins with 0x the number will be parsed as a hexadecimal (case insensitive), if it otherwise begins with 0, it will be parsed as an octal number. Otherwise it will be parsed as a decimal.

res

Where to write the result of the conversion on success.

Description

Returns 0 on success, -ERANGE on overflow and -EINVAL on parsing error. Used as a replacement for the obsolete `simple_strtoul`. Return code must be checked.

kstrtoint

LINUX

Kernel Hackers ManualSeptember 2014

Name

`kstrtoint` — convert a string to an int

Synopsis

```
int kstrtoint (const char * s, unsigned int base, int * res);
```

Arguments

s

The start of the string. The string must be null-terminated, and may also include a single newline before its terminating null. The first character may also be a plus sign or a minus sign.

base

The number base to use. The maximum supported base is 16. If base is given as 0, then the base of the string is automatically detected with the conventional semantics - If it begins with 0x the number will be parsed as a hexadecimal (case insensitive), if it otherwise begins with 0, it will be parsed as an octal number. Otherwise it will be parsed as a decimal.

res

Where to write the result of the conversion on success.

Description

Returns 0 on success, -ERANGE on overflow and -EINVAL on parsing error. Used as a replacement for the obsolete `simple_strtoul`. Return code must be checked.

2.2. String Manipulation

strnicmp

LINUX

Name

`strnicmp` — Case insensitive, length-limited string comparison

Synopsis

```
int strnicmp (const char * s1, const char * s2, size_t len);
```

Arguments

s1

One string

s2

The other string

len

the maximum number of characters to compare

strcpy

LINUX

Name

`strcpy` — Copy a NUL terminated string

Synopsis

```
char * strcpy (char * dest, const char * src);
```

Arguments

dest

Where to copy the string to

src

Where to copy the string from

strncpy

LINUX

Kernel Hackers ManualSeptember 2014

Name

`strncpy` — Copy a length-limited, C-string

Synopsis

```
char * strncpy (char * dest, const char * src, size_t count);
```

Arguments

dest

Where to copy the string to

src

Where to copy the string from

count

The maximum number of bytes to copy

Description

The result is not NUL-terminated if the source exceeds *count* bytes.

In the case where the length of *src* is less than that of *count*, the remainder of *dest* will be padded with NUL.

strncpy

LINUX

Kernel Hackers ManualSeptember 2014

Name

`strncpy` — Copy a C-string into a sized buffer

Synopsis

```
size_t strncpy (char * dest, const char * src, size_t size);
```

Arguments

dest

Where to copy the string to

src

Where to copy the string from

size

size of destination buffer

BSD

the result is always a valid NUL-terminated string that fits in the buffer (unless, of course, the buffer size is zero). It does not pad out the result like `strncpy` does.

strcat

LINUX

Kernel Hackers Manual September 2014

Name

`strcat` — Append one NUL-terminated string to another

Synopsis

```
char * strcat (char * dest, const char * src);
```

Arguments

dest

The string to be appended to

src

The string to append to it

strncat

LINUX

Kernel Hackers ManualSeptember 2014

Name

`strncat` — Append a length-limited, C-string to another

Synopsis

```
char * strncat (char * dest, const char * src, size_t count);
```

Arguments

dest

The string to be appended to

src

The string to append to it

count

The maximum numbers of bytes to copy

Description

Note that in contrast to `strncpy`, `strncat` ensures the result is terminated.

strlcat

LINUX

Kernel Hackers ManualSeptember 2014

Name

`strlcat` — Append a length-limited, C-string to another

Synopsis

```
size_t strlcat (char * dest, const char * src, size_t count);
```

Arguments

dest

The string to be appended to

src

The string to append to it

count

The size of the destination buffer.

strcmp

LINUX

Kernel Hackers ManualSeptember 2014

Name

`strcmp` — Compare two strings

Synopsis

```
int strcmp (const char * cs, const char * ct);
```

Arguments

cs

One string

ct

Another string

strncmp

LINUX

Kernel Hackers ManualSeptember 2014

Name

`strncmp` — Compare two length-limited strings

Synopsis

```
int strncmp (const char * cs, const char * ct, size_t count);
```

Arguments

cs

One string

ct

Another string

count

The maximum number of bytes to compare

strchr

LINUX

Kernel Hackers ManualSeptember 2014

Name

`strchr` — Find the first occurrence of a character in a string

Synopsis

```
char * strchr (const char * s, int c);
```

Arguments

s

The string to be searched

c

The character to search for

strchrnul

LINUX

Kernel Hackers ManualSeptember 2014

Name

`strchrnul` — Find and return a character in a string, or end of string

Synopsis

```
char * strchrnul (const char * s, int c);
```

Arguments

s

The string to be searched

c

The character to search for

Description

Returns pointer to first occurrence of 'c' in s. If c is not found, then return a pointer to the null byte at the end of s.

strchr

LINUX

Kernel Hackers ManualSeptember 2014

Name

`strchr` — Find the last occurrence of a character in a string

Synopsis

```
char * strchr (const char * s, int c);
```

Arguments

s

The string to be searched

c

The character to search for

strnchr

LINUX

Kernel Hackers ManualSeptember 2014

Name

`strnchr` — Find a character in a length limited string

Synopsis

```
char * strnchr (const char * s, size_t count, int c);
```

Arguments

s

The string to be searched

count

The number of characters to be searched

c

The character to search for

skip_spaces

LINUX

Name

`skip_spaces` — Removes leading whitespace from *str*.

Synopsis

```
char * skip_spaces (const char * str);
```

Arguments

str

The string to be stripped.

Description

Returns a pointer to the first non-whitespace character in *str*.

strim

LINUX

Name

`strim` — Removes leading and trailing whitespace from *s*.

Synopsis

```
char * strim (char * s);
```

Arguments

s

The string to be stripped.

Description

Note that the first trailing whitespace is replaced with a NUL-terminator in the given string *s*. Returns a pointer to the first non-whitespace character in *s*.

strlen

LINUX

Kernel Hackers ManualSeptember 2014

Name

`strlen` — Find the length of a string

Synopsis

```
size_t strlen (const char * s);
```


Arguments

s

The string to be sized

strnlen

LINUX

Kernel Hackers ManualSeptember 2014

Name

`strnlen` — Find the length of a length-limited string

Synopsis

```
size_t strnlen (const char * s, size_t count);
```

Arguments

s

The string to be sized

count

The maximum number of bytes to search

strspn

LINUX

Kernel Hackers ManualSeptember 2014

Name

`strspn` — Calculate the length of the initial substring of *s* which only contain letters in *accept*

Synopsis

```
size_t strspn (const char * s, const char * accept);
```

Arguments

s

The string to be searched

accept

The string to search for

strcspn

LINUX

Kernel Hackers ManualSeptember 2014

Name

`strcspn` — Calculate the length of the initial substring of *s* which does not contain letters in *reject*

Synopsis

```
size_t strcspn (const char * s, const char * reject);
```

Arguments

s

The string to be searched

reject

The string to avoid

strpbrk

LINUX

Kernel Hackers ManualSeptember 2014

Name

strpbrk — Find the first occurrence of a set of characters

Synopsis

```
char * strpbrk (const char * cs, const char * ct);
```

Arguments

cs

The string to be searched

ct

The characters to search for

strsep

LINUX

Kernel Hackers ManualSeptember 2014

Name

`strsep` — Split a string into tokens

Synopsis

```
char * strsep (char ** s, const char * ct);
```

Arguments

s

The string to be searched

ct

The characters to search for

Description

`strsep` updates `s` to point after the token, ready for the next call.

It returns empty tokens, too, behaving exactly like the libc function of that name. In fact, it was stolen from glibc2 and de-fancy-fied. Same semantics, slimmer shape. :)

sysfs_streq

LINUX

Kernel Hackers Manual September 2014

Name

`sysfs_streq` — return true if strings are equal, modulo trailing newline

Synopsis

```
bool sysfs_streq (const char * s1, const char * s2);
```

Arguments

s1

one string

s2

another string

Description

This routine returns true iff two strings are equal, treating both NUL and newline-then-NUL as equivalent string terminations. It's geared for use with `sysfs`

input strings, which generally terminate with newlines but are compared against values without newlines.

strtobool

LINUX

Kernel Hackers Manual September 2014

Name

`strtobool` — convert common user inputs into boolean values

Synopsis

```
int strtobool (const char * s, bool * res);
```

Arguments

s

input string

res

result

Description

This routine returns 0 iff the first character is one of 'Yy1Nn0'. Otherwise it will return -EINVAL. Value pointed to by *res* is updated upon finding a match.

memset

LINUX

Kernel Hackers ManualSeptember 2014

Name

`memset` — Fill a region of memory with the given value

Synopsis

```
void * memset (void * s, int c, size_t count);
```

Arguments

s

Pointer to the start of the area.

c

The byte to fill the area with

count

The size of the area.

Description

Do not use `memset` to access IO space, use `memset_io` instead.

memcpy

LINUX

Kernel Hackers ManualSeptember 2014

Name

`memcpy` — Copy one area of memory to another

Synopsis

```
void * memcpy (void * dest, const void * src, size_t count);
```

Arguments

dest

Where to copy to

src

Where to copy from

count

The size of the area.

Description

You should not use this function to access IO space, use `memcpy_toio` or `memcpy_fromio` instead.

memmove

LINUX

Kernel Hackers ManualSeptember 2014

Name

`memmove` — Copy one area of memory to another

Synopsis

```
void * memmove (void * dest, const void * src, size_t count);
```

Arguments

dest

Where to copy to

src

Where to copy from

count

The size of the area.

Description

Unlike `memcpy`, `memmove` copes with overlapping areas.

memcmp

LINUX

Name

`memcmp` — Compare two areas of memory

Synopsis

```
__visible int memcmp (const void * cs, const void * ct, size_t  
count);
```

Arguments

cs

One area of memory

ct

Another area of memory

count

The size of the area.

`memscan`

LINUX

Name

`memscan` — Find a character in an area of memory.

Synopsis

```
void * memscan (void * addr, int c, size_t size);
```

Arguments

addr

The memory area

c

The byte to search for

size

The size of the area.

Description

returns the address of the first occurrence of *c*, or 1 byte past the area if *c* is not found

strstr

LINUX

Kernel Hackers ManualSeptember 2014

Name

`strstr` — Find the first substring in a NUL terminated string

Synopsis

```
char * strstr (const char * s1, const char * s2);
```

Arguments

s1

The string to be searched

s2

The string to search for

strnstr

LINUX

Kernel Hackers ManualSeptember 2014

Name

`strnstr` — Find the first substring in a length-limited string

Synopsis

```
char * strnstr (const char * s1, const char * s2, size_t len);
```

Arguments

s1

The string to be searched

s2

The string to search for

len

the maximum number of characters to search

memchr

LINUX

Kernel Hackers ManualSeptember 2014

Name

`memchr` — Find a character in an area of memory.

Synopsis

```
void * memchr (const void * s, int c, size_t n);
```

Arguments

s

The memory area

c

The byte to search for

n

The size of the area.

Description

returns the address of the first occurrence of *c*, or `NULL` if *c* is not found

memchr_inv

LINUX

Kernel Hackers ManualSeptember 2014

Name

`memchr_inv` — Find an unmatching character in an area of memory.

Synopsis

```
void * memchr_inv (const void * start, int c, size_t bytes);
```

Arguments

start

The memory area

c

Find a character other than *c*

bytes

The size of the area.

Description

returns the address of the first character other than `c`, or `NULL` if the whole buffer contains just `c`.

2.3. Bit Operations

set_bit

LINUX

Kernel Hackers ManualSeptember 2014

Name

`set_bit` — Atomically set a bit in memory

Synopsis

```
void set_bit (long nr, volatile unsigned long * addr);
```

Arguments

nr

the bit to set

addr

the address to start counting from

Description

This function is atomic and may not be reordered. See `__set_bit` if you do not require the atomic guarantees.

Note

there are no guarantees that this function will not be reordered on non x86 architectures, so if you are writing portable code, make sure not to rely on its reordering guarantees.

Note that *nr* may be almost arbitrarily large; this function is not restricted to acting on a single-word quantity.

`__set_bit`

LINUX

Kernel Hackers Manual September 2014

Name

`__set_bit` — Set a bit in memory

Synopsis

```
void __set_bit (long nr, volatile unsigned long * addr);
```

Arguments

nr

the bit to set

addr

the address to start counting from

Description

Unlike `set_bit`, this function is non-atomic and may be reordered. If it's called on the same region of memory simultaneously, the effect may be that only one operation succeeds.

clear_bit

LINUX

Kernel Hackers ManualSeptember 2014

Name

`clear_bit` — Clears a bit in memory

Synopsis

```
void clear_bit (long nr, volatile unsigned long * addr);
```

Arguments

nr

Bit to clear

addr

Address to start counting from

Description

`clear_bit` is atomic and may not be reordered. However, it does not contain a memory barrier, so if it is used for locking purposes, you should call `smp_mb__before_atomic` and/or `smp_mb__after_atomic` in order to ensure changes are visible on other processors.

__change_bit

LINUX

Kernel Hackers Manual September 2014

Name

`__change_bit` — Toggle a bit in memory

Synopsis

```
void __change_bit (long nr, volatile unsigned long * addr);
```

Arguments

nr

the bit to change

addr

the address to start counting from

Description

Unlike `change_bit`, this function is non-atomic and may be reordered. If it's called on the same region of memory simultaneously, the effect may be that only one operation succeeds.

change_bit

LINUX

Kernel Hackers Manual September 2014

Name

`change_bit` — Toggle a bit in memory

Synopsis

```
void change_bit (long nr, volatile unsigned long * addr);
```

Arguments

nr

Bit to change

addr

Address to start counting from

Description

`change_bit` is atomic and may not be reordered. Note that *nr* may be almost arbitrarily large; this function is not restricted to acting on a single-word quantity.

test_and_set_bit

LINUX

Kernel Hackers ManualSeptember 2014

Name

`test_and_set_bit` — Set a bit and return its old value

Synopsis

```
int test_and_set_bit (long nr, volatile unsigned long * addr);
```

Arguments

nr

Bit to set

addr

Address to count from

Description

This operation is atomic and cannot be reordered. It also implies a memory barrier.

test_and_set_bit_lock

LINUX

Kernel Hackers ManualSeptember 2014

Name

`test_and_set_bit_lock` — Set a bit and return its old value for lock

Synopsis

```
int test_and_set_bit_lock (long nr, volatile unsigned long *  
addr);
```

Arguments

nr

Bit to set

addr

Address to count from

Description

This is the same as `test_and_set_bit` on x86.

__test_and_set_bit

LINUX

Name

`__test_and_set_bit` — Set a bit and return its old value

Synopsis

```
int __test_and_set_bit (long nr, volatile unsigned long *  
addr);
```

Arguments

nr

Bit to set

addr

Address to count from

Description

This operation is non-atomic and can be reordered. If two examples of this operation race, one can appear to succeed but actually fail. You must protect multiple accesses with a lock.

test_and_clear_bit

LINUX

Name

`test_and_clear_bit` — Clear a bit and return its old value

Synopsis

```
int test_and_clear_bit (long nr, volatile unsigned long *  
addr);
```

Arguments

nr

Bit to clear

addr

Address to count from

Description

This operation is atomic and cannot be reordered. It also implies a memory barrier.

__test_and_clear_bit

LINUX

Name

`__test_and_clear_bit` — Clear a bit and return its old value

Synopsis

```
int __test_and_clear_bit (long nr, volatile unsigned long *  
addr);
```

Arguments

nr

Bit to clear

addr

Address to count from

Description

This operation is non-atomic and can be reordered. If two examples of this operation race, one can appear to succeed but actually fail. You must protect multiple accesses with a lock.

Note

the operation is performed atomically with respect to the local CPU, but not other CPUs. Portable code should not rely on this behaviour. KVM relies on this behaviour on x86 for modifying memory that is also

accessed from a hypervisor on the same CPU if running in a VM

don't change this without also updating arch/x86/kernel/kvm.c

test_and_change_bit

LINUX

Kernel Hackers ManualSeptember 2014

Name

`test_and_change_bit` — Change a bit and return its old value

Synopsis

```
int test_and_change_bit (long nr, volatile unsigned long *  
addr);
```

Arguments

nr

Bit to change

addr

Address to count from

Description

This operation is atomic and cannot be reordered. It also implies a memory barrier.

test_bit

LINUX

Name

`test_bit` — Determine whether a bit is set

Synopsis

```
int test_bit (int nr, const volatile unsigned long * addr);
```

Arguments

nr

bit number to test

addr

Address to start counting from

`__ffs`

LINUX

Name

`__ffs` — find first set bit in word

Synopsis

```
unsigned long __ffs (unsigned long word);
```

Arguments

word

The word to search

Description

Undefined if no bit exists, so code should check against 0 first.

ffz

LINUX

Kernel Hackers ManualSeptember 2014

Name

`ffz` — find first zero bit in word

Synopsis

```
unsigned long ffz (unsigned long word);
```

Arguments

word

The word to search

Description

Undefined if no zero exists, so code should check against ~0UL first.

ffs

LINUX

Kernel Hackers ManualSeptember 2014

Name

`ffs` — find first set bit in word

Synopsis

```
int ffs (int x);
```

Arguments

`x`

the word to search

Description

This is defined the same way as the libc and compiler builtin ffs routines, therefore differs in spirit from the other bitops.

`ffs(value)` returns 0 if value is 0 or the position of the first set bit if value is nonzero. The first (least significant) bit is at position 1.

fls

LINUX

Kernel Hackers ManualSeptember 2014

Name

`fls` — find last set bit in word

Synopsis

```
int fls (int x);
```

Arguments

`x`

the word to search

Description

This is defined in a similar way as the libc and compiler builtin `ffs`, but returns the position of the most significant set bit.

`fls(value)` returns 0 if value is 0 or the position of the last set bit if value is nonzero. The last (most significant) bit is at position 32.

fls64

LINUX

Name

`fls64` — find last set bit in a 64-bit word

Synopsis

```
int fls64 (__u64 x);
```

Arguments

`x`

the word to search

Description

This is defined in a similar way as the libc and compiler builtin `ffsll`, but returns the position of the most significant set bit.

`fls64(value)` returns 0 if value is 0 or the position of the last set bit if value is nonzero. The last (most significant) bit is at position 64.

Chapter 3. Basic Kernel Library Functions

The Linux kernel provides more basic utility functions.

3.1. Bitmap Operations

`__bitmap_shift_right`

LINUX

Kernel Hackers ManualSeptember 2014

Name

`__bitmap_shift_right` — logical right shift of the bits in a bitmap

Synopsis

```
void __bitmap_shift_right (unsigned long * dst, const unsigned  
long * src, int shift, int bits);
```

Arguments

dst

destination bitmap

src

source bitmap

shift

shift by this many bits

bits

bitmap size, in bits

Description

Shifting right (dividing) means moving bits in the MS -> LS bit direction. Zeros are fed into the vacated MS positions and the LS bits shifted off the bottom are lost.

__bitmap_shift_left

LINUX

Kernel Hackers ManualSeptember 2014

Name

`__bitmap_shift_left` — logical left shift of the bits in a bitmap

Synopsis

```
void __bitmap_shift_left (unsigned long * dst, const unsigned  
long * src, int shift, int bits);
```

Arguments

dst

destination bitmap

src

source bitmap

shift

shift by this many bits

bits

bitmap size, in bits

Description

Shifting left (multiplying) means moving bits in the LS -> MS direction. Zeros are fed into the vacated LS bit positions and those MS bits shifted off the top are lost.

bitmap_scnprintf

LINUX

Kernel Hackers ManualSeptember 2014

Name

`bitmap_scnprintf` — convert bitmap to an ASCII hex string.

Synopsis

```
int bitmap_scnprintf (char * buf, unsigned int buflen, const  
unsigned long * maskp, int nmaskbits);
```

Arguments

buf

byte buffer into which string is placed

buflen

reserved size of *buf*, in bytes

maskp

pointer to bitmap to convert

nmaskbits

size of bitmap, in bits

Description

Exactly *nmaskbits* bits are displayed. Hex digits are grouped into comma-separated sets of eight digits per set. Returns the number of characters which were written to **buf*, excluding the trailing `\0`.

__bitmap_parse

LINUX

Kernel Hackers ManualSeptember 2014

Name

`__bitmap_parse` — convert an ASCII hex string into a bitmap.

Synopsis

```
int __bitmap_parse (const char * buf, unsigned int buflen, int  
is_user, unsigned long * maskp, int nmaskbits);
```

Arguments

buf

pointer to buffer containing string.

buflen

buffer size in bytes. If string is smaller than this then it must be terminated with a `\0`.

is_user

location of buffer, 0 indicates kernel space

maskp

pointer to bitmap array that will contain result.

nmaskbits

size of bitmap, in bits.

Description

Commas group hex digits into chunks. Each chunk defines exactly 32 bits of the resultant bitmask. No chunk may specify a value larger than 32 bits (`-EOVERFLOW`), and if a chunk specifies a smaller value then leading 0-bits are prepended. `-EINVAL` is returned for illegal characters and for grouping errors such as “1,,5”, “,44”, “,” and “”. Leading and trailing whitespace accepted, but not embedded whitespace.

bitmap_parse_user

LINUX

Kernel Hackers Manual September 2014

Name

`bitmap_parse_user` — convert an ASCII hex string in a user buffer into a bitmap

Synopsis

```
int bitmap_parse_user (const char __user * ubuf, unsigned int  
ulen, unsigned long * maskp, int nmaskbits);
```

Arguments

ubuf

pointer to user buffer containing string.

ulen

buffer size in bytes. If string is smaller than this then it must be terminated with a `\0`.

maskp

pointer to bitmap array that will contain result.

nmaskbits

size of bitmap, in bits.

Description

Wrapper for `__bitmap_parse`, providing it with user buffer.

We cannot have this as an inline function in `bitmap.h` because it needs `linux/uaccess.h` to get the `access_ok` declaration and this causes cyclic dependencies.

bitmap_scnlistprintf

LINUX

Name

`bitmap_scnlistprintf` — convert bitmap to list format ASCII string

Synopsis

```
int bitmap_scnlistprintf (char * buf, unsigned int buflen,  
const unsigned long * maskp, int nmaskbits);
```

Arguments

buf

byte buffer into which string is placed

buflen

reserved size of *buf*, in bytes

maskp

pointer to bitmap to convert

nmaskbits

size of bitmap, in bits

Description

Output format is a comma-separated list of decimal numbers and ranges. Consecutively set bits are shown as two hyphen-separated decimal numbers, the smallest and largest bit numbers set in the range. Output format is compatible with the format accepted as input by `bitmap_parselist`.

The return value is the number of characters which were written to **buf* excluding the trailing `'\0'`, as per ISO C99's `scnprintf`.

bitmap_parselist_user

LINUX

Kernel Hackers Manual September 2014

Name

`bitmap_parselist_user` —

Synopsis

```
int bitmap_parselist_user (const char __user * ubuf, unsigned  
int ulen, unsigned long * maskp, int nmaskbits);
```

Arguments

ubuf

pointer to user buffer containing string.

ulen

buffer size in bytes. If string is smaller than this then it must be terminated with a `\0`.

maskp

pointer to bitmap array that will contain result.

nmaskbits

size of bitmap, in bits.

Description

Wrapper for `bitmap_parselist`, providing it with user buffer.

We cannot have this as an inline function in `bitmap.h` because it needs `linux/uaccess.h` to get the `access_ok` declaration and this causes cyclic dependencies.

bitmap_remap

LINUX

Kernel Hackers Manual September 2014

Name

`bitmap_remap` — Apply map defined by a pair of bitmaps to another bitmap

Synopsis

```
void bitmap_remap (unsigned long * dst, const unsigned long *  
src, const unsigned long * old, const unsigned long * new,  
int bits);
```

Arguments

dst

remapped result

src

subset to be remapped

old

defines domain of map

new

defines range of map

bits

number of bits in each of these bitmaps

Description

Let *old* and *new* define a mapping of bit positions, such that whatever position is held by the *n*-th set bit in *old* is mapped to the *n*-th set bit in *new*. In the more general case, allowing for the possibility that the weight 'w' of *new* is less than the weight of *old*, map the position of the *n*-th set bit in *old* to the position of the *m*-th set bit in *new*, where $m == n \% w$.

If either of the *old* and *new* bitmaps are empty, or if *src* and *dst* point to the same location, then this routine copies *src* to *dst*.

The positions of unset bits in *old* are mapped to themselves (the identify map).

Apply the above specified mapping to *src*, placing the result in *dst*, clearing any bits previously set in *dst*.

For example, lets say that *old* has bits 4 through 7 set, and *new* has bits 12 through 15 set. This defines the mapping of bit position 4 to 12, 5 to 13, 6 to 14 and 7 to 15, and of all other bit positions unchanged. So if say *src* comes into this routine with bits 1, 5 and 7 set, then *dst* should leave with bits 1, 13 and 15 set.

bitmap_bitremap

LINUX

Kernel Hackers Manual September 2014

Name

`bitmap_bitremap` — Apply map defined by a pair of bitmaps to a single bit

Synopsis

```
int bitmap_bitremap (int oldbit, const unsigned long * old,
const unsigned long * new, int bits);
```


Arguments

oldbit

bit position to be mapped

old

defines domain of map

new

defines range of map

bits

number of bits in each of these bitmaps

Description

Let *old* and *new* define a mapping of bit positions, such that whatever position is held by the *n*-th set bit in *old* is mapped to the *n*-th set bit in *new*. In the more general case, allowing for the possibility that the weight 'w' of *new* is less than the weight of *old*, map the position of the *n*-th set bit in *old* to the position of the *m*-th set bit in *new*, where $m == n \% w$.

The positions of unset bits in *old* are mapped to themselves (the identify map).

Apply the above specified mapping to bit position *oldbit*, returning the new bit position.

For example, lets say that *old* has bits 4 through 7 set, and *new* has bits 12 through 15 set. This defines the mapping of bit position 4 to 12, 5 to 13, 6 to 14 and 7 to 15, and of all other bit positions unchanged. So if say *oldbit* is 5, then this routine returns 13.

bitmap_onto

LINUX

Name

`bitmap_onto` — translate one bitmap relative to another

Synopsis

```
void bitmap_onto (unsigned long * dst, const unsigned long *  
orig, const unsigned long * relmap, int bits);
```

Arguments

dst

resulting translated bitmap

orig

original untranslated bitmap

relmap

bitmap relative to which translated

bits

number of bits in each of these bitmaps

Description

Set the *n*-th bit of *dst* iff there exists some *m* such that the *n*-th bit of *relmap* is set, the *m*-th bit of *orig* is set, and the *n*-th bit of *relmap* is also the *m*-th `_set_` bit of *relmap*. (If you understood the previous sentence the first time you read it, you're overqualified for your current job.)

In other words, *orig* is mapped onto (surjectively) *dst*, using the the map { <*n*, *m*> | the *n*-th bit of *relmap* is the *m*-th set bit of *relmap* }.

Any set bits in *orig* above bit number *W*, where *W* is the weight of (number of set bits in) *relmap* are mapped nowhere. In particular, if for all bits *m* set in *orig*, *m*

$\geq W$, then *dst* will end up empty. In situations where the possibility of such an empty result is not desired, one way to avoid it is to use the `bitmap_fold` operator, below, to first fold the *orig* bitmap over itself so that all its set bits *x* are in the range $0 \leq x < W$. The `bitmap_fold` operator does this by setting the bit $(m \% W)$ in *dst*, for each bit (*m*) set in *orig*.

Example [1] for `bitmap_onto`: Let's say *relmap* has bits 30-39 set, and *orig* has bits 1, 3, 5, 7, 9 and 11 set. Then on return from this routine, *dst* will have bits 31, 33, 35, 37 and 39 set.

When bit 0 is set in *orig*, it means turn on the bit in *dst* corresponding to whatever is the first bit (if any) that is turned on in *relmap*. Since bit 0 was off in the above example, we leave off that bit (bit 30) in *dst*.

When bit 1 is set in *orig* (as in the above example), it means turn on the bit in *dst* corresponding to whatever is the second bit that is turned on in *relmap*. The second bit in *relmap* that was turned on in the above example was bit 31, so we turned on bit 31 in *dst*.

Similarly, we turned on bits 33, 35, 37 and 39 in *dst*, because they were the 4th, 6th, 8th and 10th set bits set in *relmap*, and the 4th, 6th, 8th and 10th bits of *orig* (i.e. bits 3, 5, 7 and 9) were also set.

When bit 11 is set in *orig*, it means turn on the bit in *dst* corresponding to whatever is the twelfth bit that is turned on in *relmap*. In the above example, there were only ten bits turned on in *relmap* (30..39), so that bit 11 was set in *orig* had no affect on *dst*.

Example [2] for `bitmap_fold + bitmap_onto`: Let's say *relmap* has these ten bits set: 40 41 42 43 45 48 53 61 74 95 (for the curious, that's 40 plus the first ten terms of the Fibonacci sequence.)

Further lets say we use the following code, invoking `bitmap_fold` then `bitmap_onto`, as suggested above to avoid the possitility of an empty *dst* result:

```
unsigned long *tmp; // a temporary bitmap's bits

bitmap_fold(tmp, orig, bitmap_weight(relmap, bits), bits); bitmap_onto(dst, tmp,
relmap, bits);
```

Then this table shows what various values of *dst* would be, for various *orig*'s. I list the zero-based positions of each set bit. The tmp column shows the intermediate result, as computed by using `bitmap_fold` to fold the *orig* bitmap modulo ten (the weight of *relmap*).

<i>orig</i>	<i>tmp</i>	<i>dst</i>	0 0 40 1 1 41 9 9 95 10 0 40 (*)	1 3 5 7 1 3 5 7 41 43 48 61 0 1 2 3 4
0 1 2 3 4 40 41 42 43 45 0 9 18 27 0 9 8 7 40 61 74 95 0 10 20 30 0 40 0 11 22 33 0				
1 2 3 40 41 42 43 0 12 24 36 0 2 4 6 40 42 45 53 78 102 211 1 2 8 41 42 74 (*)				

(*) For these marked lines, if we hadn't first done `bitmap_fold` into `tmp`, then the `dst` result would have been empty.

If either of `orig` or `relmap` is empty (no set bits), then `dst` will be returned empty.

If (as explained above) the only set bits in `orig` are in positions `m` where $m \geq W$, (where `W` is the weight of `relmap`) then `dst` will once again be returned empty.

All bits in `dst` not set by the above rule are cleared.

bitmap_fold

LINUX

Kernel Hackers Manual September 2014

Name

`bitmap_fold` — fold larger bitmap into smaller, modulo specified size

Synopsis

```
void bitmap_fold (unsigned long * dst, const unsigned long *  
orig, int sz, int bits);
```

Arguments

dst

resulting smaller bitmap

orig

original larger bitmap

sz

specified size

bits

number of bits in each of these bitmaps

Description

For each bit *oldbit* in *orig*, set bit *oldbit* mod *sz* in *dst*. Clear all other bits in *dst*. See further the comment and Example [2] for `bitmap_onto` for why and how to use this.

bitmap_find_free_region

LINUX

Kernel Hackers ManualSeptember 2014

Name

`bitmap_find_free_region` — find a contiguous aligned mem region

Synopsis

```
int bitmap_find_free_region (unsigned long * bitmap, int bits,
int order);
```

Arguments

bitmap

array of unsigned longs corresponding to the bitmap

bits

number of bits in the bitmap

order

region size (log base 2 of number of bits) to find

Description

Find a region of free (zero) bits in a *bitmap* of *bits* bits and allocate them (set them to one). Only consider regions of length a power (*order*) of two, aligned to that power of two, which makes the search algorithm much faster.

Return the bit offset in bitmap of the allocated region, or -errno on failure.

bitmap_release_region

LINUX

Kernel Hackers ManualSeptember 2014

Name

`bitmap_release_region` — release allocated bitmap region

Synopsis

```
void bitmap_release_region (unsigned long * bitmap, int pos,  
int order);
```

Arguments

bitmap

array of unsigned longs corresponding to the bitmap

pos

beginning of bit region to release

order

region size (log base 2 of number of bits) to release

Description

This is the complement to `__bitmap_find_free_region` and releases the found region (by clearing it in the bitmap).

No return value.

bitmap_allocate_region

LINUX

Kernel Hackers ManualSeptember 2014

Name

`bitmap_allocate_region` — allocate bitmap region

Synopsis

```
int bitmap_allocate_region (unsigned long * bitmap, int pos,  
int order);
```

Arguments

bitmap

array of unsigned longs corresponding to the bitmap

pos

beginning of bit region to allocate

order

region size (log base 2 of number of bits) to allocate

Description

Allocate (set bits in) a specified region of a bitmap.

Return 0 on success, or `-EBUSY` if specified region wasn't free (not all bits were zero).

bitmap_copy_le

LINUX

Kernel Hackers ManualSeptember 2014

Name

`bitmap_copy_le` — copy a bitmap, putting the bits into little-endian order.

Synopsis

```
void bitmap_copy_le (void * dst, const unsigned long * src,  
int nbits);
```

Arguments

dst

destination buffer

src

bitmap to copy

nbits

number of bits in the bitmap

Description

Require `nbits % BITS_PER_LONG == 0`.

__bitmap_parselist

LINUX

Kernel Hackers ManualSeptember 2014

Name

`__bitmap_parselist` — convert list format ASCII string to bitmap

Synopsis

```
int __bitmap_parselist (const char * buf, unsigned int buflen,  
int is_user, unsigned long * maskp, int nmaskbits);
```

Arguments

buf

read nul-terminated user string from this buffer

buflen

buffer size in bytes. If string is smaller than this then it must be terminated with a `\0`.

is_user

location of buffer, 0 indicates kernel space

maskp

write resulting mask here

nmaskbits

number of bits in mask to be written

Description

Input format is a comma-separated list of decimal numbers and ranges. Consecutively set bits are shown as two hyphen-separated decimal numbers, the smallest and largest bit numbers set in the range.

Returns 0 on success, -errno on invalid input strings.

Error values

-EINVAL: second number in range smaller than first -EINVAL: invalid character in string -ERANGE: bit number specified too large for mask

bitmap_pos_to_ord

LINUX

Kernel Hackers ManualSeptember 2014

Name

`bitmap_pos_to_ord` — find ordinal of set bit at given position in bitmap

Synopsis

```
int bitmap_pos_to_ord (const unsigned long * buf, int pos, int
bits);
```

Arguments

buf

pointer to a bitmap

pos

a bit position in *buf* ($0 \leq pos < bits$)

bits

number of valid bit positions in *buf*

Description

Map the bit at position *pos* in *buf* (of length *bits*) to the ordinal of which set bit it is. If it is not set or if *pos* is not a valid bit position, map to -1.

If for example, just bits 4 through 7 are set in *buf*, then *pos* values 4 through 7 will get mapped to 0 through 3, respectively, and other *pos* values will get mapped to 0. When *pos* value 7 gets mapped to (returns) *ord* value 3 in this example, that means that bit 7 is the 3rd (starting with 0th) set bit in *buf*.

The bit positions 0 through *bits* are valid positions in *buf*.

bitmap_ord_to_pos

LINUX

Name

`bitmap_ord_to_pos` — find position of n-th set bit in bitmap

Synopsis

```
int bitmap_ord_to_pos (const unsigned long * buf, int ord, int  
bits);
```

Arguments

buf

pointer to bitmap

ord

ordinal bit position (n-th set bit, $n \geq 0$)

bits

number of valid bit positions in *buf*

Description

Map the ordinal offset of bit *ord* in *buf* to its position in *buf*. Value of *ord* should be in range $0 \leq ord < \text{weight}(\text{buf})$, else results are undefined.

If for example, just bits 4 through 7 are set in *buf*, then *ord* values 0 through 3 will get mapped to 4 through 7, respectively, and all other *ord* values return undefined values. When *ord* value 3 gets mapped to (returns) *pos* value 7 in this example, that means that the 3rd set bit (starting with 0th) is at position 7 in *buf*.

The bit positions 0 through *bits* are valid positions in *buf*.

3.2. Command-line Parsing

get_option

LINUX

Kernel Hackers Manual September 2014

Name

`get_option` — Parse integer from an option string

Synopsis

```
int get_option (char ** str, int * pint);
```

Arguments

str

option string

pint

(output) integer value parsed from *str*

Description

Read an int from an option string; if available accept a subsequent comma as well.

Return values

0 - no int in string 1 - int found, no subsequent comma 2 - int found including a subsequent comma 3 - hyphen found to denote a range

get_options

LINUX

Kernel Hackers Manual September 2014

Name

`get_options` — Parse a string into a list of integers

Synopsis

```
char * get_options (const char * str, int nints, int * ints);
```

Arguments

str

String to be parsed

nints

size of integer array

ints

integer array

Description

This function parses a string containing a comma-separated list of integers, a hyphen-separated range of `_positive_` integers, or a combination of both. The parse halts when the array is full, or when no more numbers can be retrieved from the string.

Return value is the character in the string which caused the parse to end (typically a null terminator, if *str* is completely parseable).

memparse

LINUX

Kernel Hackers ManualSeptember 2014

Name

`memparse` — parse a string with mem suffixes into a number

Synopsis

```
unsigned long long memparse (const char * ptr, char **  
retptr);
```

Arguments

ptr

Where parse begins

retptr

(output) Optional pointer to next char after parse completes

Description

Parses a string into a number. The number stored at *ptr* is potentially suffixed with *K* (for kilobytes, or 1024 bytes), *M* (for megabytes, or 1048576 bytes), or *G* (for gigabytes, or 1073741824). If the number is suffixed with K, M, or G, then the return value is the number multiplied by one kilobyte, one megabyte, or one gigabyte, respectively.

3.3. CRC Functions

crc7_be

LINUX

Kernel Hackers Manual September 2014

Name

`crc7_be` — update the CRC7 for the data buffer

Synopsis

```
u8 crc7_be (u8 crc, const u8 * buffer, size_t len);
```

Arguments

crc

previous CRC7 value

buffer

data pointer

len

number of bytes in the buffer

Context

any

Description

Returns the updated CRC7 value. The CRC7 is left-aligned in the byte (the lsb is always 0), as that makes the computation easier, and all callers want it in that form.

crc16

LINUX

Kernel Hackers Manual September 2014

Name

`crc16` — compute the CRC-16 for the data buffer

Synopsis

```
u16 crc16 (u16 crc, u8 const * buffer, size_t len);
```

Arguments

crc

previous CRC value

buffer

data pointer

len

number of bytes in the buffer

Description

Returns the updated CRC value.

crc_itu_t

LINUX

Kernel Hackers ManualSeptember 2014

Name

`crc_itu_t` — Compute the CRC-ITU-T for the data buffer

Synopsis

```
u16 crc_itu_t (u16 crc, const u8 * buffer, size_t len);
```

Arguments

crc

previous CRC value

buffer

data pointer

len

number of bytes in the buffer

Description

Returns the updated CRC value

/usr/src/linux-3.16.3-4.2.gd2bbe7f//lib/crc32.c

Name

/usr/src/linux-3.16.3-4.2.gd2bbe7f//lib/crc32.c —
Document generation inconsistency

Oops

Warning

The template for this document tried to insert the structured comment from the file

/usr/src/linux-3.16.3-4.2.gd2bbe7f//lib/crc32.c at this point, but none was found. This dummy section is inserted to allow generation to continue.

crc_ccitt

LINUX

Kernel Hackers ManualSeptember 2014

Name

`crc_ccitt` — recompute the CRC for the data buffer

Synopsis

```
u16 crc_ccitt (u16 crc, u8 const * buffer, size_t len);
```

Arguments

crc

previous CRC value

buffer

data pointer

len

number of bytes in the buffer

3.4. idr/ida Functions

idr synchronization (stolen from radix-tree.h)

`idr_find` is able to be called locklessly, using RCU. The caller must ensure calls to this function are made within `rcu_read_lock` regions. Other readers (lock-free or otherwise) and modifications may be running concurrently.

It is still required that the caller manage the synchronization and lifetimes of the items. So if RCU lock-free lookups are used, typically this would mean that the items have their own locks, or are amenable to lock-free access; and that the items are freed by RCU (or only freed after having been deleted from the idr tree *and* a `synchronize_rcu` grace period).

IDA - IDR based ID allocator

This is id allocator without id -> pointer translation. Memory usage is much lower than full blown idr because each id only occupies a bit. ida uses a custom leaf node which contains `IDA_BITMAP_BITS` slots.

2007-04-25 written by Tejun Heo <htejun@gmail.com>

idr_preload

LINUX

Name

`idr_preload` — preload for `idr_alloc`

Synopsis

```
void idr_preload (gfp_t gfp_mask);
```

Arguments

gfp_mask

allocation mask to use for preloading

Description

Preload per-cpu layer buffer for `idr_alloc`. Can only be used from process context and each `idr_preload` invocation should be matched with `idr_preload_end`. Note that preemption is disabled while preloaded.

The first `idr_alloc` in the preloaded section can be treated as if it were invoked with *gfp_mask* used for preloading. This allows using more permissive allocation masks for idrs protected by spinlocks.

For example, if `idr_alloc` below fails, the failure can be treated as if `idr_alloc` were called with `GFP_KERNEL` rather than `GFP_NOWAIT`.

```
idr_preload(GFP_KERNEL); spin_lock(lock);
```

```
id = idr_alloc(idr, ptr, start, end, GFP_NOWAIT);
```

```
spin_unlock(lock); idr_preload_end; if (id < 0) error;
```

idr_alloc

LINUX

Kernel Hackers ManualSeptember 2014

Name

`idr_alloc` — allocate new idr entry

Synopsis

```
int idr_alloc (struct idr * idr, void * ptr, int start, int  
end, gfp_t gfp_mask);
```

Arguments

idr

the (initialized) idr

ptr

pointer to be associated with the new id

start

the minimum id (inclusive)

end

the maximum id (exclusive, <= 0 for max)

gfp_mask

memory allocation flags

Description

Allocate an id in `[start, end)` and associate it with `ptr`. If no ID is available in the specified range, returns `-ENOSPC`. On memory allocation failure, returns `-ENOMEM`.

Note that `end` is treated as max when `<= 0`. This is to always allow using `start + N` as `end` as long as `N` is inside integer range.

The user is responsible for exclusively synchronizing all operations which may modify `idr`. However, read-only accesses such as `idr_find` or iteration can be performed under RCU read lock provided the user destroys `ptr` in RCU-safe way after removal from `idr`.

idr_alloc_cyclic

LINUX

Kernel Hackers Manual September 2014

Name

`idr_alloc_cyclic` — allocate new `idr` entry in a cyclical fashion

Synopsis

```
int idr_alloc_cyclic (struct idr * idr, void * ptr, int start,
int end, gfp_t gfp_mask);
```

Arguments

idr

the (initialized) `idr`

ptr

pointer to be associated with the new id

start

the minimum id (inclusive)

end

the maximum id (exclusive, ≤ 0 for max)

gfp_mask

memory allocation flags

Description

Essentially the same as `idr_alloc`, but prefers to allocate progressively higher ids if it can. If the “cur” counter wraps, then it will start again at the “start” end of the range and allocate one that has already been used.

idr_remove

LINUX

Kernel Hackers Manual September 2014

Name

`idr_remove` — remove the given id and free its slot

Synopsis

```
void idr_remove (struct idr * idp, int id);
```


Arguments

idp

idr handle

id

unique key

idr_destroy

LINUX

Kernel Hackers ManualSeptember 2014

Name

`idr_destroy` — release all cached layers within an idr tree

Synopsis

```
void idr_destroy (struct idr * idp);
```

Arguments

idp

idr handle

Description

Free all id mappings and all `idp_layers`. After this function, *idp* is completely unused and can be freed / recycled. The caller is responsible for ensuring that no one else accesses *idp* during or after `idr_destroy`.

A typical clean-up sequence for objects stored in an `idr` tree will use `idr_for_each` to free all objects, if necessary, then `idr_destroy` to free up the id mappings and cached `idr` layers.

idr_for_each

LINUX

Kernel Hackers Manual September 2014

Name

`idr_for_each` — iterate through all stored pointers

Synopsis

```
int idr_for_each (struct idr * idp, int (*fn) (int id, void
*p, void *data), void * data);
```

Arguments

idp

idr handle

fn

function to be called for each pointer

data

data passed back to callback function

Description

Iterate over the pointers registered with the given `idr`. The callback function will be called for each pointer currently registered, passing the `id`, the pointer and the data pointer passed to this function. It is not safe to modify the `idr` tree while in the callback, so functions such as `idr_get_new` and `idr_remove` are not allowed.

We check the return of `fn` each time. If it returns anything other than 0, we break out and return that value.

The caller must serialize `idr_for_each` vs `idr_get_new` and `idr_remove`.

idr_get_next

LINUX

Kernel Hackers Manual September 2014

Name

`idr_get_next` — lookup next object of `id` to given `id`.

Synopsis

```
void * idr_get_next (struct idr * idp, int * nextidp);
```

Arguments

idp

idr handle

nextidp

pointer to lookup key

Description

Returns pointer to registered object with id, which is next number to given id. After being looked up, **nextidp* will be updated for the next iteration.

This function can be called under `rcu_read_lock`, given that the leaf pointers lifetimes are correctly managed.

idr_replace

LINUX

Kernel Hackers ManualSeptember 2014

Name

`idr_replace` — replace pointer for given id

Synopsis

```
void * idr_replace (struct idr * idp, void * ptr, int id);
```

Arguments

idp

idr handle

ptr

pointer you want associated with the id

id

lookup key

Description

Replace the pointer registered with an id and return the old value. A `-ENOENT` return indicates that `id` was not found. A `-EINVAL` return indicates that `id` was not within valid constraints.

The caller must serialize with writers.

idr_init

LINUX

Kernel Hackers ManualSeptember 2014

Name

`idr_init` — initialize idr handle

Synopsis

```
void idr_init (struct idr * idp);
```

Arguments

idp

idr handle

Description

This function is use to set up the handle (*idp*) that you will pass to the rest of the functions.

ida_pre_get

LINUX

Kernel Hackers ManualSeptember 2014

Name

`ida_pre_get` — reserve resources for ida allocation

Synopsis

```
int ida_pre_get (struct ida * ida, gfp_t gfp_mask);
```

Arguments

ida

ida handle

gfp_mask

memory allocation flag

Description

This function should be called prior to locking and calling the following function. It preallocates enough memory to satisfy the worst possible allocation.

If the system is REALLY out of memory this function returns 0, otherwise 1.

ida_get_new_above

LINUX

Name

`ida_get_new_above` — allocate new ID above or equal to a start id

Synopsis

```
int ida_get_new_above (struct ida * ida, int starting_id, int  
* p_id);
```

Arguments

ida

ida handle

starting_id

id to start search at

p_id

pointer to the allocated handle

Description

Allocate new ID above or equal to *starting_id*. It should be called with any required locks.

If memory is required, it will return `-EAGAIN`, you should unlock and go back to the `ida_pre_get` call. If the ida is full, it will return `-ENOSPC`.

p_id returns a value in the range *starting_id* ... 0x7fffffff.

ida_remove

LINUX

Kernel Hackers ManualSeptember 2014

Name

`ida_remove` — remove the given ID

Synopsis

```
void ida_remove (struct ida * ida, int id);
```

Arguments

ida

ida handle

id

ID to free

ida_destroy

LINUX

Kernel Hackers ManualSeptember 2014

Name

`ida_destroy` — release all cached layers within an ida tree

Synopsis

```
void ida_destroy (struct ida * ida);
```

Arguments

ida

ida handle

ida_simple_get

LINUX

Kernel Hackers ManualSeptember 2014

Name

`ida_simple_get` — get a new id.

Synopsis

```
int ida_simple_get (struct ida * ida, unsigned int start,  
unsigned int end, gfp_t gfp_mask);
```

Arguments

ida

the (initialized) ida.

start

the minimum id (inclusive, < 0x8000000)

end

the maximum id (exclusive, < 0x8000000 or 0)

gfp_mask

memory allocation flags

Description

Allocates an id in the range `start <= id < end`, or returns `-ENOSPC`. On memory allocation failure, returns `-ENOMEM`.

Use `ida_simple_remove` to get rid of an id.

ida_simple_remove

LINUX

Kernel Hackers ManualSeptember 2014

Name

`ida_simple_remove` — remove an allocated id.

Synopsis

```
void ida_simple_remove (struct ida * ida, unsigned int id);
```

Arguments

ida

the (initialized) ida.

id

the id returned by `ida_simple_get`.

ida_init

LINUX

Kernel Hackers ManualSeptember 2014

Name

`ida_init` — initialize ida handle

Synopsis

```
void ida_init (struct ida * ida);
```

Arguments

ida

ida handle

Description

This function is use to set up the handle (*ida*) that you will pass to the rest of the functions.

Chapter 4. Memory Management in Linux

4.1. The Slab Cache

kmalloc

LINUX

Kernel Hackers ManualSeptember 2014

Name

`kmalloc` — allocate memory

Synopsis

```
void * kmalloc (size_t size, gfp_t flags);
```

Arguments

size

how many bytes of memory are required.

flags

the type of memory to allocate.

Description

`kmalloc` is the normal method of allocating memory for objects smaller than page size in the kernel.

The *flags* argument may be one of:

GFP_USER - Allocate memory on behalf of user. May sleep.

GFP_KERNEL - Allocate normal kernel ram. May sleep.

GFP_ATOMIC - Allocation will not sleep. May use emergency pools. For example, use this inside interrupt handlers.

GFP_HIGHUSER - Allocate pages from high memory.

GFP_NOIO - Do not do any I/O at all while trying to get memory.

GFP_NOFS - Do not make any fs calls while trying to get memory.

GFP_NOWAIT - Allocation will not sleep.

__GFP_THISNODE - Allocate node-local memory only.

GFP_DMA - Allocation suitable for DMA. Should only be used for `kmalloc` caches. Otherwise, use a slab created with `SLAB_DMA`.

Also it is possible to set different flags by OR'ing in one or more of the following additional *flags*:

__GFP_COLD - Request cache-cold pages instead of trying to return cache-warm pages.

__GFP_HIGH - This allocation has high priority and may use emergency pools.

__GFP_NOFAIL - Indicate that this allocation is in no way allowed to fail (think twice before using).

__GFP_NORETRY - If memory is not immediately available, then give up at once.

__GFP_NOWARN - If allocation fails, don't issue any warnings.

__GFP_REPEAT - If allocation fails initially, try once more before failing.

There are other flags available as well, but these are not intended for general use, and so are not documented here. For a full list of potential flags, always refer to `linux/gfp.h`.

kmalloc_array

LINUX

Name

`kmalloc_array` — allocate memory for an array.

Synopsis

```
void * kmalloc_array (size_t n, size_t size, gfp_t flags);
```

Arguments

n

number of elements.

size

element size.

flags

the type of memory to allocate (see `kmalloc`).

kcalloc

LINUX

Name

`kcalloc` — allocate memory for an array. The memory is set to zero.

Synopsis

```
void * kcalloc (size_t n, size_t size, gfp_t flags);
```

Arguments

n

number of elements.

size

element size.

flags

the type of memory to allocate (see `kmalloc`).

kzalloc

LINUX

Kernel Hackers ManualSeptember 2014

Name

`kzalloc` — allocate memory. The memory is set to zero.

Synopsis

```
void * kzalloc (size_t size, gfp_t flags);
```


Arguments

size

how many bytes of memory are required.

flags

the type of memory to allocate (see `kmalloc`).

kzalloc_node

LINUX

Kernel Hackers Manual September 2014

Name

`kzalloc_node` — allocate zeroed memory from a particular memory node.

Synopsis

```
void * kzalloc_node (size_t size, gfp_t flags, int node);
```

Arguments

size

how many bytes of memory are required.

flags

the type of memory to allocate (see `kmalloc`).

node

memory node from which to allocate

kmem_cache_alloc

LINUX

Kernel Hackers Manual September 2014

Name

`kmem_cache_alloc` — Allocate an object

Synopsis

```
void * kmem_cache_alloc (struct kmem_cache * cachep, gfp_t  
flags);
```

Arguments

cachep

The cache to allocate from.

flags

See `kmalloc`.

Description

Allocate an object from this cache. The flags are only relevant if the cache has no available objects.

kmem_cache_alloc_node

LINUX

Kernel Hackers Manual September 2014

Name

`kmem_cache_alloc_node` — Allocate an object on the specified node

Synopsis

```
void * kmem_cache_alloc_node (struct kmem_cache * cachep,  
gfp_t flags, int nodeid);
```

Arguments

cachep

The cache to allocate from.

flags

See `kmalloc`.

nodeid

node number of the target node.

Description

Identical to `kmem_cache_alloc` but it will allocate memory on the given node, which can improve the performance for cpu bound structures.

Fallback to other node is possible if `__GFP_THISNODE` is not set.

kmem_cache_free

LINUX

Kernel Hackers ManualSeptember 2014

Name

`kmem_cache_free` — Deallocate an object

Synopsis

```
void kmem_cache_free (struct kmem_cache * cachep, void *  
objp);
```

Arguments

cachep

The cache the allocation was from.

objp

The previously allocated object.

Description

Free an object which was previously allocated from this cache.

kfree

LINUX

Name

`kfree` — free previously allocated memory

Synopsis

```
void kfree (const void * objp);
```

Arguments

objp

pointer returned by `kmalloc`.

Description

If *objp* is `NULL`, no operation is performed.

Don't free memory not originally allocated by `kmalloc` or you will run into trouble.

ksize

LINUX

Name

`ksize` — get the actual amount of memory allocated for a given object

Synopsis

```
size_t ksize (const void * objp);
```

Arguments

objp

Pointer to the object

Description

`kmalloc` may internally round up allocations and return more memory than requested. `ksize` can be used to determine the actual amount of memory allocated. The caller may use this additional memory, even though a smaller amount of memory was initially specified with the `kmalloc` call. The caller must guarantee that *objp* points to a valid object previously allocated with either `kmalloc` or `kmem_cache_alloc`. The object must not be freed during the duration of the call.

kstrdup

LINUX

Kernel Hackers Manual September 2014

Name

`kstrdup` — allocate space for and copy an existing string

Synopsis

```
char * kstrdup (const char * s, gfp_t gfp);
```

Arguments

s

the string to duplicate

gfp

the GFP mask used in the `kmalloc` call when allocating memory

kstrndup

LINUX

Kernel Hackers Manual September 2014

Name

`kstrndup` — allocate space for and copy an existing string

Synopsis

```
char * kstrndup (const char * s, size_t max, gfp_t gfp);
```

Arguments

s

the string to duplicate

max

read at most *max* chars from *s*

gfp

the GFP mask used in the `kmalloc` call when allocating memory

kmemdup

LINUX

Kernel Hackers ManualSeptember 2014

Name

`kmemdup` — duplicate region of memory

Synopsis

```
void * kmemdup (const void * src, size_t len, gfp_t gfp);
```

Arguments

src

memory region to duplicate

len

memory region length

gfp

GFP mask to use

memdup_user

LINUX

Kernel Hackers ManualSeptember 2014

Name

`memdup_user` — duplicate memory region from user space

Synopsis

```
void * memdup_user (const void __user * src, size_t len);
```

Arguments

src

source address in user space

len

number of bytes to copy

Description

Returns an `ERR_PTR` on failure.

__krealloc

LINUX

Name

`__krealloc` — like `krealloc` but don't free *p*.

Synopsis

```
void * __krealloc (const void * p, size_t new_size, gfp_t
flags);
```

Arguments

p

object to reallocate memory for.

new_size

how many bytes of memory are required.

flags

the type of memory to allocate.

Description

This function is like `krealloc` except it never frees the originally allocated buffer. Use this if you don't want to free the buffer immediately like, for example, with RCU.

krealloc

LINUX

Name

`krealloc` — reallocate memory. The contents will remain unchanged.

Synopsis

```
void * krealloc (const void * p, size_t new_size, gfp_t  
flags);
```

Arguments

p

object to reallocate memory for.

new_size

how many bytes of memory are required.

flags

the type of memory to allocate.

Description

The contents of the object pointed to are preserved up to the lesser of the new and old sizes. If *p* is `NULL`, `krealloc` behaves exactly like `kmalloc`. If *new_size* is 0 and *p* is not a `NULL` pointer, the object pointed to is freed.

kzfree

LINUX

Name

`kzfree` — like `kfree` but zero memory

Synopsis

```
void kzfree (const void * p);
```

Arguments

p

object to free memory of

Description

The memory of the object *p* points to is zeroed before freed. If *p* is `NULL`, `kzfree` does nothing.

Note

this function zeroes the whole allocated buffer which can be a good deal bigger than the requested buffer size passed to `kmalloc`. So be careful when using this function in performance sensitive code.

get_user_pages_fast

LINUX

Name

`get_user_pages_fast` — pin user pages in memory

Synopsis

```
int get_user_pages_fast (unsigned long start, int nr_pages,
int write, struct page ** pages);
```

Arguments

start

starting user address

nr_pages

number of pages from start to pin

write

whether pages will be written to

pages

array that receives pointers to the pages pinned. Should be at least `nr_pages` long.

Description

Returns number of pages pinned. This may be fewer than the number requested. If `nr_pages` is 0 or negative, returns 0. If no pages were pinned, returns `-errno`.

`get_user_pages_fast` provides equivalent functionality to `get_user_pages`, operating on `current` and `current->mm`, with `force=0` and `vma=NULL`. However unlike `get_user_pages`, it must be called without `mmap_sem` held.

`get_user_pages_fast` may take `mmap_sem` and page table locks, so no assumptions can be made about lack of locking. `get_user_pages_fast` is to be implemented in a

way that is advantageous (vs `get_user_pages`) when the user memory area is already faulted in and present in ptes. However if the pages have to be faulted in, it may turn out to be slightly slower so callers need to carefully consider what to use. On many architectures, `get_user_pages_fast` simply falls back to `get_user_pages`.

4.2. User Space Memory Access

`__copy_to_user_inatomic`

LINUX

Kernel Hackers Manual September 2014

Name

`__copy_to_user_inatomic` — Copy a block of data into user space, with less checking.

Synopsis

```
unsigned long __copy_to_user_inatomic (void __user * to, const  
void * from, unsigned long n);
```

Arguments

to

Destination address, in user space.

from

Source address, in kernel space.

n

Number of bytes to copy.

Context

User context only.

Description

Copy data from kernel space to user space. Caller must check the specified block with `access_ok` before calling this function. The caller should also make sure he pins the user space address so that we don't result in page fault and sleep.

Here we special-case 1, 2 and 4-byte `copy_*_user` invocations. On a fault we return the initial request size (1, 2 or 4), as `copy_*_user` should do. If a store crosses a page boundary and gets a fault, the x86 will not write anything, so this is accurate.

__copy_to_user

LINUX

Kernel Hackers Manual September 2014

Name

`__copy_to_user` — Copy a block of data into user space, with less checking.

Synopsis

```
unsigned long __copy_to_user (void __user * to, const void *
from, unsigned long n);
```

Arguments

to

Destination address, in user space.

from

Source address, in kernel space.

n

Number of bytes to copy.

Context

User context only. This function may sleep.

Description

Copy data from kernel space to user space. Caller must check the specified block with `access_ok` before calling this function.

Returns number of bytes that could not be copied. On success, this will be zero.

__copy_from_user

LINUX

Kernel Hackers ManualSeptember 2014

Name

`__copy_from_user` — Copy a block of data from user space, with less checking.

Synopsis

```
unsigned long __copy_from_user (void * to, const void __user *  
from, unsigned long n);
```

Arguments

to

Destination address, in kernel space.

from

Source address, in user space.

n

Number of bytes to copy.

Context

User context only. This function may sleep.

Description

Copy data from user space to kernel space. Caller must check the specified block with `access_ok` before calling this function.

Returns number of bytes that could not be copied. On success, this will be zero.

If some data could not be copied, this function will pad the copied data to the requested size using zero bytes.

An alternate version - `__copy_from_user_inatomic` - may be called from atomic context and will fail rather than sleep. In this case the uncopied bytes will **NOT** be padded with zeros. See `fs/filemap.h` for explanation of why this is needed.

clear_user

LINUX

Kernel Hackers ManualSeptember 2014

Name

`clear_user` — Zero a block of memory in user space.

Synopsis

```
unsigned long clear_user (void __user * to, unsigned long n);
```

Arguments

to

Destination address, in user space.

n

Number of bytes to zero.

Description

Zero a block of memory in user space.

Returns number of bytes that could not be cleared. On success, this will be zero.

__clear_user

LINUX

Name

`__clear_user` — Zero a block of memory in user space, with less checking.

Synopsis

```
unsigned long __clear_user (void __user * to, unsigned long  
n);
```

Arguments

to

Destination address, in user space.

n

Number of bytes to zero.

Description

Zero a block of memory in user space. Caller must check the specified block with `access_ok` before calling this function.

Returns number of bytes that could not be cleared. On success, this will be zero.

`__copy_to_user`

LINUX

Name

`_copy_to_user` — Copy a block of data into user space.

Synopsis

```
unsigned long _copy_to_user (void __user * to, const void *  
from, unsigned n);
```

Arguments

to

Destination address, in user space.

from

Source address, in kernel space.

n

Number of bytes to copy.

Context

User context only. This function may sleep.

Description

Copy data from kernel space to user space.

Returns number of bytes that could not be copied. On success, this will be zero.

_copy_from_user

LINUX

Kernel Hackers Manual September 2014

Name

`_copy_from_user` — Copy a block of data from user space.

Synopsis

```
unsigned long _copy_from_user (void * to, const void __user *  
from, unsigned n);
```

Arguments

to

Destination address, in kernel space.

from

Source address, in user space.

n

Number of bytes to copy.

Context

User context only. This function may sleep.

Description

Copy data from user space to kernel space.

Returns number of bytes that could not be copied. On success, this will be zero.

If some data could not be copied, this function will pad the copied data to the requested size using zero bytes.

4.3. More Memory Management Functions

read_cache_pages

LINUX

Kernel Hackers Manual September 2014

Name

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

Synopsis

```
int read_cache_pages (struct address_space * mapping, struct
list_head * pages, int (*filler) (void *, struct page *), void
* data);
```

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.

filler

callback routine for filling a single page.

data

private data for the callback routine.

Description

Hides the details of the LRU cache etc from the filesystems.

page_cache_sync_readahead

LINUX

Kernel Hackers ManualSeptember 2014

Name

page_cache_sync_readahead — generic file readahead

Synopsis

```
void page_cache_sync_readahead (struct address_space *  
mapping, struct file_ra_state * ra, struct file * filp,  
pgoff_t offset, unsigned long req_size);
```

Arguments

mapping

address_space which holds the pagecache and I/O vectors

ra

file_ra_state which holds the readahead state

filp

passed on to ->readpage and ->readpages

offset

start offset into *mapping*, in pagecache page-sized units

req_size

hint: total size of the read which the caller is performing in pagecache pages

Description

page_cache_sync_readahead should be called when a cache miss happened: it will submit the read. The readahead logic may decide to piggyback more pages onto the read request if access patterns suggest it will improve performance.

page_cache_async_readahead

LINUX

Kernel Hackers ManualSeptember 2014

Name

page_cache_async_readahead — file readahead for marked pages

Synopsis

```
void page_cache_async_readahead (struct address_space *  
mapping, struct file_ra_state * ra, struct file * filp, struct  
page * page, pgoff_t offset, unsigned long req_size);
```


Arguments

mapping

address_space which holds the pagecache and I/O vectors

ra

file_ra_state which holds the readahead state

filp

passed on to ->readpage and ->readpages

page

the page at *offset* which has the PG_readahead flag set

offset

start offset into *mapping*, in pagecache page-sized units

req_size

hint: total size of the read which the caller is performing in pagecache pages

Description

page_cache_async_readahead should be called when a page is used which has the PG_readahead flag; this is a marker to suggest that the application has used up enough of the readahead window that we should start pulling in more pages.

delete_from_page_cache

LINUX

Kernel Hackers Manual September 2014

Name

delete_from_page_cache — delete page from page cache

Synopsis

```
void delete_from_page_cache (struct page * page);
```

Arguments

page

the page which the kernel is trying to remove from page cache

Description

This must be called only on pages that have been verified to be in the page cache and locked. It will never put the page into the free list, the caller has a reference on the page.

filemap_flush

LINUX

Kernel Hackers ManualSeptember 2014

Name

`filemap_flush` — mostly a non-blocking flush

Synopsis

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

Arguments

mapping

target address_space

Description

This is a mostly non-blocking flush. Not suitable for data-integrity purposes - I/O may not be started against all dirty pages.

filemap_fdatawait_range

LINUX

Kernel Hackers ManualSeptember 2014

Name

filemap_fdatawait_range — wait for writeback to complete

Synopsis

```
int filemap_fdatawait_range (struct address_space * mapping,  
loff_t start_byte, loff_t end_byte);
```

Arguments

mapping

address space structure to wait for

start_byte

offset in bytes where the range starts

end_byte

offset in bytes where the range ends (inclusive)

Description

Walk the list of under-writeback pages of the given address space in the given range and wait for all of them.

filemap_fdatawait

LINUX

Kernel Hackers ManualSeptember 2014

Name

`filemap_fdatawait` — wait for all under-writeback pages to complete

Synopsis

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

Arguments

mapping

address space structure to wait for

Description

Walk the list of under-writeback pages of the given address space and wait for all of them.

filemap_write_and_wait_range

LINUX

Kernel Hackers Manual September 2014

Name

`filemap_write_and_wait_range` — write out & wait on a file range

Synopsis

```
int filemap_write_and_wait_range (struct address_space *  
mapping, loff_t lstart, loff_t lend);
```

Arguments

mapping

the `address_space` for the pages

lstart

offset in bytes where the range starts

lend

offset in bytes where the range ends (inclusive)

Description

Write out and wait upon file offsets `lstart->lend`, inclusive.

Note that ‘`lend`’ is inclusive (describes the last byte to be written) so that this function can be used to write to the very end-of-file (`end = -1`).

replace_page_cache_page

LINUX

Kernel Hackers Manual September 2014

Name

`replace_page_cache_page` — replace a pagecache page with a new one

Synopsis

```
int replace_page_cache_page (struct page * old, struct page *  
new, gfp_t gfp_mask);
```

Arguments

old

page to be replaced

new

page to replace with

gfp_mask

allocation mode

Description

This function replaces a page in the pagecache with a new one. On success it acquires the pagecache reference for the new page and drops it for the old page. Both the old and new pages must be locked. This function does not add the new page to the LRU, the caller must do that.

The remove + add is atomic. The only way this function can fail is memory allocation failure.

add_to_page_cache_locked

LINUX

Kernel Hackers Manual September 2014

Name

`add_to_page_cache_locked` — add a locked page to the pagecache

Synopsis

```
int add_to_page_cache_locked (struct page * page, struct  
address_space * mapping, pgoff_t offset, gfp_t gfp_mask);
```

Arguments

page

page to add

mapping

the page's `address_space`

offset

page index

gfp_mask

page allocation mode

Description

This function is used to add a page to the pagecache. It must be locked. This function does not add the page to the LRU. The caller must do that.

add_page_wait_queue

LINUX

Kernel Hackers ManualSeptember 2014

Name

`add_page_wait_queue` — Add an arbitrary waiter to a page's wait queue

Synopsis

```
void add_page_wait_queue (struct page * page, wait_queue_t *  
waiter);
```

Arguments

page

Page defining the wait queue of interest

waiter

Waiter to add to the queue

Description

Add an arbitrary *waiter* to the wait queue for the nominated *page*.

unlock_page

LINUX

Kernel Hackers Manual September 2014

Name

unlock_page — unlock a locked page

Synopsis

```
void unlock_page (struct page * page);
```

Arguments

page

the page

Description

Unlocks the page and wakes up sleepers in `___wait_on_page_locked`. Also wakes sleepers in `wait_on_page_writeback` because the wakeup mechanism between PageLocked pages and PageWriteback pages is shared. But that's OK - sleepers in `wait_on_page_writeback` just go back to sleep.

The mb is necessary to enforce ordering between the `clear_bit` and the read of the waitqueue (to avoid SMP races with a parallel `wait_on_page_locked`).

end_page_writeback

LINUX

Name

`end_page_writeback` — end writeback against a page

Synopsis

```
void end_page_writeback (struct page * page);
```

Arguments

page

the page

__lock_page

LINUX

Name

`__lock_page` — get a lock on the page, assuming we need to sleep to get it

Synopsis

```
void __lock_page (struct page * page);
```

Arguments

page

the page to lock

page_cache_next_hole

LINUX

Kernel Hackers Manual September 2014

Name

`page_cache_next_hole` — find the next hole (not-present entry)

Synopsis

```
pgoff_t page_cache_next_hole (struct address_space * mapping,  
pgoff_t index, unsigned long max_scan);
```

Arguments

mapping

`mapping`

index

`index`

max_scan

maximum range to search

Description

Search the set [index, min(index+max_scan-1, MAX_INDEX)] for the lowest indexed hole.

Returns

the index of the hole if found, otherwise returns an index outside of the set specified (in which case 'return - index >= max_scan' will be true). In rare cases of index wrap-around, 0 will be returned.

page_cache_next_hole may be called under rcu_read_lock. However, like radix_tree_gang_lookup, this will not atomically search a snapshot of the tree at a single point in time. For example, if a hole is created at index 5, then subsequently a hole is created at index 10, page_cache_next_hole covering both indexes may return 10 if called under rcu_read_lock.

page_cache_prev_hole

LINUX

Kernel Hackers ManualSeptember 2014

Name

page_cache_prev_hole — find the prev hole (not-present entry)

Synopsis

```
pgoff_t page_cache_prev_hole (struct address_space * mapping,  
pgoff_t index, unsigned long max_scan);
```

Arguments

mapping

mapping

index

index

max_scan

maximum range to search

Description

Search backwards in the range $[\max(\text{index} - \text{max_scan} + 1, 0), \text{index}]$ for the first hole.

Returns

the index of the hole if found, otherwise returns an index outside of the set specified (in which case `'index - return >= max_scan'` will be true). In rare cases of wrap-around, `ULONG_MAX` will be returned.

`page_cache_prev_hole` may be called under `rcu_read_lock`. However, like `radix_tree_gang_lookup`, this will not atomically search a snapshot of the tree at a single point in time. For example, if a hole is created at index 10, then subsequently a hole is created at index 5, `page_cache_prev_hole` covering both indexes may return 5 if called under `rcu_read_lock`.

find_get_entry

LINUX

Kernel Hackers Manual September 2014

Name

`find_get_entry` — find and get a page cache entry

Synopsis

```
struct page * find_get_entry (struct address_space * mapping,
                                pgoff_t offset);
```

Arguments

mapping

the address_space to search

offset

the page cache index

Description

Looks up the page cache slot at *mapping* & *offset*. If there is a page cache page, it is returned with an increased refcount.

If the slot holds a shadow entry of a previously evicted page, or a swap entry from shmem/tmpfs, it is returned.

Otherwise, NULL is returned.

find_lock_entry

LINUX

Kernel Hackers Manual September 2014

Name

`find_lock_entry` — locate, pin and lock a page cache entry

Synopsis

```
struct page * find_lock_entry (struct address_space * mapping,
                                pgoff_t offset);
```

Arguments

mapping

the address_space to search

offset

the page cache index

Description

Looks up the page cache slot at *mapping* & *offset*. If there is a page cache page, it is returned locked and with an increased refcount.

If the slot holds a shadow entry of a previously evicted page, or a swap entry from shmem/tmpfs, it is returned.

Otherwise, NULL is returned.

`find_lock_entry` may sleep.

pagecache_get_page

LINUX

Kernel Hackers Manual September 2014

Name

`pagecache_get_page` — find and get a page reference

Synopsis

```
struct page * pagecache_get_page (struct address_space *  
mapping, pgoff_t offset, int fgp_flags, gfp_t cache_gfp_mask,  
gfp_t radix_gfp_mask);
```

Arguments

mapping

the address_space to search

offset

the page index

fgp_flags

PCG flags

cache_gfp_mask

gfp mask to use for the page cache data page allocation

radix_gfp_mask

gfp mask to use for radix tree node allocation

Description

Looks up the page cache slot at *mapping* & *offset*.

PCG flags modify how the page is returned.

FGP_ACCESSED

the page will be marked accessed

FGP_LOCK

Page is return locked

FGP_CREAT

If page is not present then a new page is allocated using *cache_gfp_mask* and added to the page cache and the VM's LRU list. If radix tree nodes are allocated during page cache insertion then *radix_gfp_mask* is used. The page is returned locked and with an increased refcount. Otherwise, `NULL` is returned.

If `FGP_LOCK` or `FGP_CREAT` are specified then the function may sleep even if the GFP flags specified for `FGP_CREAT` are atomic.

If there is a page cache page, it is returned with an increased refcount.

find_get_pages_contig

LINUX

Kernel Hackers Manual September 2014

Name

`find_get_pages_contig` — gang contiguous pagecache lookup

Synopsis

```
unsigned find_get_pages_contig (struct address_space *
mapping, pgoff_t index, unsigned int nr_pages, struct page **
pages);
```

Arguments

mapping

The `address_space` to search

index

The starting page index

nr_pages

The maximum number of pages

pages

Where the resulting pages are placed

Description

`find_get_pages_contig` works exactly like `find_get_pages`, except that the returned number of pages are guaranteed to be contiguous.

`find_get_pages_contig` returns the number of pages which were found.

find_get_pages_tag

LINUX

Kernel Hackers ManualSeptember 2014

Name

`find_get_pages_tag` — find and return pages that match *tag*

Synopsis

```
unsigned find_get_pages_tag (struct address_space * mapping,  
pgoff_t * index, int tag, unsigned int nr_pages, struct page  
** pages);
```

Arguments

mapping

the `address_space` to search

index

the starting page index

tag

the tag index

nr_pages

the maximum number of pages

pages

where the resulting pages are placed

Description

Like `find_get_pages`, except we only return pages which are tagged with *tag*. We update *index* to index the next page for the traversal.

generic_file_read_iter

LINUX

Kernel Hackers ManualSeptember 2014

Name

`generic_file_read_iter` — generic filesystem read routine

Synopsis

```
ssize_t generic_file_read_iter (struct kiocb * iocb, struct  
iov_iter * iter);
```

Arguments

iocb

kernel I/O control block

iter

destination for the data read

Description

This is the “`read_iter`” routine for all filesystems that can use the page cache directly.

filemap_fault

LINUX

Kernel Hackers ManualSeptember 2014

Name

`filemap_fault` — read in file data for page fault handling

Synopsis

```
int filemap_fault (struct vm_area_struct * vma, struct
vm_fault * vmf);
```

Arguments

vma

vma in which the fault was taken

*vmf*struct `vm_fault` containing details of the fault

Description

`filemap_fault` is invoked via the `vma` operations vector for a mapped memory region to read in file data during a page fault.

The `goto`'s are kind of ugly, but this streamlines the normal case of having it in the page cache, and handles the special cases reasonably without having a lot of duplicated code.

read_cache_page

LINUX

Kernel Hackers Manual September 2014

Name

`read_cache_page` — read into page cache, fill it if needed

Synopsis

```
struct page * read_cache_page (struct address_space * mapping,
pgoff_t index, int (*filler) (void *, struct page *), void *
data);
```

Arguments

*mapping*the page's `address_space`

index

the page index

filler

function to perform the read

data

first arg to filler(data, page) function, often left as NULL

Description

Read into the page cache. If a page already exists, and `PageUptodate` is not set, try to fill the page and wait for it to become unlocked.

If the page does not get brought uptodate, return `-EIO`.

read_cache_page_gfp

LINUX

Kernel Hackers Manual September 2014

Name

`read_cache_page_gfp` — read into page cache, using specified page allocation flags.

Synopsis

```
struct page * read_cache_page_gfp (struct address_space *  
mapping, pgoff_t index, gfp_t gfp);
```

Arguments

mapping

the page's address_space

index

the page index

gfp

the page allocator flags to use if allocating

Description

This is the same as “read_mapping_page(mapping, index, NULL)”, but with any new page allocations done using the specified allocation flags.

If the page does not get brought uptodate, return -EIO.

__generic_file_write_iter

LINUX

Kernel Hackers Manual September 2014

Name

`__generic_file_write_iter` — write data to a file

Synopsis

```
ssize_t __generic_file_write_iter (struct kiocb * iocb, struct
iov_iter * from);
```

Arguments

iocb

IO state structure (file, offset, etc.)

from

iov_iter with data to write

Description

This function does all the work needed for actually writing data to a file. It does all basic checks, removes SUID from the file, updates modification times and calls proper subroutines depending on whether we do direct IO or a standard buffered write.

It expects `i_mutex` to be grabbed unless we work on a block device or similar object which does not need locking at all.

This function does **not** take care of syncing data in case of `O_SYNC` write. A caller has to handle it. This is mainly due to the fact that we want to avoid syncing under `i_mutex`.

generic_file_write_iter

LINUX

Kernel Hackers ManualSeptember 2014

Name

`generic_file_write_iter` — write data to a file

Synopsis

```
ssize_t generic_file_write_iter (struct kiocb * iocb, struct
iov_iter * from);
```


Arguments

iocb

IO state structure

from

iov_iter with data to write

Description

This is a wrapper around `__generic_file_write_iter` to be used by most filesystems. It takes care of syncing the file in case of `O_SYNC` file and acquires `i_mutex` as needed.

try_to_release_page

LINUX

Kernel Hackers ManualSeptember 2014

Name

`try_to_release_page` — release old fs-specific metadata on a page

Synopsis

```
int try_to_release_page (struct page * page, gfp_t gfp_mask);
```

Arguments

page

the page which the kernel is trying to free

gfp_mask

memory allocation flags (and I/O mode)

Description

The `address_space` is to try to release any data against the page (presumably at `page->private`). If the release was successful, return '1'. Otherwise return zero.

This may also be called if `PG_fscache` is set on a page, indicating that the page is known to the local caching routines.

The `gfp_mask` argument specifies whether I/O may be performed to release this page (`__GFP_IO`), and whether the call may block (`__GFP_WAIT` & `__GFP_FS`).

zap_page_range

LINUX

Kernel Hackers Manual September 2014

Name

`zap_page_range` — remove user pages in a given range

Synopsis

```
void zap_page_range (struct vm_area_struct * vma, unsigned
long start, unsigned long size, struct zap_details * details);
```

Arguments

vma

vm_area_struct holding the applicable pages

start

starting address of pages to zap

size

number of bytes to zap

details

details of nonlinear truncation or shared cache invalidation

Description

Caller must protect the VMA list

zap_vma_ptes

LINUX

Kernel Hackers ManualSeptember 2014

Name

zap_vma_ptes — remove ptes mapping the vma

Synopsis

```
int zap_vma_ptes (struct vm_area_struct * vma, unsigned long  
address, unsigned long size);
```

Arguments

vma

vm_area_struct holding ptes to be zapped

address

starting address of pages to zap

size

number of bytes to zap

Description

This function only unmaps ptes assigned to VM_PFNMAP vmas.

The entire address range must be fully contained within the vma.

Returns 0 if successful.

vm_insert_page

LINUX

Kernel Hackers ManualSeptember 2014

Name

vm_insert_page — insert single page into user vma

Synopsis

```
int vm_insert_page (struct vm_area_struct * vma, unsigned long  
addr, struct page * page);
```

Arguments

vma

user vma to map to

addr

target user address of this page

page

source kernel page

Description

This allows drivers to insert individual pages they've allocated into a user vma.

The page has to be a nice clean `_individual_` kernel allocation. If you allocate a compound page, you need to have marked it as such (`__GFP_COMP`), or manually just split the page up yourself (see `split_page`).

NOTE! Traditionally this was done with “`remap_pfn_range`” which took an arbitrary page protection parameter. This doesn't allow that. Your vma protection will have to be set up correctly, which means that if you want a shared writable mapping, you'd better ask for a shared writable mapping!

The page does not need to be reserved.

Usually this function is called from `f_op->mmap` handler under `mm->mmap_sem` write-lock, so it can change `vma->vm_flags`. Caller must set `VM_MIXEDMAP` on vma if it wants to call this function from other places, for example from page-fault handler.

vm_insert_pfn

LINUX

Name

`vm_insert_pfn` — insert single pfn into user vma

Synopsis

```
int vm_insert_pfn (struct vm_area_struct * vma, unsigned long  
addr, unsigned long pfn);
```

Arguments

vma

user vma to map to

addr

target user address of this page

pfn

source kernel pfn

Description

Similar to `vm_insert_page`, this allows drivers to insert individual pages they've allocated into a user vma. Same comments apply.

This function should only be called from a `vm_ops->fault` handler, and in that case the handler should return `NULL`.

vma cannot be a COW mapping.

As this is called only for pages that do not currently exist, we do not need to flush old virtual caches or the TLB.

remap_pfn_range

LINUX

Kernel Hackers Manual September 2014

Name

`remap_pfn_range` — remap kernel memory to userspace

Synopsis

```
int remap_pfn_range (struct vm_area_struct * vma, unsigned
long addr, unsigned long pfn, unsigned long size, pgprot_t
prot);
```

Arguments

vma

user vma to map to

addr

target user address to start at

pfn

physical address of kernel memory

size

size of map area

prot

page protection flags for this mapping

Note

this is only safe if the mm semaphore is held when called.

vm_iomap_memory

LINUX

Kernel Hackers Manual September 2014

Name

`vm_iomap_memory` — remap memory to userspace

Synopsis

```
int vm_iomap_memory (struct vm_area_struct * vma, phys_addr_t
start, unsigned long len);
```

Arguments

vma

user vma to map to

start

start of area

len

size of area

Description

This is a simplified `io_remap_pfn_range` for common driver use. The driver just needs to give us the physical memory range to be mapped, we'll figure out the rest from the vma information.

NOTE! Some drivers might want to tweak `vma->vm_page_prot` first to get whatever write-combining details or similar.

unmap_mapping_range

LINUX

Kernel Hackers Manual September 2014

Name

`unmap_mapping_range` — unmap the portion of all mmaps in the specified `address_space` corresponding to the specified page range in the underlying file.

Synopsis

```
void unmap_mapping_range (struct address_space * mapping,  
loff_t const holebegin, loff_t const holelen, int even_cows);
```

Arguments

mapping

the address space containing mmaps to be unmapped.

holebegin

byte in first page to unmap, relative to the start of the underlying file. This will be rounded down to a `PAGE_SIZE` boundary. Note that this is different from `truncate_pagecache`, which must keep the partial page. In contrast, we must get rid of partial pages.

holelen

size of prospective hole in bytes. This will be rounded up to a `PAGE_SIZE` boundary. A `holelen` of zero truncates to the end of the file.

even_cows

1 when truncating a file, unmap even private COWed pages; but 0 when invalidating pagecache, don't throw away private data.

follow_pfn

LINUX

Kernel Hackers ManualSeptember 2014

Name

`follow_pfn` — look up PFN at a user virtual address

Synopsis

```
int follow_pfn (struct vm_area_struct * vma, unsigned long
address, unsigned long * pfn);
```

Arguments

vma

memory mapping

address

user virtual address

pfn

location to store found PFN

Description

Only IO mappings and raw PFN mappings are allowed.

Returns zero and the pfn at *pfn* on success, -ve otherwise.

vm_unmap_aliases

LINUX

Kernel Hackers ManualSeptember 2014

Name

`vm_unmap_aliases` — unmap outstanding lazy aliases in the vmap layer

Synopsis

```
void vm_unmap_aliases ( void );
```

Arguments

void

no arguments

Description

The vmap/vmalloc layer lazily flushes kernel virtual mappings primarily to amortize TLB flushing overheads. What this means is that any page you have now, may, in a former life, have been mapped into kernel virtual address by the vmap layer and so there might be some CPUs with TLB entries still referencing that page (additional to the regular 1:1 kernel mapping).

`vm_unmap_aliases` flushes all such lazy mappings. After it returns, we can be sure that none of the pages we have control over will have any aliases from the `vmap` layer.

vm_unmap_ram

LINUX

Kernel Hackers Manual September 2014

Name

`vm_unmap_ram` — unmap linear kernel address space set up by `vm_map_ram`

Synopsis

```
void vm_unmap_ram (const void * mem, unsigned int count);
```

Arguments

mem

the pointer returned by `vm_map_ram`

count

the count passed to that `vm_map_ram` call (cannot unmap partial)

vm_map_ram

LINUX

Name

`vm_map_ram` — map pages linearly into kernel virtual address (vmalloc space)

Synopsis

```
void * vm_map_ram (struct page ** pages, unsigned int count,  
int node, pgprot_t prot);
```

Arguments

pages

an array of pointers to the pages to be mapped

count

number of pages

node

prefer to allocate data structures on this node

prot

memory protection to use. `PAGE_KERNEL` for regular RAM

Description

If you use this function for less than `VMAP_MAX_ALLOC` pages, it could be faster than `vmap` so it's good. But if you mix long-life and short-life objects with `vm_map_ram`, it could consume lots of address space through fragmentation (especially on a 32bit machine). You could see failures in the end. Please use this function for short-lived objects.

Returns

a pointer to the address that has been mapped, or `NULL` on failure

unmap_kernel_range_noflush

LINUX

Kernel Hackers ManualSeptember 2014

Name

`unmap_kernel_range_noflush` — unmap kernel VM area

Synopsis

```
void unmap_kernel_range_noflush (unsigned long addr, unsigned  
long size);
```

Arguments

addr

start of the VM area to unmap

size

size of the VM area to unmap

Description

Unmap `PFN_UP(size)` pages at *addr*. The VM area *addr* and *size* specify should have been allocated using `get_vm_area` and its friends.

NOTE

This function does NOT do any cache flushing. The caller is responsible for calling `flush_cache_vunmap` on to-be-mapped areas before calling this function and `flush_tlb_kernel_range` after.

unmap_kernel_range

LINUX

Kernel Hackers ManualSeptember 2014

Name

`unmap_kernel_range` — unmap kernel VM area and flush cache and TLB

Synopsis

```
void unmap_kernel_range (unsigned long addr, unsigned long
size);
```

Arguments

addr

start of the VM area to unmap

size

size of the VM area to unmap

Description

Similar to `unmap_kernel_range_noflush` but flushes vcache before the unmapping and tlb after.

vfree

LINUX

Kernel Hackers Manual September 2014

Name

`vfree` — release memory allocated by `vmalloc`

Synopsis

```
void vfree (const void * addr);
```

Arguments

addr

memory base address

Description

Free the virtually continuous memory area starting at *addr*, as obtained from `vmalloc`, `vmalloc_32` or `__vmalloc`. If *addr* is `NULL`, no operation is performed.

Must not be called in NMI context (strictly speaking, only if we don't have `CONFIG_ARCH_HAVE_NMI_SAFE_CMPXCHG`, but making the calling conventions for `vfree` arch-depenedent would be a really bad idea)

NOTE

assumes that the object at `*addr` has a size `>= sizeof(llist_node)`

vunmap

LINUX

Kernel Hackers ManualSeptember 2014

Name

vunmap — release virtual mapping obtained by vmap

Synopsis

```
void vunmap (const void * addr);
```

Arguments

addr

memory base address

Description

Free the virtually contiguous memory area starting at *addr*, which was created from the page array passed to vmap.

Must not be called in interrupt context.

vmap

LINUX

Name

`vmap` — map an array of pages into virtually contiguous space

Synopsis

```
void * vmap (struct page ** pages, unsigned int count,  
unsigned long flags, pgprot_t prot);
```

Arguments

pages

array of page pointers

count

number of pages to map

flags

`vm_area->flags`

prot

page protection for the mapping

Description

Maps *count* pages from *pages* into contiguous kernel virtual space.

`vmalloc`

LINUX

Name

`vmalloc` — allocate virtually contiguous memory

Synopsis

```
void * vmalloc (unsigned long size);
```

Arguments

size

allocation size Allocate enough pages to cover *size* from the page level allocator and map them into contiguous kernel virtual space.

Description

For tight control over page level allocator and protection flags use `__vmalloc` instead.

vzalloc

LINUX

Name

`vzalloc` — allocate virtually contiguous memory with zero fill

Synopsis

```
void * vzalloc (unsigned long size);
```

Arguments

size

allocation size Allocate enough pages to cover *size* from the page level allocator and map them into contiguous kernel virtual space. The memory allocated is set to zero.

Description

For tight control over page level allocator and protection flags use `__vmalloc` instead.

vmalloc_user

LINUX

Kernel Hackers Manual September 2014

Name

`vmalloc_user` — allocate zeroed virtually contiguous memory for userspace

Synopsis

```
void * vmalloc_user (unsigned long size);
```

Arguments

size

allocation size

Description

The resulting memory area is zeroed so it can be mapped to userspace without leaking data.

vmalloc_node

LINUX

Kernel Hackers ManualSeptember 2014

Name

`vmalloc_node` — allocate memory on a specific node

Synopsis

```
void * vmalloc_node (unsigned long size, int node);
```

Arguments

size

allocation size

node

numa node

Description

Allocate enough pages to cover *size* from the page level allocator and map them into contiguous kernel virtual space.

For tight control over page level allocator and protection flags use `__vmalloc` instead.

vzalloc_node

LINUX

Kernel Hackers Manual September 2014

Name

`vzalloc_node` — allocate memory on a specific node with zero fill

Synopsis

```
void * vzalloc_node (unsigned long size, int node);
```

Arguments

size

allocation size

node

numa node

Description

Allocate enough pages to cover *size* from the page level allocator and map them into contiguous kernel virtual space. The memory allocated is set to zero.

For tight control over page level allocator and protection flags use `__vmalloc_node` instead.

vmalloc_32

LINUX

Kernel Hackers ManualSeptember 2014

Name

`vmalloc_32` — allocate virtually contiguous memory (32bit addressable)

Synopsis

```
void * vmalloc_32 (unsigned long size);
```

Arguments

size

allocation size

Description

Allocate enough 32bit PA addressable pages to cover *size* from the page level allocator and map them into contiguous kernel virtual space.

vmalloc_32_user

LINUX

Kernel Hackers ManualSeptember 2014

Name

`vmalloc_32_user` — allocate zeroed virtually contiguous 32bit memory

Synopsis

```
void * vmalloc_32_user (unsigned long size);
```

Arguments

size

allocation size

Description

The resulting memory area is 32bit addressable and zeroed so it can be mapped to userspace without leaking data.

remap_vmalloc_range_partial

LINUX

Name

`remap_vmalloc_range_partial` — map vmalloc pages to userspace

Synopsis

```
int remap_vmalloc_range_partial (struct vm_area_struct * vma,  
unsigned long uaddr, void * kaddr, unsigned long size);
```

Arguments

vma

vma to cover

uaddr

target user address to start at

kaddr

virtual address of vmalloc kernel memory

size

size of map area

Returns

0 for success, -Exxx on failure

This function checks that *kaddr* is a valid vmalloc'ed area, and that it is big enough to cover the range starting at *uaddr* in *vma*. Will return failure if that criteria isn't met.

Similar to `remap_pfn_range` (see `mm/memory.c`)

remap_vmalloc_range

LINUX

Kernel Hackers Manual September 2014

Name

remap_vmalloc_range — map vmalloc pages to userspace

Synopsis

```
int remap_vmalloc_range (struct vm_area_struct * vma, void *  
addr, unsigned long pgoff);
```

Arguments

vma

vma to cover (map full range of vma)

addr

vmalloc memory

pgoff

number of pages into addr before first page to map

Returns

0 for success, -Exxx on failure

This function checks that *addr* is a valid vmalloc'ed area, and that it is big enough to cover the *vma*. Will return failure if that criteria isn't met.

Similar to `remap_pfn_range` (see `mm/memory.c`)

alloc_vm_area

LINUX

Kernel Hackers Manual September 2014

Name

`alloc_vm_area` — allocate a range of kernel address space

Synopsis

```
struct vm_struct * alloc_vm_area (size_t size, pte_t ** ptes);
```

Arguments

size

size of the area

ptes

returns the PTEs for the address space

Returns

NULL on failure, `vm_struct` on success

This function reserves a range of kernel address space, and allocates pagetables to map that range. No actual mappings are created.

If *ptes* is non-NULL, pointers to the PTEs (in `init_mm`) allocated for the VM area are returned.

nr_free_zone_pages

LINUX

Kernel Hackers ManualSeptember 2014

Name

`nr_free_zone_pages` — count number of pages beyond high watermark

Synopsis

```
unsigned long nr_free_zone_pages (int offset);
```

Arguments

offset

The zone index of the highest zone

Description

`nr_free_zone_pages` counts the number of counts pages which are beyond the high watermark within all zones at or below a given zone index. For each zone, the number of pages is calculated as: `managed_pages - high_pages`

nr_free_pagecache_pages

LINUX

Name

`nr_free_pagecache_pages` — count number of pages beyond high watermark

Synopsis

```
unsigned long nr_free_pagecache_pages ( void );
```

Arguments

void

no arguments

Description

`nr_free_pagecache_pages` counts the number of pages which are beyond the high watermark within all zones.

find_next_best_node

LINUX

Name

`find_next_best_node` — find the next node that should appear in a given node's fallback list

Synopsis

```
int find_next_best_node (int node, nodemask_t *  
used_node_mask);
```

Arguments

node

node whose fallback list we're appending

used_node_mask

nodemask_t of already used nodes

Description

We use a number of factors to determine which is the next node that should appear on a given node's fallback list. The node should not have appeared already in *node*'s fallback list, and it should be the next closest node according to the distance array (which contains arbitrary distance values from each node to each node in the system), and should also prefer nodes with no CPUs, since presumably they'll have very little allocation pressure on them otherwise. It returns -1 if no node is found.

free_bootmem_with_active_regions

LINUX

Kernel Hackers Manual September 2014

Name

`free_bootmem_with_active_regions` — Call `memblock_free_early_nid` for each active range

Synopsis

```
void free_bootmem_with_active_regions (int nid, unsigned long  
max_low_pfn);
```

Arguments

nid

The node to free memory on. If MAX_NUMNODES, all nodes are freed.

max_low_pfn

The highest PFN that will be passed to memblock_free_early_nid

Description

If an architecture guarantees that all ranges registered contain no holes and may be freed, this this function may be used instead of calling memblock_free_early_nid manually.

sparse_memory_present_with_active_regions

LINUX

Kernel Hackers ManualSeptember 2014

Name

sparse_memory_present_with_active_regions — Call memory_present for each active range

Synopsis

```
void sparse_memory_present_with_active_regions (int nid);
```

Arguments

nid

The node to call `memory_present` for. If `MAX_NUMNODES`, all nodes will be used.

Description

If an architecture guarantees that all ranges registered contain no holes and may be freed, this function may be used instead of calling `memory_present` manually.

get_pfn_range_for_nid

LINUX

Kernel Hackers ManualSeptember 2014

Name

`get_pfn_range_for_nid` — Return the start and end page frames for a node

Synopsis

```
void __meminit get_pfn_range_for_nid (unsigned int nid,  
unsigned long * start_pfn, unsigned long * end_pfn);
```


Arguments

nid

The nid to return the range for. If MAX_NUMNODES, the min and max PFN are returned.

start_pfn

Passed by reference. On return, it will have the node start_pfn.

end_pfn

Passed by reference. On return, it will have the node end_pfn.

Description

It returns the start and end page frame of a node based on information provided by memblock_set_node. If called for a node with no available memory, a warning is printed and the start and end PFNs will be 0.

absent_pages_in_range

LINUX

Kernel Hackers ManualSeptember 2014

Name

absent_pages_in_range — Return number of page frames in holes within a range

Synopsis

```
unsigned long absent_pages_in_range (unsigned long start_pfn,  
unsigned long end_pfn);
```

Arguments

start_pfn

The start PFN to start searching for holes

end_pfn

The end PFN to stop searching for holes

Description

It returns the number of pages frames in memory holes within a range.

node_map_pfn_alignment

LINUX

Kernel Hackers ManualSeptember 2014

Name

`node_map_pfn_alignment` — determine the maximum internode alignment

Synopsis

```
unsigned long node_map_pfn_alignment ( void );
```

Arguments

void

no arguments

Description

This function should be called after node map is populated and sorted. It calculates the maximum power of two alignment which can distinguish all the nodes.

For example, if all nodes are 1GiB and aligned to 1GiB, the return value would indicate 1GiB alignment with $(1 \ll (30 - \text{PAGE_SHIFT}))$. If the nodes are shifted by 256MiB, 256MiB. Note that if only the last node is shifted, 1GiB is enough and this function will indicate so.

This is used to test whether pfn -> nid mapping of the chosen memory model has fine enough granularity to avoid incorrect mapping for the populated node map.

Returns the determined alignment in pfn's. 0 if there is no alignment requirement (single node).

find_min_pfn_with_active_regions

LINUX

Kernel Hackers Manual September 2014

Name

`find_min_pfn_with_active_regions` — Find the minimum PFN registered

Synopsis

```
unsigned long find_min_pfn_with_active_regions ( void );
```

Arguments

void

no arguments

Description

It returns the minimum PFN based on information provided via `memblock_set_node`.

free_area_init_nodes

LINUX

Kernel Hackers ManualSeptember 2014

Name

`free_area_init_nodes` — Initialise all `pg_data_t` and zone data

Synopsis

```
void free_area_init_nodes (unsigned long * max_zone_pfn);
```

Arguments

max_zone_pfn

an array of max PFNs for each zone

Description

This will call `free_area_init_node` for each active node in the system. Using the page ranges provided by `memblock_set_node`, the size of each zone in each node and their holes is calculated. If the maximum PFN between two adjacent zones match, it is assumed that the zone is empty. For example, if `arch_max_dma_pfn == arch_max_dma32_pfn`, it is assumed that `arch_max_dma32_pfn` has no pages. It is also assumed that a zone starts where the previous one ended. For example, `ZONE_DMA32` starts at `arch_max_dma_pfn`.

set_dma_reserve

LINUX

Kernel Hackers ManualSeptember 2014

Name

`set_dma_reserve` — set the specified number of pages reserved in the first zone

Synopsis

```
void set_dma_reserve (unsigned long new_dma_reserve);
```

Arguments

new_dma_reserve

The number of pages to mark reserved

Description

The per-cpu batchsize and zone watermarks are determined by `present_pages`. In the DMA zone, a significant percentage may be consumed by kernel image and other unfreeable allocations which can skew the watermarks badly. This function may optionally be used to account for unfreeable pages in the first zone (e.g., `ZONE_DMA`). The effect will be lower watermarks and smaller per-cpu batchsize.

setup_per_zone_wmarks

LINUX

Kernel Hackers ManualSeptember 2014

Name

`setup_per_zone_wmarks` — called when `min_free_kbytes` changes or when memory is hot-`{added|removed}`

Synopsis

```
void setup_per_zone_wmarks ( void );
```

Arguments

void

no arguments

Description

Ensures that the watermark[`min,low,high`] values for each zone are set correctly with respect to `min_free_kbytes`.

get_pfnblock_flags_mask

LINUX

Name

`get_pfnblock_flags_mask` — Return the requested group of flags for the `pageblock_nr_pages` block of pages

Synopsis

```
unsigned long get_pfnblock_flags_mask (struct page * page,  
unsigned long pfn, unsigned long end_bitidx, unsigned long  
mask);
```

Arguments

page

The page within the block of interest

pfn

The target page frame number

end_bitidx

The last bit of interest to retrieve

mask

mask of bits that the caller is interested in

Return

`pageblock_bits` flags

set_pfnblock_flags_mask

LINUX

Kernel Hackers ManualSeptember 2014

Name

`set_pfnblock_flags_mask` — Set the requested group of flags for a `pageblock_nr_pages` block of pages

Synopsis

```
void set_pfnblock_flags_mask (struct page * page, unsigned  
long flags, unsigned long pfn, unsigned long end_bitidx,  
unsigned long mask);
```

Arguments

page

The page within the block of interest

flags

The flags to set

pfn

The target page frame number

end_bitidx

The last bit of interest

mask

mask of bits that the caller is interested in

alloc_contig_range

LINUX

Kernel Hackers Manual September 2014

Name

`alloc_contig_range` — - tries to allocate given range of pages

Synopsis

```
int alloc_contig_range (unsigned long start, unsigned long
end, unsigned migratetype);
```

Arguments

start

start PFN to allocate

end

one-past-the-last PFN to allocate

migratetype

migratetype of the underlying pageblocks (either `#MIGRATE_MOVABLE` or `#MIGRATE_CMA`). All pageblocks in range must have the same migratetype and it must be either of the two.

Description

The PFN range does not have to be pageblock or `MAX_ORDER_NR_PAGES` aligned, however it's the caller's responsibility to guarantee that we are the only thread that changes migrate type of pageblocks the pages fall in.

The PFN range must belong to a single zone.

Returns zero on success or negative error code. On success all pages which PFN is in [start, end) are allocated for the caller and need to be freed with `free_contig_range`.

mempool_destroy

LINUX

Kernel Hackers Manual September 2014

Name

`mempool_destroy` — deallocate a memory pool

Synopsis

```
void mempool_destroy (mempool_t * pool);
```

Arguments

pool

pointer to the memory pool which was allocated via `mempool_create`.

Description

Free all reserved elements in *pool* and *pool* itself. This function only sleeps if the `free_fn` function sleeps.

mempool_create

LINUX

Kernel Hackers Manual September 2014

Name

`mempool_create` — create a memory pool

Synopsis

```
mempool_t * mempool_create (int min_nr, mempool_alloc_t *  
alloc_fn, mempool_free_t * free_fn, void * pool_data);
```

Arguments

min_nr

the minimum number of elements guaranteed to be allocated for this pool.

alloc_fn

user-defined element-allocation function.

free_fn

user-defined element-freeing function.

pool_data

optional private data available to the user-defined functions.

Description

this function creates and allocates a guaranteed size, preallocated memory pool. The pool can be used from the `mempool_alloc` and `mempool_free` functions. This function might sleep. Both the `alloc_fn` and the `free_fn` functions might sleep - as long as the `mempool_alloc` function is not called from IRQ contexts.

mempool_resize

LINUX

Kernel Hackers Manual September 2014

Name

`mempool_resize` — resize an existing memory pool

Synopsis

```
int mempool_resize (mempool_t * pool, int new_min_nr, gfp_t
gfp_mask);
```

Arguments

pool

pointer to the memory pool which was allocated via `mempool_create`.

new_min_nr

the new minimum number of elements guaranteed to be allocated for this pool.

gfp_mask

the usual allocation bitmask.

Description

This function shrinks/grows the pool. In the case of growing, it cannot be guaranteed that the pool will be grown to the new size immediately, but new `mempool_free` calls will refill it.

Note, the caller must guarantee that no `mempool_destroy` is called while this function is running. `mempool_alloc` & `mempool_free` might be called (eg. from IRQ contexts) while this function executes.

mempool_alloc

LINUX

Kernel Hackers ManualSeptember 2014

Name

`mempool_alloc` — allocate an element from a specific memory pool

Synopsis

```
void * mempool_alloc (mempool_t * pool, gfp_t gfp_mask);
```

Arguments

pool

pointer to the memory pool which was allocated via `mempool_create`.

gfp_mask

the usual allocation bitmask.

Description

this function only sleeps if the `alloc_fn` function sleeps or returns NULL. Note that due to preallocation, this function **never** fails when called from process contexts. (it might fail if called from an IRQ context.)

Note

using `__GFP_ZERO` is not supported.

mempool_free

LINUX

Kernel Hackers ManualSeptember 2014

Name

`mempool_free` — return an element to the pool.

Synopsis

```
void mempool_free (void * element, mempool_t * pool);
```

Arguments

element

pool element pointer.

pool

pointer to the memory pool which was allocated via `mempool_create`.

Description

this function only sleeps if the `free_fn` function sleeps.

dma_pool_create

LINUX

Kernel Hackers Manual September 2014

Name

`dma_pool_create` — Creates a pool of consistent memory blocks, for dma.

Synopsis

```
struct dma_pool * dma_pool_create (const char * name, struct
device * dev, size_t size, size_t align, size_t boundary);
```

Arguments

name

name of pool, for diagnostics

dev

device that will be doing the DMA

size

size of the blocks in this pool.

align

alignment requirement for blocks; must be a power of two

boundary

returned blocks won't cross this power of two boundary

Context

`!in_interrupt`

Description

Returns a dma allocation pool with the requested characteristics, or null if one can't be created. Given one of these pools, `dma_pool_alloc` may be used to allocate memory. Such memory will all have “consistent” DMA mappings, accessible by the device and its driver without using cache flushing primitives. The actual size of blocks allocated may be larger than requested because of alignment.

If *boundary* is nonzero, objects returned from `dma_pool_alloc` won't cross that size boundary. This is useful for devices which have addressing restrictions on individual DMA transfers, such as not crossing boundaries of 4KBytes.

`dma_pool_destroy`

LINUX

Kernel Hackers Manual September 2014

Name

`dma_pool_destroy` — destroys a pool of dma memory blocks.

Synopsis

```
void dma_pool_destroy (struct dma_pool * pool);
```

Arguments

pool

dma pool that will be destroyed

Context

`!in_interrupt`

Description

Caller guarantees that no more memory from the pool is in use, and that nothing will try to use the pool after this call.

dma_pool_alloc

LINUX

Kernel Hackers ManualSeptember 2014

Name

`dma_pool_alloc` — get a block of consistent memory

Synopsis

```
void * dma_pool_alloc (struct dma_pool * pool, gfp_t  
mem_flags, dma_addr_t * handle);
```

Arguments

pool

dma pool that will produce the block

mem_flags

GFP_* bitmask

handle

pointer to dma address of block

Description

This returns the kernel virtual address of a currently unused block, and reports its dma address through the handle. If such a memory block can't be allocated, `NULL` is returned.

`dma_pool_free`

LINUX

Kernel Hackers Manual September 2014

Name

`dma_pool_free` — put block back into dma pool

Synopsis

```
void dma_pool_free (struct dma_pool * pool, void * vaddr,  
dma_addr_t dma);
```

Arguments

pool

the dma pool holding the block

vaddr

virtual address of block

dma

dma address of block

Description

Caller promises neither device nor driver will again touch this block unless it is first re-allocated.

dmam_pool_create

LINUX

Kernel Hackers ManualSeptember 2014

Name

dmam_pool_create — Managed dma_pool_create

Synopsis

```
struct dma_pool * dmam_pool_create (const char * name, struct  
device * dev, size_t size, size_t align, size_t allocation);
```

Arguments

name

name of pool, for diagnostics

dev

device that will be doing the DMA

size

size of the blocks in this pool.

align

alignment requirement for blocks; must be a power of two

allocation

returned blocks won't cross this boundary (or zero)

Description

Managed `dma_pool_create`. DMA pool created with this function is automatically destroyed on driver detach.

dmam_pool_destroy

LINUX

Kernel Hackers ManualSeptember 2014

Name

`dmam_pool_destroy` — Managed `dma_pool_destroy`

Synopsis

```
void dmam_pool_destroy (struct dma_pool * pool);
```

Arguments

pool

dma pool that will be destroyed

Description

Managed `dma_pool_destroy`.

balance_dirty_pages_ratelimited

LINUX

Kernel Hackers Manual September 2014

Name

`balance_dirty_pages_ratelimited` — balance dirty memory state

Synopsis

```
void balance_dirty_pages_ratelimited (struct address_space *  
mapping);
```

Arguments

mapping

address_space which was dirtied

Description

Processes which are dirtying memory should call in here once for each page which was newly dirtied. The function will periodically check the system's dirty state and will initiate writeback if needed.

On really big machines, `get_writeback_state` is expensive, so try to avoid calling it too often (ratelimiting). But once we're over the dirty memory limit we decrease the ratelimiting by a lot, to prevent individual processes from overshooting the limit by (`ratelimit_pages`) each.

tag_pages_for_writeback

LINUX

Kernel Hackers Manual September 2014

Name

`tag_pages_for_writeback` — tag pages to be written by `write_cache_pages`

Synopsis

```
void tag_pages_for_writeback (struct address_space * mapping,  
pgoff_t start, pgoff_t end);
```

Arguments

mapping

address space structure to write

start

starting page index

end

ending page index (inclusive)

Description

This function scans the page range from *start* to *end* (inclusive) and tags all pages that have DIRTY tag set with a special TOWRITE tag. The idea is that `write_cache_pages` (or whoever calls this function) will then use TOWRITE tag to identify pages eligible for writeback. This mechanism is used to avoid livelocking of writeback by a process steadily creating new dirty pages in the file (thus it is important for this function to be quick so that it can tag pages faster than a dirtying process can create them).

write_cache_pages

LINUX

Kernel Hackers Manual September 2014

Name

`write_cache_pages` — walk the list of dirty pages of the given address space and write all of them.

Synopsis

```
int write_cache_pages (struct address_space * mapping, struct
writeback_control * wbc, writepage_t writepage, void * data);
```

Arguments

mapping

address space structure to write

wbc

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

writepage

function called for each page

data

data passed to writepage function

Description

If a page is already under I/O, `write_cache_pages` 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.

To avoid livelocks (when other process dirties new pages), we first tag pages which should be written back with `TOWRITE` tag and only then start writing them. For data-integrity sync we have to be careful so that we do not miss some pages (e.g., because some other process has cleared `TOWRITE` tag we set). The rule we follow is that `TOWRITE` tag can be cleared only by the process clearing the `DIRTY` tag (and submitting the page for IO).

generic_writepages

LINUX

Kernel Hackers Manual September 2014

Name

`generic_writepages` — walk the list of dirty pages of the given address space and `writepage` all of them.

Synopsis

```
int generic_writepages (struct address_space * mapping, struct
writeback_control * wbc);
```


Arguments

mapping

address space structure to write

wbc

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

Description

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

write_one_page

LINUX

Kernel Hackers ManualSeptember 2014

Name

`write_one_page` — write out a single page and optionally wait on I/O

Synopsis

```
int write_one_page (struct page * page, int wait);
```

Arguments

page

the page to write

wait

if true, wait on writeout

Description

The page must be locked by the caller and will be unlocked upon return.

`write_one_page` returns a negative error code if I/O failed.

wait_for_stable_page

LINUX

Kernel Hackers ManualSeptember 2014

Name

`wait_for_stable_page` — wait for writeback to finish, if necessary.

Synopsis

```
void wait_for_stable_page (struct page * page);
```

Arguments

page

The page to wait on.

Description

This function determines if the given page is related to a backing device that requires page contents to be held stable during writeback. If so, then it will wait for any pending writeback to complete.

truncate_inode_pages_range

LINUX

Kernel Hackers Manual September 2014

Name

`truncate_inode_pages_range` — truncate range of pages specified by start & end byte offsets

Synopsis

```
void truncate_inode_pages_range (struct address_space *
mapping, loff_t lstart, loff_t lend);
```

Arguments

mapping

mapping to truncate

lstart

offset from which to truncate

lend

offset to which to truncate (inclusive)

Description

Truncate the page cache, removing the pages that are between specified offsets (and zeroing out partial pages if `lstart` or `lend + 1` is not page aligned).

Truncate takes two passes - the first pass is nonblocking. It will not block on page locks and it will not block on writeback. The second pass will wait. This is to prevent as much IO as possible in the affected region. The first pass will remove most pages, so the search cost of the second pass is low.

We pass down the cache-hot hint to the page freeing code. Even if the mapping is large, it is probably the case that the final pages are the most recently touched, and freeing happens in ascending file offset order.

Note that since `->invalidatepage` accepts range to invalidate `truncate_inode_pages_range` is able to handle cases where `lend + 1` is not page aligned properly.

truncate_inode_pages

LINUX

Kernel Hackers Manual September 2014

Name

`truncate_inode_pages` — truncate **all** the pages from an offset

Synopsis

```
void truncate_inode_pages (struct address_space * mapping,  
loff_t lstart);
```

Arguments

mapping

mapping to truncate

lstart

offset from which to truncate

Description

Called under (and serialised by) `inode->i_mutex`.

Note

When this function returns, there can be a page in the process of deletion (inside `__delete_from_page_cache`) in the specified range. Thus `mapping->nrpages` can be non-zero when this function returns even after truncation of the whole mapping.

truncate_inode_pages_final

LINUX

Kernel Hackers Manual September 2014

Name

`truncate_inode_pages_final` — truncate **all** pages before inode dies

Synopsis

```
void truncate_inode_pages_final (struct address_space *
mapping);
```

Arguments

mapping

mapping to truncate

Description

Called under (and serialized by) inode->i_mutex.

Filesystems have to use this in the .evict_inode path to inform the VM that this is the final truncate and the inode is going away.

invalidate_mapping_pages

LINUX

Kernel Hackers ManualSeptember 2014

Name

invalidate_mapping_pages — Invalidate all the unlocked pages of one inode

Synopsis

```
unsigned long invalidate_mapping_pages (struct address_space *  
mapping, pgoff_t start, pgoff_t end);
```

Arguments

mapping

the address_space which holds the pages to invalidate

start

the offset 'from' which to invalidate

end

the offset 'to' which to invalidate (inclusive)

Description

This function only removes the unlocked pages, if you want to remove all the pages of one inode, you must call `truncate_inode_pages`.

`invalidate_mapping_pages` will not block on IO activity. It will not invalidate pages which are dirty, locked, under writeback or mapped into pagetables.

invalidate_inode_pages2_range

LINUX

Kernel Hackers Manual September 2014

Name

`invalidate_inode_pages2_range` — remove range of pages from an `address_space`

Synopsis

```
int invalidate_inode_pages2_range (struct address_space *  
mapping, pgoff_t start, pgoff_t end);
```

Arguments

mapping

the `address_space`

start

the page offset 'from' which to invalidate

end

the page offset 'to' which to invalidate (inclusive)

Description

Any pages which are found to be mapped into pagetables are unmapped prior to invalidation.

Returns `-EBUSY` if any pages could not be invalidated.

invalidate_inode_pages2

LINUX

Kernel Hackers ManualSeptember 2014

Name

`invalidate_inode_pages2` — remove all pages from an `address_space`

Synopsis

```
int invalidate_inode_pages2 (struct address_space * mapping);
```


Arguments

mapping

the `address_space`

Description

Any pages which are found to be mapped into pagetables are unmapped prior to invalidation.

Returns `-EBUSY` if any pages could not be invalidated.

truncate_pagecache

LINUX

Kernel Hackers ManualSeptember 2014

Name

`truncate_pagecache` — unmap and remove pagecache that has been truncated

Synopsis

```
void truncate_pagecache (struct inode * inode, loff_t  
newsize);
```

Arguments

inode

`inode`

newsize

new file size

Description

inode's new `i_size` must already be written before `truncate_pagecache` is called.

This function should typically be called before the filesystem releases resources associated with the freed range (eg. deallocates blocks). This way, pagecache will always stay logically coherent with on-disk format, and the filesystem would not have to deal with situations such as `writepage` being called for a page that has already had its underlying blocks deallocated.

truncate_setsize

LINUX

Kernel Hackers ManualSeptember 2014

Name

`truncate_setsize` — update inode and pagecache for a new file size

Synopsis

```
void truncate_setsize (struct inode * inode, loff_t newsize);
```

Arguments

inode

inode

newsize

new file size

Description

`truncate_setsize` updates `i_size` and performs pagecache truncation (if necessary) to *newsize*. It will be typically be called from the filesystem's `setattr` function when `ATTR_SIZE` is passed in.

Must be called with `inode_mutex` held and before all filesystem specific block truncation has been performed.

truncate_pagecache_range

LINUX

Kernel Hackers ManualSeptember 2014

Name

`truncate_pagecache_range` — unmap and remove pagecache that is hole-punched

Synopsis

```
void truncate_pagecache_range (struct inode * inode, loff_t
lstart, loff_t lend);
```

Arguments

inode

inode

lstart

offset of beginning of hole

lend

offset of last byte of hole

Description

This function should typically be called before the filesystem releases resources associated with the freed range (eg. deallocates blocks). This way, pagecache will always stay logically coherent with on-disk format, and the filesystem would not have to deal with situations such as writepage being called for a page that has already had its underlying blocks deallocated.

Chapter 5. Kernel IPC facilities

5.1. IPC utilities

ipc_init

LINUX

Kernel Hackers ManualSeptember 2014

Name

`ipc_init` — initialise ipc subsystem

Synopsis

```
int ipc_init ( void );
```

Arguments

void

no arguments

Description

The various sysv ipc resources (semaphores, messages and shared memory) are initialised.

A callback routine is registered into the memory hotplug notifier

chain

since msgmni scales to lowmem this callback routine will be called upon successful memory add / remove to recompute msgmni.

ipc_init_ids

LINUX

Kernel Hackers ManualSeptember 2014

Name

`ipc_init_ids` — initialise ipc identifiers

Synopsis

```
void ipc_init_ids (struct ipc_ids * ids);
```

Arguments

ids

ipc identifier set

Description

Set up the sequence range to use for the ipc identifier range (limited below IPCMNI) then initialise the ids idr.

ipc_init_proc_interface

LINUX

Kernel Hackers Manual September 2014

Name

`ipc_init_proc_interface` — create a proc interface for sysipc types using a `seq_file` interface.

Synopsis

```
void ipc_init_proc_interface (const char * path, const char *  
header, int ids, int (*show) (struct seq_file *, void *));
```

Arguments

path

Path in `procfs`

header

Banner to be printed at the beginning of the file.

ids

ipc id table to iterate.

show

show routine.

ipc_findkey

LINUX

Kernel Hackers ManualSeptember 2014

Name

`ipc_findkey` — find a key in an ipc identifier set

Synopsis

```
struct kern_ipc_perm * ipc_findkey (struct ipc_ids * ids,  
key_t key);
```

Arguments

ids

ipc identifier set

key

key to find

Description

Returns the locked pointer to the ipc structure if found or NULL otherwise. If key is found ipc points to the owning ipc structure

Called with `ipc_ids.rwsem` held.

ipc_get_maxid

LINUX

Kernel Hackers ManualSeptember 2014

Name

`ipc_get_maxid` — get the last assigned id

Synopsis

```
int ipc_get_maxid (struct ipc_ids * ids);
```

Arguments

ids

ipc identifier set

Description

Called with `ipc_ids.rwsem` held.

ipc_addid

LINUX

Kernel Hackers ManualSeptember 2014

Name

`ipc_addid` — add an ipc identifier

Synopsis

```
int ipc_addid (struct ipc_ids * ids, struct kern_ipc_perm *  
new, int size);
```

Arguments

ids

ipc identifier set

new

new ipc permission set

size

limit for the number of used ids

Description

Add an entry 'new' to the ipc ids idr. The permissions object is initialised and the first free entry is set up and the id assigned is returned. The 'new' entry is returned in a locked state on success. On failure the entry is not locked and a negative err-code is returned.

Called with writer ipc_ids.rwsem held.

ipcget_new

LINUX

Kernel Hackers Manual September 2014

Name

ipcget_new — create a new ipc object

Synopsis

```
int ipcget_new (struct ipc_namespace * ns, struct ipc_ids *
ids, const struct ipc_ops * ops, struct ipc_params * params);
```

Arguments

ns

ipc namespace

ids

ipc identifier set

ops

the actual creation routine to call

params

its parameters

Description

This routine is called by `sys_msgget`, `sys_semget` and `sys_shmget` when the key is `IPC_PRIVATE`.

ipc_check_perms

LINUX

Kernel Hackers Manual September 2014

Name

`ipc_check_perms` — check security and permissions for an ipc object

Synopsis

```
int ipc_check_perms (struct ipc_namespace * ns, struct
kern_ipc_perm * ipcp, const struct ipc_ops * ops, struct
ipc_params * params);
```

Arguments

ns

ipc namespace

ipcp

ipc permission set

ops

the actual security routine to call

params

its parameters

Description

This routine is called by `sys_msgget`, `sys_semget` and `sys_shmget` when the key is not `IPC_PRIVATE` and that key already exists in the ds IDR.

On success, the ipc id is returned.

It is called with `ipc_ids.rwsem` and `ipcp->lock` held.

ipcget_public

LINUX

Name

`ipcget_public` — get an ipc object or create a new one

Synopsis

```
int ipcget_public (struct ipc_namespace * ns, struct ipc_ids *  
ids, const struct ipc_ops * ops, struct ipc_params * params);
```

Arguments

ns

ipc namespace

ids

ipc identifier set

ops

the actual creation routine to call

params

its parameters

Description

This routine is called by `sys_msgget`, `sys_semget` and `sys_shmget` when the key is not `IPC_PRIVATE`. It adds a new entry if the key is not found and does some permission / security checkings if the key is found.

On success, the ipc id is returned.

ipc_rmid

LINUX

Kernel Hackers ManualSeptember 2014

Name

`ipc_rmid` — remove an ipc identifier

Synopsis

```
void ipc_rmid (struct ipc_ids * ids, struct kern_ipc_perm *  
ipcp);
```

Arguments

ids

ipc identifier set

ipcp

ipc perm structure containing the identifier to remove

Description

`ipc_ids.rwsem` (as a writer) and the spinlock for this ID are held before this function is called, and remain locked on the exit.

ipc_alloc

LINUX

Name

`ipc_alloc` — allocate ipc space

Synopsis

```
void * ipc_alloc (int size);
```

Arguments

size

size desired

Description

Allocate memory from the appropriate pools and return a pointer to it. NULL is returned if the allocation fails

ipc_free

LINUX

Name

`ipc_free` — free ipc space

Synopsis

```
void ipc_free (void * ptr, int size);
```

Arguments

ptr

pointer returned by `ipc_alloc`

size

size of block

Description

Free a block created with `ipc_alloc`. The caller must know the size used in the allocation call.

ipc_rcu_alloc

LINUX

Kernel Hackers ManualSeptember 2014

Name

`ipc_rcu_alloc` — allocate ipc and rcu space

Synopsis

```
void * ipc_rcu_alloc (int size);
```


Arguments

size

size desired

Description

Allocate memory for the rcu header structure + the object. Returns the pointer to the object or NULL upon failure.

ipcperrs

LINUX

Kernel Hackers ManualSeptember 2014

Name

ipcperrs — check ipc permissions

Synopsis

```
int ipcperrs (struct ipc_namespace * ns, struct kern_ipc_perm
* ipcp, short flag);
```

Arguments

ns

ipc namespace

ipcp

ipc permission set

flag

desired permission set

Description

Check user, group, other permissions for access to ipc resources. return 0 if allowed

flag will most probably be 0 or S_...UGO from <linux/stat.h>

kernel_to_ipc64_perm

LINUX

Kernel Hackers ManualSeptember 2014

Name

kernel_to_ipc64_perm — convert kernel ipc permissions to user

Synopsis

```
void kernel_to_ipc64_perm (struct kern_ipc_perm * in, struct  
ipc64_perm * out);
```

Arguments

in

kernel permissions

out

new style ipc permissions

Description

Turn the kernel object *in* into a set of permissions descriptions for returning to userspace (*out*).

ipc64_perm_to_ipc_perm

LINUX

Kernel Hackers ManualSeptember 2014

Name

`ipc64_perm_to_ipc_perm` — convert new ipc permissions to old

Synopsis

```
void ipc64_perm_to_ipc_perm (struct ipc64_perm * in, struct
ipc_perm * out);
```

Arguments

in

new style ipc permissions

out

old style ipc permissions

Description

Turn the new style permissions object *in* into a compatibility object and store it into the *out* pointer.

ipc_obtain_object

LINUX

Kernel Hackers ManualSeptember 2014

Name

`ipc_obtain_object` —

Synopsis

```
struct kern_ipc_perm * ipc_obtain_object (struct ipc_ids *  
ids, int id);
```

Arguments

ids

ipc identifier set

id

ipc id to look for

Description

Look for an id in the ipc ids idr and return associated ipc object.

Call inside the RCU critical section. The ipc object is **not** locked on exit.

ipc_lock

LINUX

Kernel Hackers Manual September 2014

Name

`ipc_lock` — lock an ipc structure without rwsem held

Synopsis

```
struct kern_ipc_perm * ipc_lock (struct ipc_ids * ids, int
id);
```

Arguments

ids

ipc identifier set

id

ipc id to look for

Description

Look for an id in the ipc ids idr and lock the associated ipc object.

The ipc object is locked on successful exit.

ipc_obtain_object_check

LINUX

Name

`ipc_obtain_object_check` —

Synopsis

```
struct kern_ipc_perm * ipc_obtain_object_check (struct ipc_ids  
* ids, int id);
```

Arguments

ids

ipc identifier set

id

ipc id to look for

Description

Similar to `ipc_obtain_object` but also checks the ipc object reference counter.

Call inside the RCU critical section. The ipc object is **not** locked on exit.

ipcget

LINUX

Name

`ipcget` — Common `sys_*get` code

Synopsis

```
int ipcget (struct ipc_namespace * ns, struct ipc_ids * ids,  
const struct ipc_ops * ops, struct ipc_params * params);
```

Arguments

ns

namespace

ids

ipc identifier set

ops

operations to be called on ipc object creation, permission checks and further checks

params

the parameters needed by the previous operations.

Description

Common routine called by `sys_msgget`, `sys_semget` and `sys_shmget`.

ipc_update_perm

LINUX

Kernel Hackers ManualSeptember 2014

Name

`ipc_update_perm` — update the permissions of an ipc object

Synopsis

```
int ipc_update_perm (struct ipc64_perm * in, struct  
kern_ipc_perm * out);
```

Arguments

in

the permission given as input.

out

the permission of the ipc to set.

ipcctl_pre_down_nolock

LINUX

Kernel Hackers ManualSeptember 2014

Name

`ipcctl_pre_down_nolock` — retrieve an ipc and check permissions for some
IPC_XXX cmd

Synopsis

```
struct kern_ipc_perm * ipcctl_pre_down_nolock (struct
ipc_namespace * ns, struct ipc_ids * ids, int id, int cmd,
struct ipc64_perm * perm, int extra_perm);
```

Arguments

ns

ipc namespace

ids

the table of ids where to look for the ipc

id

the id of the ipc to retrieve

cmd

the cmd to check

perm

the permission to set

extra_perm

one extra permission parameter used by msq

Description

This function does some common audit and permissions check for some IPC_XXX cmd and is called from semctl_down, shmctl_down and msgctl_down. It must be called without any lock held and - retrieves the ipc with the given id in the given table. - performs some audit and permission check, depending on the given cmd - returns a pointer to the ipc object or otherwise, the corresponding error.

Call holding the both the rwsem and the rcu read lock.

ipc_parse_version

LINUX

Kernel Hackers ManualSeptember 2014

Name

`ipc_parse_version` — ipc call version

Synopsis

```
int ipc_parse_version (int * cmd);
```

Arguments

cmd

pointer to command

Description

Return `IPC_64` for new style IPC and `IPC_OLD` for old style IPC. The *cmd* value is turned from an encoding command and version into just the command code.

Chapter 6. FIFO Buffer

6.1. kfifo interface

DECLARE_KFIFO_PTR

LINUX

Kernel Hackers Manual September 2014

Name

DECLARE_KFIFO_PTR — macro to declare a fifo pointer object

Synopsis

```
DECLARE_KFIFO_PTR ( fifo, type );
```

Arguments

fifo

name of the declared fifo

type

type of the fifo elements

DECLARE_KFIFO

LINUX

Name

`DECLARE_KFIFO` — macro to declare a fifo object

Synopsis

```
DECLARE_KFIFO ( fifo, type, size );
```

Arguments

fifo

name of the declared fifo

type

type of the fifo elements

size

the number of elements in the fifo, this must be a power of 2

INIT_KFIFO

LINUX

Name

`INIT_KFIFO` — Initialize a fifo declared by `DECLARE_KFIFO`

Synopsis

```
INIT_KFIFO ( fifo );
```

Arguments

fifo

name of the declared fifo datatype

DEFINE_KFIFO

LINUX

Kernel Hackers Manual September 2014

Name

DEFINE_KFIFO — macro to define and initialize a fifo

Synopsis

```
DEFINE_KFIFO ( fifo, type, size );
```

Arguments

fifo

name of the declared fifo datatype

type

type of the fifo elements

size

the number of elements in the fifo, this must be a power of 2

Note

the macro can be used for global and local fifo data type variables.

kfifo_initialized

LINUX

Kernel Hackers ManualSeptember 2014

Name

`kfifo_initialized` — Check if the fifo is initialized

Synopsis

```
kfifo_initialized ( fifo );
```

Arguments

fifo

address of the fifo to check

Description

Return `true` if `fifo` is initialized, otherwise `false`. Assumes the `fifo` was 0 before.

kfifo_esize

LINUX

Kernel Hackers ManualSeptember 2014

Name

`kfifo_esize` — returns the size of the element managed by the `fifo`

Synopsis

```
kfifo_esize ( fifo );
```

Arguments

fifo

address of the `fifo` to be used

kfifo_resize

LINUX

Name

`kfifo_recsz` — returns the size of the record length field

Synopsis

```
kfifo_recsz ( fifo );
```

Arguments

fifo

address of the fifo to be used

kfifo_size

LINUX

Name

`kfifo_size` — returns the size of the fifo in elements

Synopsis

```
kfifo_size ( fifo );
```


Arguments

fifo

address of the fifo to be used

kfifo_reset

LINUX

Kernel Hackers ManualSeptember 2014

Name

`kfifo_reset` — removes the entire fifo content

Synopsis

```
kfifo_reset ( fifo );
```

Arguments

fifo

address of the fifo to be used

Note

usage of `kfifo_reset` is dangerous. It should be only called when the fifo is exclusived locked or when it is secured that no other thread is accessing the fifo.

kfifo_reset_out

LINUX

Kernel Hackers ManualSeptember 2014

Name

`kfifo_reset_out` — skip fifo content

Synopsis

```
kfifo_reset_out ( fifo);
```

Arguments

fifo

address of the fifo to be used

Note

The usage of `kfifo_reset_out` is safe until it will be only called from the reader thread and there is only one concurrent reader. Otherwise it is dangerous and must be handled in the same way as `kfifo_reset`.

kfifo_len

LINUX

Name

`kfifo_len` — returns the number of used elements in the fifo

Synopsis

```
kfifo_len ( fifo );
```

Arguments

fifo

address of the fifo to be used

kfifo_is_empty

LINUX

Name

`kfifo_is_empty` — returns true if the fifo is empty

Synopsis

```
kfifo_is_empty ( fifo );
```

Arguments

fifo

address of the fifo to be used

kfifo_is_full

LINUX

Kernel Hackers ManualSeptember 2014

Name

`kfifo_is_full` — returns true if the fifo is full

Synopsis

```
kfifo_is_full ( fifo );
```

Arguments

fifo

address of the fifo to be used

kfifo_avail

LINUX

Name

`kfifo_avail` — returns the number of unused elements in the fifo

Synopsis

```
kfifo_avail ( fifo );
```

Arguments

fifo

address of the fifo to be used

kfifo_skip

LINUX

Name

`kfifo_skip` — skip output data

Synopsis

```
kfifo_skip ( fifo );
```

Arguments

fifo

address of the fifo to be used

kfifo_peek_len

LINUX

Kernel Hackers ManualSeptember 2014

Name

`kfifo_peek_len` — gets the size of the next fifo record

Synopsis

```
kfifo_peek_len ( fifo );
```

Arguments

fifo

address of the fifo to be used

Description

This function returns the size of the next fifo record in number of bytes.

kfifo_alloc

LINUX

Kernel Hackers Manual September 2014

Name

`kfifo_alloc` — dynamically allocates a new fifo buffer

Synopsis

```
kfifo_alloc ( fifo, size, gfp_mask );
```

Arguments

fifo

pointer to the fifo

size

the number of elements in the fifo, this must be a power of 2

gfp_mask

get_free_pages mask, passed to `kmalloc`

Description

This macro dynamically allocates a new fifo buffer.

The number of elements will be rounded-up to a power of 2. The fifo will be released with `kfifo_free`. Return 0 if no error, otherwise an error code.

kfifo_free

LINUX

Kernel Hackers ManualSeptember 2014

Name

`kfifo_free` — frees the fifo

Synopsis

```
kfifo_free ( fifo);
```

Arguments

fifo

the fifo to be freed

kfifo_init

LINUX

Kernel Hackers ManualSeptember 2014

Name

`kfifo_init` — initialize a fifo using a preallocated buffer

Synopsis

```
kfifo_init ( fifo, buffer, size );
```

Arguments

fifo

the fifo to assign the buffer

buffer

the preallocated buffer to be used

size

the size of the internal buffer, this have to be a power of 2

Description

This macro initialize a fifo using a preallocated buffer.

The numer of elements will be rounded-up to a power of 2. Return 0 if no error, otherwise an error code.

kfifo_put

LINUX

Kernel Hackers Manual September 2014

Name

`kfifo_put` — put data into the fifo

Synopsis

```
kfifo_put ( fifo, val );
```

Arguments

fifo

address of the fifo to be used

val

the data to be added

Description

This macro copies the given value into the fifo. It returns 0 if the fifo was full. Otherwise it returns the number processed elements.

Note that with only one concurrent reader and one concurrent writer, you don't need extra locking to use these macro.

kfifo_get

LINUX

Kernel Hackers Manual September 2014

Name

`kfifo_get` — get data from the fifo

Synopsis

```
kfifo_get ( fifo, val );
```

Arguments

fifo

address of the fifo to be used

val

address where to store the data

Description

This macro reads the data from the fifo. It returns 0 if the fifo was empty. Otherwise it returns the number processed elements.

Note that with only one concurrent reader and one concurrent writer, you don't need extra locking to use these macro.

kfifo_peek

LINUX

Kernel Hackers Manual September 2014

Name

`kfifo_peek` — get data from the fifo without removing

Synopsis

```
kfifo_peek ( fifo, val );
```

Arguments

fifo

address of the fifo to be used

val

address where to store the data

Description

This reads the data from the fifo without removing it from the fifo. It returns 0 if the fifo was empty. Otherwise it returns the number processed elements.

Note that with only one concurrent reader and one concurrent writer, you don't need extra locking to use these macro.

kfifo_in

LINUX

Kernel Hackers ManualSeptember 2014

Name

`kfifo_in` — put data into the fifo

Synopsis

```
kfifo_in ( fifo, buf, n );
```

Arguments

fifo

address of the fifo to be used

buf

the data to be added

n

number of elements to be added

Description

This macro copies the given buffer into the fifo and returns the number of copied elements.

Note that with only one concurrent reader and one concurrent writer, you don't need extra locking to use these macro.

kfifo_in_spinlocked

LINUX

Kernel Hackers Manual September 2014

Name

`kfifo_in_spinlocked` — put data into the fifo using a spinlock for locking

Synopsis

```
kfifo_in_spinlocked ( fifo, buf, n, lock );
```

Arguments

fifo

address of the fifo to be used

buf

the data to be added

n

number of elements to be added

lock

pointer to the spinlock to use for locking

Description

This macro copies the given values buffer into the fifo and returns the number of copied elements.

kfifo_out

LINUX

Kernel Hackers ManualSeptember 2014

Name

`kfifo_out` — get data from the fifo

Synopsis

```
kfifo_out ( fifo, buf, n );
```

Arguments

fifo

address of the fifo to be used

buf

pointer to the storage buffer

n

max. number of elements to get

Description

This macro get some data from the fifo and return the numbers of elements copied.

Note that with only one concurrent reader and one concurrent writer, you don't need extra locking to use these macro.

kfifo_out_spinlocked

LINUX

Kernel Hackers Manual September 2014

Name

`kfifo_out_spinlocked` — get data from the fifo using a spinlock for locking

Synopsis

```
kfifo_out_spunlocked ( fifo, buf, n, lock );
```

Arguments

fifo

address of the fifo to be used

buf

pointer to the storage buffer

n

max. number of elements to get

lock

pointer to the spinlock to use for locking

Description

This macro get the data from the fifo and return the numbers of elements copied.

kfifo_from_user

LINUX

Kernel Hackers ManualSeptember 2014

Name

`kfifo_from_user` — puts some data from user space into the fifo

Synopsis

```
kfifo_from_user ( fifo, from, len, copied );
```

Arguments

fifo

address of the fifo to be used

from

pointer to the data to be added

len

the length of the data to be added

copied

pointer to output variable to store the number of copied bytes

Description

This macro copies at most *len* bytes from the *from* into the fifo, depending of the available space and returns -EFAULT/0.

Note that with only one concurrent reader and one concurrent writer, you don't need extra locking to use these macro.

kfifo_to_user

LINUX

Name

`kfifo_to_user` — copies data from the fifo into user space

Synopsis

```
kfifo_to_user ( fifo, to, len, copied );
```

Arguments

fifo

address of the fifo to be used

to

where the data must be copied

len

the size of the destination buffer

copied

pointer to output variable to store the number of copied bytes

Description

This macro copies at most *len* bytes from the fifo into the *to* buffer and returns `-EFAULT/0`.

Note that with only one concurrent reader and one concurrent writer, you don't need extra locking to use these macro.

kfifo_dma_in_prepare

LINUX

Kernel Hackers Manual September 2014

Name

`kfifo_dma_in_prepare` — setup a scatterlist for DMA input

Synopsis

```
kfifo_dma_in_prepare ( fifo, sgl, nents, len );
```

Arguments

fifo

address of the fifo to be used

sgl

pointer to the scatterlist array

nents

number of entries in the scatterlist array

len

number of elements to transfer

Description

This macro fills a scatterlist for DMA input. It returns the number entries in the scatterlist array.

Note that with only one concurrent reader and one concurrent writer, you don't need extra locking to use these macros.

kfifo_dma_in_finish

LINUX

Kernel Hackers ManualSeptember 2014

Name

`kfifo_dma_in_finish` — finish a DMA IN operation

Synopsis

```
kfifo_dma_in_finish ( fifo, len);
```

Arguments

fifo

address of the fifo to be used

len

number of bytes to received

Description

This macro finish a DMA IN operation. The in counter will be updated by the `len` parameter. No error checking will be done.

Note that with only one concurrent reader and one concurrent writer, you don't need extra locking to use these macros.

kfifo_dma_out_prepare

LINUX

Kernel Hackers Manual September 2014

Name

`kfifo_dma_out_prepare` — setup a scatterlist for DMA output

Synopsis

```
kfifo_dma_out_prepare ( fifo, sgl, nents, len );
```

Arguments

fifo

address of the fifo to be used

sgl

pointer to the scatterlist array

nents

number of entries in the scatterlist array

len

number of elements to transfer

Description

This macro fills a scatterlist for DMA output which at most *len* bytes to transfer. It returns the number entries in the scatterlist array. A zero means there is no space available and the scatterlist is not filled.

Note that with only one concurrent reader and one concurrent writer, you don't need extra locking to use these macros.

kfifo_dma_out_finish

LINUX

Kernel Hackers ManualSeptember 2014

Name

`kfifo_dma_out_finish` — finish a DMA OUT operation

Synopsis

```
kfifo_dma_out_finish ( fifo, len );
```

Arguments

fifo

address of the fifo to be used

len

number of bytes transferred

Description

This macro finish a DMA OUT operation. The out counter will be updated by the `len` parameter. No error checking will be done.

Note that with only one concurrent reader and one concurrent writer, you don't need extra locking to use these macros.

kfifo_out_peek

LINUX

Kernel Hackers Manual September 2014

Name

`kfifo_out_peek` — gets some data from the fifo

Synopsis

```
kfifo_out_peek ( fifo, buf, n );
```

Arguments

fifo

address of the fifo to be used

buf

pointer to the storage buffer

n

max. number of elements to get

Description

This macro get the data from the fifo and return the numbers of elements copied. The data is not removed from the fifo.

Note that with only one concurrent reader and one concurrent writer, you don't need extra locking to use these macro.

Chapter 7. relay interface support

Relay interface support is designed to provide an efficient mechanism for tools and facilities to relay large amounts of data from kernel space to user space.

7.1. relay interface

relay_buf_full

LINUX

Kernel Hackers ManualSeptember 2014

Name

`relay_buf_full` — boolean, is the channel buffer full?

Synopsis

```
int relay_buf_full (struct rchan_buf * buf);
```

Arguments

buf

channel buffer

Description

Returns 1 if the buffer is full, 0 otherwise.

relay_reset

LINUX

Kernel Hackers ManualSeptember 2014

Name

`relay_reset` — reset the channel

Synopsis

```
void relay_reset (struct rchan * chan);
```

Arguments

chan

the channel

Description

This has the effect of erasing all data from all channel buffers and restarting the channel in its initial state. The buffers are not freed, so any mappings are still in effect.

NOTE. Care should be taken that the channel isn't actually being used by anything when this call is made.

relay_open

LINUX

Name

`relay_open` — create a new relay channel

Synopsis

```
struct rchan * relay_open (const char * base_filename, struct  
dentry * parent, size_t subbuf_size, size_t n_subbufs, struct  
rchan_callbacks * cb, void * private_data);
```

Arguments

base_filename

base name of files to create, `NULL` for buffering only

parent

dentry of parent directory, `NULL` for root directory or buffer

subbuf_size

size of sub-buffers

n_subbufs

number of sub-buffers

cb

client callback functions

private_data

user-defined data

Description

Returns channel pointer if successful, `NULL` otherwise.

Creates a channel buffer for each cpu using the sizes and attributes specified. The created channel buffer files will be named `base_filename0...base_filenameN-1`. File permissions will be `S_IRUSR`.

relay_switch_subbuf

LINUX

Kernel Hackers ManualSeptember 2014

Name

`relay_switch_subbuf` — switch to a new sub-buffer

Synopsis

```
size_t relay_switch_subbuf (struct rchan_buf * buf, size_t
length);
```

Arguments

buf

channel buffer

length

size of current event

Description

Returns either the length passed in or 0 if full.

Performs sub-buffer-switch tasks such as invoking callbacks, updating padding counts, waking up readers, etc.

relay_subbufs_consumed

LINUX

Kernel Hackers ManualSeptember 2014

Name

`relay_subbufs_consumed` — update the buffer's sub-buffers-consumed count

Synopsis

```
void relay_subbufs_consumed (struct rchan * chan, unsigned int  
cpu, size_t subbufs_consumed);
```

Arguments

chan

the channel

cpu

the cpu associated with the channel buffer to update

subbufs_consumed

number of sub-buffers to add to current buf's count

Description

Adds to the channel buffer's consumed sub-buffer count. `subbufs_consumed` should be the number of sub-buffers newly consumed, not the total consumed.

NOTE. Kernel clients don't need to call this function if the channel mode is 'overwrite'.

relay_close

LINUX

Kernel Hackers ManualSeptember 2014

Name

`relay_close` — close the channel

Synopsis

```
void relay_close (struct rchan * chan);
```

Arguments

chan

the channel

Description

Closes all channel buffers and frees the channel.

relay_flush

LINUX

Kernel Hackers ManualSeptember 2014

Name

`relay_flush` — close the channel

Synopsis

```
void relay_flush (struct rchan * chan);
```

Arguments

chan

the channel

Description

Flushes all channel buffers, i.e. forces buffer switch.

relay_mmap_buf

LINUX

Kernel Hackers ManualSeptember 2014

Name

`relay_mmap_buf` — mmap channel buffer to process address space

Synopsis

```
int relay_mmap_buf (struct rchan_buf * buf, struct
vm_area_struct * vma);
```

Arguments

buf

relay channel buffer

vma

vm_area_struct describing memory to be mapped

Description

Returns 0 if ok, negative on error

Caller should already have grabbed mmap_sem.

relay_alloc_buf

LINUX

Kernel Hackers Manual September 2014

Name

relay_alloc_buf — allocate a channel buffer

Synopsis

```
void * relay_alloc_buf (struct rchan_buf * buf, size_t *  
size);
```

Arguments

buf

the buffer struct

size

total size of the buffer

Description

Returns a pointer to the resulting buffer, `NULL` if unsuccessful. The passed in size will get page aligned, if it isn't already.

relay_create_buf

LINUX

Kernel Hackers Manual September 2014

Name

`relay_create_buf` — allocate and initialize a channel buffer

Synopsis

```
struct rchan_buf * relay_create_buf (struct rchan * chan);
```

Arguments

chan

the relay channel

Description

Returns channel buffer if successful, `NULL` otherwise.

relay_destroy_channel

LINUX

Kernel Hackers ManualSeptember 2014

Name

`relay_destroy_channel` — free the channel struct

Synopsis

```
void relay_destroy_channel (struct kref * kref);
```

Arguments

kref

target kernel reference that contains the relay channel

Description

Should only be called from `kref_put`.

relay_destroy_buf

LINUX

Kernel Hackers ManualSeptember 2014

Name

`relay_destroy_buf` — destroy an `rchan_buf` struct and associated buffer

Synopsis

```
void relay_destroy_buf (struct rchan_buf * buf);
```

Arguments

buf

the buffer struct

relay_remove_buf

LINUX

Name

`relay_remove_buf` — remove a channel buffer

Synopsis

```
void relay_remove_buf (struct kref * kref);
```

Arguments

kref

target kernel reference that contains the relay buffer

Description

Removes the file from the filesystem, which also frees the `rchan_buf_struct` and the channel buffer. Should only be called from `kref_put`.

relay_buf_empty

LINUX

Name

`relay_buf_empty` — boolean, is the channel buffer empty?

Synopsis

```
int relay_buf_empty (struct rchan_buf * buf);
```

Arguments

buf

channel buffer

Description

Returns 1 if the buffer is empty, 0 otherwise.

wakeup_readers

LINUX

Kernel Hackers ManualSeptember 2014

Name

`wakeup_readers` — wake up readers waiting on a channel

Synopsis

```
void wakeup_readers (unsigned long data);
```

Arguments

data

contains the channel buffer

Description

This is the timer function used to defer reader waking.

__relay_reset

LINUX

Kernel Hackers ManualSeptember 2014

Name

`__relay_reset` — reset a channel buffer

Synopsis

```
void __relay_reset (struct rchan_buf * buf, unsigned int  
init);
```

Arguments

buf

the channel buffer

init

1 if this is a first-time initialization

Description

See `relay_reset` for description of effect.

relay_close_buf

LINUX

Kernel Hackers ManualSeptember 2014

Name

`relay_close_buf` — close a channel buffer

Synopsis

```
void relay_close_buf (struct rchan_buf * buf);
```

Arguments

buf

channel buffer

Description

Marks the buffer finalized and restores the default callbacks. The channel buffer and channel buffer data structure are then freed automatically when the last reference is given up.

relay_hotcpu_callback

LINUX

Kernel Hackers ManualSeptember 2014

Name

relay_hotcpu_callback — CPU hotplug callback

Synopsis

```
int relay_hotcpu_callback (struct notifier_block * nb,  
unsigned long action, void * hcpu);
```

Arguments

nb

notifier block

action

hotplug action to take

hcpu

CPU number

Description

Returns the success/failure of the operation. (NOTIFY_OK, NOTIFY_BAD)

relay_late_setup_files

LINUX

Kernel Hackers ManualSeptember 2014

Name

`relay_late_setup_files` — triggers file creation

Synopsis

```
int relay_late_setup_files (struct rchan * chan, const char *  
base_filename, struct dentry * parent);
```

Arguments

chan

channel to operate on

base_filename

base name of files to create

parent

dentry of parent directory, NULL for root directory

Description

Returns 0 if successful, non-zero otherwise.

Use to setup files for a previously buffer-only channel. Useful to do early tracing in kernel, before VFS is up, for example.

relay_file_open

LINUX

Kernel Hackers ManualSeptember 2014

Name

`relay_file_open` — open file op for relay files

Synopsis

```
int relay_file_open (struct inode * inode, struct file *  
filp);
```

Arguments

inode

the inode

filp

the file

Description

Increments the channel buffer refcount.

relay_file_mmap

LINUX

Name

`relay_file_mmap` — mmap file op for relay files

Synopsis

```
int relay_file_mmap (struct file * filp, struct vm_area_struct  
* vma);
```

Arguments

filp

the file

vma

the vma describing what to map

Description

Calls upon `relay_mmap_buf` to map the file into user space.

relay_file_poll

LINUX

Name

`relay_file_poll` — poll file op for relay files

Synopsis

```
unsigned int relay_file_poll (struct file * filp, poll_table *  
wait);
```

Arguments

filp

the file

wait

poll table

Description

Poll implementation.

relay_file_release

LINUX

Kernel Hackers ManualSeptember 2014

Name

`relay_file_release` — release file op for relay files

Synopsis

```
int relay_file_release (struct inode * inode, struct file *  
filp);
```

Arguments

inode

the inode

filp

the file

Description

Decrements the channel refcount, as the filesystem is no longer using it.

relay_file_read_subbuf_avail

LINUX

Kernel Hackers ManualSeptember 2014

Name

`relay_file_read_subbuf_avail` — return bytes available in sub-buffer

Synopsis

```
size_t relay_file_read_subbuf_avail (size_t read_pos, struct  
rchan_buf * buf);
```

Arguments

read_pos

file read position

buf

relay channel buffer

relay_file_read_start_pos

LINUX

Kernel Hackers ManualSeptember 2014

Name

`relay_file_read_start_pos` — find the first available byte to read

Synopsis

```
size_t relay_file_read_start_pos (size_t read_pos, struct  
rchan_buf * buf);
```

Arguments

read_pos

file read position

buf

relay channel buffer

Description

If the *read_pos* is in the middle of padding, return the position of the first actually available byte, otherwise return the original value.

relay_file_read_end_pos

LINUX

Kernel Hackers ManualSeptember 2014

Name

`relay_file_read_end_pos` — return the new read position

Synopsis

```
size_t relay_file_read_end_pos (struct rchan_buf * buf, size_t  
read_pos, size_t count);
```

Arguments

buf

relay channel buffer

read_pos

file read position

count

number of bytes to be read

Chapter 8. Module Support

8.1. Module Loading

`__request_module`

LINUX

Kernel Hackers Manual September 2014

Name

`__request_module` — try to load a kernel module

Synopsis

```
int __request_module (bool wait, const char * fmt, ...);
```

Arguments

wait

wait (or not) for the operation to complete

fmt

printf style format string for the name of the module @...: arguments as specified in the format string

...

variable arguments

Description

Load a module using the user mode module loader. The function returns zero on success or a negative `errno` code on failure. Note that a successful module load does not mean the module did not then unload and exit on an error of its own. Callers must check that the service they requested is now available not blindly invoke it.

If module auto-loading support is disabled then this function becomes a no-operation.

call_usermodehelper_setup

LINUX

Kernel Hackers ManualSeptember 2014

Name

`call_usermodehelper_setup` — prepare to call a usermode helper

Synopsis

```
struct subprocess_info * call_usermodehelper_setup (char *  
path, char ** argv, char ** envp, gfp_t gfp_mask, int (*init)  
(struct subprocess_info *info, struct cred *new), void  
(*cleanup) (struct subprocess_info *info), void * data);
```

Arguments

path

path to usermode executable

argv

arg vector for process

envp

environment for process

gfp_mask

gfp mask for memory allocation

init

an init function

cleanup

a cleanup function

data

arbitrary context sensitive data

Description

Returns either `NULL` on allocation failure, or a `subprocess_info` structure. This should be passed to `call_usermodehelper_exec` to exec the process and free the structure.

The init function is used to customize the helper process prior to exec. A non-zero return code causes the process to error out, exit, and return the failure to the calling process

The cleanup function is just before the `subprocess_info` is about to be freed. This can be used for freeing the `argv` and `envp`. The Function must be runnable in either a process context or the context in which `call_usermodehelper_exec` is called.

call_usermodehelper_exec

LINUX

Kernel Hackers Manual September 2014

Name

`call_usermodehelper_exec` — start a usermode application

Synopsis

```
int call_usermodehelper_exec (struct subprocess_info *  
sub_info, int wait);
```

Arguments

sub_info

information about the subprocessa

wait

wait for the application to finish and return status. when UMH_NO_WAIT don't wait at all, but you get no useful error back when the program couldn't be exec'ed. This makes it safe to call from interrupt context.

Description

Runs a user-space application. The application is started asynchronously if wait is not set, and runs as a child of keventd. (ie. it runs with full root capabilities).

call_usermodehelper

LINUX

Kernel Hackers ManualSeptember 2014

Name

`call_usermodehelper` — prepare and start a usermode application

Synopsis

```
int call_usermodehelper (char * path, char ** argv, char **  
envp, int wait);
```

Arguments

path

path to usermode executable

argv

arg vector for process

envp

environment for process

wait

wait for the application to finish and return status. when UMH_NO_WAIT don't wait at all, but you get no useful error back when the program couldn't be exec'ed. This makes it safe to call from interrupt context.

Description

This function is the equivalent to use `call_usermodehelper_setup` and `call_usermodehelper_exec`.

8.2. Inter Module support

Refer to the file `kernel/module.c` for more information.

Chapter 9. Hardware Interfaces

9.1. Interrupt Handling

synchronize_hardirq

LINUX

Kernel Hackers ManualSeptember 2014

Name

`synchronize_hardirq` — wait for pending hard IRQ handlers (on other CPUs)

Synopsis

```
void synchronize_hardirq (unsigned int irq);
```

Arguments

irq

interrupt number to wait for

Description

This function waits for any pending hard IRQ handlers for this interrupt to complete before returning. If you use this function while holding a resource the IRQ handler may need you will deadlock. It does not take associated threaded handlers into account.

Do not use this for shutdown scenarios where you must be sure that all parts (hardirq and threaded handler) have completed.

This function may be called - with care - from IRQ context.

synchronize_irq

LINUX

Kernel Hackers ManualSeptember 2014

Name

`synchronize_irq` — wait for pending IRQ handlers (on other CPUs)

Synopsis

```
void synchronize_irq (unsigned int irq);
```

Arguments

irq

interrupt number to wait for

Description

This function waits for any pending IRQ handlers for this interrupt to complete before returning. If you use this function while holding a resource the IRQ handler may need you will deadlock.

This function may be called - with care - from IRQ context.

irq_set_affinity_notifier

LINUX

Kernel Hackers Manual September 2014

Name

`irq_set_affinity_notifier` — control notification of IRQ affinity changes

Synopsis

```
int irq_set_affinity_notifier (unsigned int irq, struct
irq_affinity_notify * notify);
```

Arguments

irq

Interrupt for which to enable/disable notification

notify

Context for notification, or `NULL` to disable notification. Function pointers must be initialised; the other fields will be initialised by this function.

Description

Must be called in process context. Notification may only be enabled after the IRQ is allocated and must be disabled before the IRQ is freed using `free_irq`.

disable_irq_nosync

LINUX

Kernel Hackers ManualSeptember 2014

Name

`disable_irq_nosync` — disable an irq without waiting

Synopsis

```
void disable_irq_nosync (unsigned int irq);
```

Arguments

irq

Interrupt to disable

Description

Disable the selected interrupt line. Disables and Enables are nested. Unlike `disable_irq`, this function does not ensure existing instances of the IRQ handler have completed before returning.

This function may be called from IRQ context.

disable_irq

LINUX

Name

`disable_irq` — disable an irq and wait for completion

Synopsis

```
void disable_irq (unsigned int irq);
```

Arguments

irq

Interrupt to disable

Description

Disable the selected interrupt line. Enables and Disables are nested. This function waits for any pending IRQ handlers for this interrupt to complete before returning. If you use this function while holding a resource the IRQ handler may need you will deadlock.

This function may be called - with care - from IRQ context.

`enable_irq`

LINUX

Name

`enable_irq` — enable handling of an irq

Synopsis

```
void enable_irq (unsigned int irq);
```

Arguments

irq

Interrupt to enable

Description

Undoes the effect of one call to `disable_irq`. If this matches the last disable, processing of interrupts on this IRQ line is re-enabled.

This function may be called from IRQ context only when `desc->irq_data.chip->bus_lock` and `desc->chip->bus_sync_unlock` are NULL !

irq_set_irq_wake

LINUX

Kernel Hackers Manual September 2014

Name

`irq_set_irq_wake` — control irq power management wakeup

Synopsis

```
int irq_set_irq_wake (unsigned int irq, unsigned int on);
```

Arguments

irq

interrupt to control

on

enable/disable power management wakeup

Description

Enable/disable power management wakeup mode, which is disabled by default. Enables and disables must match, just as they match for non-wakeup mode support.

Wakeup mode lets this IRQ wake the system from sleep states like “suspend to RAM”.

irq_wake_thread

LINUX

Kernel Hackers Manual September 2014

Name

`irq_wake_thread` — wake the irq thread for the action identified by `dev_id`

Synopsis

```
void irq_wake_thread (unsigned int irq, void * dev_id);
```

Arguments

irq

Interrupt line

dev_id

Device identity for which the thread should be woken

setup_irq

LINUX

Kernel Hackers ManualSeptember 2014

Name

`setup_irq` — setup an interrupt

Synopsis

```
int setup_irq (unsigned int irq, struct irqaction * act);
```

Arguments

irq

Interrupt line to setup

act

irqaction for the interrupt

Description

Used to statically setup interrupts in the early boot process.

remove_irq

LINUX

Kernel Hackers ManualSeptember 2014

Name

`remove_irq` — free an interrupt

Synopsis

```
void remove_irq (unsigned int irq, struct irqaction * act);
```

Arguments

irq

Interrupt line to free

act

irqaction for the interrupt

Description

Used to remove interrupts statically setup by the early boot process.

free_irq

LINUX

Kernel Hackers ManualSeptember 2014

Name

`free_irq` — free an interrupt allocated with `request_irq`

Synopsis

```
void free_irq (unsigned int irq, void * dev_id);
```

Arguments

irq

Interrupt line to free

dev_id

Device identity to free

Description

Remove an interrupt handler. The handler is removed and if the interrupt line is no longer in use by any driver it is disabled. On a shared IRQ the caller must ensure the interrupt is disabled on the card it drives before calling this function. The function does not return until any executing interrupts for this IRQ have completed.

This function must not be called from interrupt context.

request_threaded_irq

LINUX

Kernel Hackers Manual September 2014

Name

`request_threaded_irq` — allocate an interrupt line

Synopsis

```
int request_threaded_irq (unsigned int irq, irq_handler_t
handler, irq_handler_t thread_fn, unsigned long irqflags,
const char * devname, void * dev_id);
```

Arguments

irq

Interrupt line to allocate

handler

Function to be called when the IRQ occurs. Primary handler for threaded interrupts If NULL and *thread_fn* != NULL the default primary handler is installed

thread_fn

Function called from the irq handler thread If NULL, no irq thread is created

irqflags

Interrupt type flags

devname

An ascii name for the claiming device

dev_id

A cookie passed back to the handler function

Description

This call allocates interrupt resources and enables the interrupt line and IRQ handling. From the point this call is made your handler function may be invoked. Since your handler function must clear any interrupt the board raises, you must take care both to initialise your hardware and to set up the interrupt handler in the right order.

If you want to set up a threaded irq handler for your device then you need to supply *handler* and *thread_fn.handler* is still called in hard interrupt context and has to check whether the interrupt originates from the device. If yes it needs to disable the interrupt on the device and return `IRQ_WAKE_THREAD` which will wake up the handler thread and run *thread_fn*. This split handler design is necessary to support shared interrupts.

Dev_id must be globally unique. Normally the address of the device data structure is used as the cookie. Since the handler receives this value it makes sense to use it.

If your interrupt is shared you must pass a non NULL *dev_id* as this is required when freeing the interrupt.

Flags

`IRQF_SHARED` Interrupt is shared `IRQF_TRIGGER_*` Specify active edge(s) or level

request_any_context_irq

LINUX

Kernel Hackers ManualSeptember 2014

Name

`request_any_context_irq` — allocate an interrupt line

Synopsis

```
int request_any_context_irq (unsigned int irq, irq_handler_t  
handler, unsigned long flags, const char * name, void *  
dev_id);
```

Arguments

irq

Interrupt line to allocate

handler

Function to be called when the IRQ occurs. Threaded handler for threaded interrupts.

flags

Interrupt type flags

name

An ascii name for the claiming device

dev_id

A cookie passed back to the handler function

Description

This call allocates interrupt resources and enables the interrupt line and IRQ handling. It selects either a hardirq or threaded handling method depending on the context.

On failure, it returns a negative value. On success, it returns either `IRQC_IS_HARDIRQ` or `IRQC_IS_NESTED`.

9.2. DMA Channels

request_dma

LINUX

Kernel Hackers ManualSeptember 2014

Name

`request_dma` — request and reserve a system DMA channel

Synopsis

```
int request_dma (unsigned int dmanr, const char * device_id);
```

Arguments

dmanr

DMA channel number

device_id

reserving device ID string, used in `/proc/dma`

free_dma

LINUX

Name

`free_dma` — free a reserved system DMA channel

Synopsis

```
void free_dma (unsigned int dmanr);
```

Arguments

dmanr

DMA channel number

9.3. Resources Management

`request_resource_conflict`

LINUX

Name

`request_resource_conflict` — request and reserve an I/O or memory resource

Synopsis

```
struct resource * request_resource_conflict (struct resource *  
root, struct resource * new);
```

Arguments

root

root resource descriptor

new

resource descriptor desired by caller

Description

Returns 0 for success, conflict resource on error.

reallocate_resource

LINUX

Kernel Hackers ManualSeptember 2014

Name

`reallocate_resource` — allocate a slot in the resource tree given range & alignment. The resource will be relocated if the new size cannot be reallocated in the current location.

Synopsis

```
int reallocate_resource (struct resource * root, struct
resource * old, resource_size_t newsize, struct
resource_constraint * constraint);
```

Arguments

root

root resource descriptor

old

resource descriptor desired by caller

newsize

new size of the resource descriptor

constraint

the size and alignment constraints to be met.

lookup_resource

LINUX

Kernel Hackers Manual September 2014

Name

`lookup_resource` — find an existing resource by a resource start address

Synopsis

```
struct resource * lookup_resource (struct resource * root,  
resource_size_t start);
```

Arguments

root

root resource descriptor

start

resource start address

Description

Returns a pointer to the resource if found, NULL otherwise

insert_resource_conflict

LINUX

Kernel Hackers ManualSeptember 2014

Name

`insert_resource_conflict` — Inserts resource in the resource tree

Synopsis

```
struct resource * insert_resource_conflict (struct resource *  
parent, struct resource * new);
```


Arguments

parent

parent of the new resource

new

new resource to insert

Description

Returns 0 on success, conflict resource if the resource can't be inserted.

This function is equivalent to `request_resource_conflict` when no conflict happens. If a conflict happens, and the conflicting resources entirely fit within the range of the new resource, then the new resource is inserted and the conflicting resources become children of the new resource.

insert_resource

LINUX

Kernel Hackers Manual September 2014

Name

`insert_resource` — Inserts a resource in the resource tree

Synopsis

```
int insert_resource (struct resource * parent, struct resource
* new);
```

Arguments

parent

parent of the new resource

new

new resource to insert

Description

Returns 0 on success, -EBUSY if the resource can't be inserted.

insert_resource_expand_to_fit

LINUX

Kernel Hackers ManualSeptember 2014

Name

`insert_resource_expand_to_fit` — Insert a resource into the resource tree

Synopsis

```
void insert_resource_expand_to_fit (struct resource * root,  
struct resource * new);
```

Arguments

root

root resource descriptor

new

new resource to insert

Description

Insert a resource into the resource tree, possibly expanding it in order to make it encompass any conflicting resources.

resource_alignment

LINUX

Kernel Hackers ManualSeptember 2014

Name

`resource_alignment` — calculate resource's alignment

Synopsis

```
resource_size_t resource_alignment (struct resource * res);
```

Arguments

res

resource pointer

Description

Returns alignment on success, 0 (invalid alignment) on failure.

release_mem_region_adjustable

LINUX

Kernel Hackers ManualSeptember 2014

Name

`release_mem_region_adjustable` — release a previously reserved memory region

Synopsis

```
int release_mem_region_adjustable (struct resource * parent,  
resource_size_t start, resource_size_t size);
```

Arguments

parent

parent resource descriptor

start

resource start address

size

resource region size

Description

This interface is intended for memory hot-delete. The requested region is released from a currently busy memory resource. The requested region must either match exactly or fit into a single busy resource entry. In the latter case, the remaining

resource is adjusted accordingly. Existing children of the busy memory resource must be immutable in the request.

Note

- Additional release conditions, such as overlapping region, can be supported after they are confirmed as valid cases. - When a busy memory resource gets split into two entries, the code assumes that all children remain in the lower address entry for simplicity. Enhance this logic when necessary.

request_resource

LINUX

Kernel Hackers Manual September 2014

Name

`request_resource` — request and reserve an I/O or memory resource

Synopsis

```
int request_resource (struct resource * root, struct resource  
* new);
```

Arguments

root

root resource descriptor

new

resource descriptor desired by caller

Description

Returns 0 for success, negative error code on error.

release_resource

LINUX

Kernel Hackers ManualSeptember 2014

Name

`release_resource` — release a previously reserved resource

Synopsis

```
int release_resource (struct resource * old);
```

Arguments

old

resource pointer

allocate_resource

LINUX

Name

`allocate_resource` — allocate empty slot in the resource tree given range & alignment. The resource will be reallocated with a new size if it was already allocated

Synopsis

```
int allocate_resource (struct resource * root, struct resource
* new, resource_size_t size, resource_size_t min,
resource_size_t max, resource_size_t align, resource_size_t
(*alignf) (void *, const struct resource *, resource_size_t,
resource_size_t), void * alignf_data);
```

Arguments

root

root resource descriptor

new

resource descriptor desired by caller

size

requested resource region size

min

minimum boundary to allocate

max

maximum boundary to allocate

align

alignment requested, in bytes

alignf

alignment function, optional, called if not NULL

alignf_data

arbitrary data to pass to the *alignf* function

adjust_resource

LINUX

Kernel Hackers Manual September 2014

Name

`adjust_resource` — modify a resource's start and size

Synopsis

```
int adjust_resource (struct resource * res, resource_size_t  
start, resource_size_t size);
```

Arguments

res

resource to modify

start

new start value

size

new size

Description

Given an existing resource, change its start and size to match the arguments. Returns 0 on success, -EBUSY if it can't fit. Existing children of the resource are assumed to be immutable.

__request_region

LINUX

Kernel Hackers Manual September 2014

Name

`__request_region` — create a new busy resource region

Synopsis

```
struct resource * __request_region (struct resource * parent,
resource_size_t start, resource_size_t n, const char * name,
int flags);
```

Arguments

parent

parent resource descriptor

start

resource start address

n

resource region size

name

reserving caller's ID string

flags

IO resource flags

__check_region

LINUX

Kernel Hackers Manual September 2014

Name

`__check_region` — check if a resource region is busy or free

Synopsis

```
int __check_region (struct resource * parent, resource_size_t
start, resource_size_t n);
```

Arguments

parent

parent resource descriptor

start

resource start address

n

resource region size

Description

Returns 0 if the region is free at the moment it is checked, returns `-EBUSY` if the region is busy.

NOTE

This function is deprecated because its use is racy. Even if it returns 0, a subsequent call to `request_region` may fail because another driver etc. just allocated the region. Do NOT use it. It will be removed from the kernel.

__release_region

LINUX

Kernel Hackers Manual September 2014

Name

`__release_region` — release a previously reserved resource region

Synopsis

```
void __release_region (struct resource * parent,
resource_size_t start, resource_size_t n);
```

Arguments

parent

parent resource descriptor

start

resource start address

n

resource region size

Description

The described resource region must match a currently busy region.

9.4. MTRR Handling

mtrr_add

LINUX

Kernel Hackers ManualSeptember 2014

Name

`mtrr_add` — Add a memory type region

Synopsis

```
int mtrr_add (unsigned long base, unsigned long size, unsigned  
int type, bool increment);
```

Arguments

base

Physical base address of region

size

Physical size of region

type

Type of MTRR desired

increment

If this is true do usage counting on the region

Description

Memory type region registers control the caching on newer Intel and non Intel processors. This function allows drivers to request an MTRR is added. The details and hardware specifics of each processor's implementation are hidden from the caller, but nevertheless the caller should expect to need to provide a power of two size on an equivalent power of two boundary.

If the region cannot be added either because all regions are in use or the CPU cannot support it a negative value is returned. On success the register number for this entry is returned, but should be treated as a cookie only.

On a multiprocessor machine the changes are made to all processors. This is required on x86 by the Intel processors.

The available types are

MTRR_TYPE_UNCACHABLE - No caching

MTRR_TYPE_WRBACK - Write data back in bursts whenever

MTRR_TYPE_WRCOMB - Write data back soon but allow bursts

MTRR_TYPE_WRTHROUGH - Cache reads but not writes

BUGS

Needs a quiet flag for the cases where drivers do not mind failures and do not wish system log messages to be sent.

mtrr_del

LINUX

Kernel Hackers ManualSeptember 2014

Name

`mtrr_del` — delete a memory type region

Synopsis

```
int mtrr_del (int reg, unsigned long base, unsigned long
size);
```

Arguments

reg

Register returned by `mtrr_add`

base

Physical base address

size

Size of region

Description

If register is supplied then base and size are ignored. This is how drivers should call it.

Releases an MTRR region. If the usage count drops to zero the register is freed and the region returns to default state. On success the register is returned, on failure a negative error code.

arch_phys_wc_add

LINUX

Kernel Hackers ManualSeptember 2014

Name

`arch_phys_wc_add` — add a WC MTRR and handle errors if PAT is unavailable

Synopsis

```
int arch_phys_wc_add (unsigned long base, unsigned long size);
```

Arguments

base

Physical base address

size

Size of region

Description

If PAT is available, this does nothing. If PAT is unavailable, it attempts to add a WC MTRR covering *size* bytes starting at *base* and logs an error if this fails.

Drivers must store the return value to pass to `mtrr_del_wc_if_needed`, but drivers should not try to interpret that return value.

9.5. PCI Support Library

pci_bus_max_busnr

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_bus_max_busnr` — returns maximum PCI bus number of given bus' children

Synopsis

```
unsigned char pci_bus_max_busnr (struct pci_bus * bus);
```

Arguments

bus

pointer to PCI bus structure to search

Description

Given a PCI bus, returns the highest PCI bus number present in the set including the given PCI bus and its list of child PCI buses.

pci_find_capability

LINUX

Name

`pci_find_capability` — query for devices' capabilities

Synopsis

```
int pci_find_capability (struct pci_dev * dev, int cap);
```

Arguments

dev

PCI device to query

cap

capability code

Description

Tell if a device supports a given PCI capability. Returns the address of the requested capability structure within the device's PCI configuration space or 0 in case the device does not support it. Possible values for *cap*:

`PCI_CAP_ID_PM` Power Management `PCI_CAP_ID_AGP` Accelerated Graphics
Port `PCI_CAP_ID_VPD` Vital Product Data `PCI_CAP_ID_SLOTID` Slot
Identification `PCI_CAP_ID_MSI` Message Signalled Interrupts
`PCI_CAP_ID_CHSWP` CompactPCI HotSwap `PCI_CAP_ID_PCIX` PCI-X
`PCI_CAP_ID_EXP` PCI Express

`pci_bus_find_capability`

LINUX

Name

`pci_bus_find_capability` — query for devices' capabilities

Synopsis

```
int pci_bus_find_capability (struct pci_bus * bus, unsigned
int devfn, int cap);
```

Arguments

bus

the PCI bus to query

devfn

PCI device to query

cap

capability code

Description

Like `pci_find_capability` but works for pci devices that do not have a `pci_dev` structure set up yet.

Returns the address of the requested capability structure within the device's PCI configuration space or 0 in case the device does not support it.

`pci_find_next_ext_capability`

LINUX

Name

`pci_find_next_ext_capability` — Find an extended capability

Synopsis

```
int pci_find_next_ext_capability (struct pci_dev * dev, int
start, int cap);
```

Arguments

dev

PCI device to query

start

address at which to start looking (0 to start at beginning of list)

cap

capability code

Description

Returns the address of the next matching extended capability structure within the device's PCI configuration space or 0 if the device does not support it. Some capabilities can occur several times, e.g., the vendor-specific capability, and this provides a way to find them all.

`pci_find_ext_capability`

LINUX

Name

`pci_find_ext_capability` — Find an extended capability

Synopsis

```
int pci_find_ext_capability (struct pci_dev * dev, int cap);
```

Arguments

dev

PCI device to query

cap

capability code

Description

Returns the address of the requested extended capability structure within the device's PCI configuration space or 0 if the device does not support it. Possible values for *cap*:

PCI_EXT_CAP_ID_ERR Advanced Error Reporting PCI_EXT_CAP_ID_VC Virtual Channel
PCI_EXT_CAP_ID_DSN Device Serial Number PCI_EXT_CAP_ID_PWR Power Budgeting

`pci_find_next_ht_capability`

LINUX

Name

`pci_find_next_ht_capability` — query a device’s Hypertransport capabilities

Synopsis

```
int pci_find_next_ht_capability (struct pci_dev * dev, int
pos, int ht_cap);
```

Arguments

dev

PCI device to query

pos

Position from which to continue searching

ht_cap

Hypertransport capability code

Description

To be used in conjunction with `pci_find_ht_capability` to search for all capabilities matching *ht_cap*. *pos* should always be a value returned from `pci_find_ht_capability`.

NB. To be 100% safe against broken PCI devices, the caller should take steps to avoid an infinite loop.

pci_find_ht_capability

LINUX

Kernel Hackers Manual September 2014

Name

`pci_find_ht_capability` — query a device's Hypertransport capabilities

Synopsis

```
int pci_find_ht_capability (struct pci_dev * dev, int ht_cap);
```

Arguments

dev

PCI device to query

ht_cap

Hypertransport capability code

Description

Tell if a device supports a given Hypertransport capability. Returns an address within the device's PCI configuration space or 0 in case the device does not support the request capability. The address points to the PCI capability, of type `PCI_CAP_ID_HT`, which has a Hypertransport capability matching *ht_cap*.

pci_find_parent_resource

LINUX

Name

`pci_find_parent_resource` — return resource region of parent bus of given region

Synopsis

```
struct resource * pci_find_parent_resource (const struct  
pci_dev * dev, struct resource * res);
```

Arguments

dev

PCI device structure contains resources to be searched

res

child resource record for which parent is sought

Description

For given resource region of given device, return the resource region of parent bus the given region is contained in.

__pci_complete_power_transition

LINUX

Name

`__pci_complete_power_transition` — Complete power transition of a PCI device

Synopsis

```
int __pci_complete_power_transition (struct pci_dev * dev,  
pci_power_t state);
```

Arguments

dev

PCI device to handle.

state

State to put the device into.

Description

This function should not be called directly by device drivers.

`pci_set_power_state`

LINUX

Name

`pci_set_power_state` — Set the power state of a PCI device

Synopsis

```
int pci_set_power_state (struct pci_dev * dev, pci_power_t  
state);
```

Arguments

dev

PCI device to handle.

state

PCI power state (D0, D1, D2, D3hot) to put the device into.

Description

Transition a device to a new power state, using the platform firmware and/or the device's PCI PM registers.

RETURN VALUE

-EINVAL if the requested state is invalid. -EIO if device does not support PCI PM or its PM capabilities register has a wrong version, or device doesn't support the requested state. 0 if device already is in the requested state. 0 if device's power state has been successfully changed.

pci_choose_state

LINUX

Kernel Hackers Manual September 2014

Name

`pci_choose_state` — Choose the power state of a PCI device

Synopsis

```
pci_power_t pci_choose_state (struct pci_dev * dev,  
pm_message_t state);
```

Arguments

dev

PCI device to be suspended

state

target sleep state for the whole system. This is the value that is passed to suspend function.

Description

Returns PCI power state suitable for given device and given system message.

pci_save_state

LINUX

Name

`pci_save_state` — save the PCI configuration space of a device before suspending

Synopsis

```
int pci_save_state (struct pci_dev * dev);
```

Arguments

dev

- PCI device that we're dealing with

pci_restore_state

LINUX

Name

`pci_restore_state` — Restore the saved state of a PCI device

Synopsis

```
void pci_restore_state (struct pci_dev * dev);
```

Arguments

dev

- PCI device that we're dealing with

pci_store_saved_state

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_store_saved_state` — Allocate and return an opaque struct containing the device saved state.

Synopsis

```
struct pci_saved_state * pci_store_saved_state (struct pci_dev  
* dev);
```

Arguments

dev

PCI device that we're dealing with

Description

Return NULL if no state or error.

pci_load_and_free_saved_state

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_load_and_free_saved_state` — Reload the save state pointed to by `state`, and free the memory allocated for it.

Synopsis

```
int pci_load_and_free_saved_state (struct pci_dev * dev,
struct pci_saved_state ** state);
```

Arguments

dev

PCI device that we're dealing with

state

Pointer to saved state returned from `pci_store_saved_state`

pci_reenable_device

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_reenable_device` — Resume abandoned device

Synopsis

```
int pci_reenable_device (struct pci_dev * dev);
```

Arguments

dev

PCI device to be resumed

Description

Note this function is a backend of `pci_default_resume` and is not supposed to be called by normal code, write proper resume handler and use it instead.

pci_enable_device_io

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_enable_device_io` — Initialize a device for use with IO space

Synopsis

```
int pci_enable_device_io (struct pci_dev * dev);
```

Arguments

dev

PCI device to be initialized

Description

Initialize device before it's used by a driver. Ask low-level code to enable I/O resources. Wake up the device if it was suspended. Beware, this function can fail.

pci_enable_device_mem

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_enable_device_mem` — Initialize a device for use with Memory space

Synopsis

```
int pci_enable_device_mem (struct pci_dev * dev);
```

Arguments

dev

PCI device to be initialized

Description

Initialize device before it's used by a driver. Ask low-level code to enable Memory resources. Wake up the device if it was suspended. Beware, this function can fail.

pci_enable_device

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_enable_device` — Initialize device before it's used by a driver.

Synopsis

```
int pci_enable_device (struct pci_dev * dev);
```

Arguments

dev

PCI device to be initialized

Description

Initialize device before it's used by a driver. Ask low-level code to enable I/O and memory. Wake up the device if it was suspended. Beware, this function can fail.

Note we don't actually enable the device many times if we call this function repeatedly (we just increment the count).

pcim_enable_device

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pcim_enable_device` — Managed `pci_enable_device`

Synopsis

```
int pcim_enable_device (struct pci_dev * pdev);
```

Arguments

pdev

PCI device to be initialized

Description

Managed `pci_enable_device`.

pcim_pin_device

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pcim_pin_device` — Pin managed PCI device

Synopsis

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

Arguments

pdev

PCI device to pin

Description

Pin managed PCI device *pdev*. Pinned device won't be disabled on driver detach. *pdev* must have been enabled with `pcim_enable_device`.

pci_disable_device

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_disable_device` — Disable PCI device after use

Synopsis

```
void pci_disable_device (struct pci_dev * dev);
```

Arguments

dev

PCI device to be disabled

Description

Signal to the system that the PCI device is not in use by the system anymore. This only involves disabling PCI bus-mastering, if active.

Note we don't actually disable the device until all callers of `pci_enable_device` have called `pci_disable_device`.

pci_set_pcie_reset_state

LINUX

Kernel Hackers Manual September 2014

Name

`pci_set_pcie_reset_state` — set reset state for device `dev`

Synopsis

```
int pci_set_pcie_reset_state (struct pci_dev * dev, enum
pcie_reset_state state);
```

Arguments

dev

the PCIe device reset

state

Reset state to enter into

Description

Sets the PCI reset state for the device.

pci_pme_capable

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_pme_capable` — check the capability of PCI device to generate PME#

Synopsis

```
bool pci_pme_capable (struct pci_dev * dev, pci_power_t
state);
```

Arguments

dev

PCI device to handle.

state

PCI state from which device will issue PME#.

pci_pme_active

LINUX

Kernel Hackers Manual September 2014

Name

`pci_pme_active` — enable or disable PCI device's PME# function

Synopsis

```
void pci_pme_active (struct pci_dev * dev, bool enable);
```

Arguments

dev

PCI device to handle.

enable

'true' to enable PME# generation; 'false' to disable it.

Description

The caller must verify that the device is capable of generating PME# before calling this function with *enable* equal to 'true'.

__pci_enable_wake

LINUX

Name

`__pci_enable_wake` — enable PCI device as wakeup event source

Synopsis

```
int __pci_enable_wake (struct pci_dev * dev, pci_power_t
state, bool runtime, bool enable);
```

Arguments

dev

PCI device affected

state

PCI state from which device will issue wakeup events

runtime

True if the events are to be generated at run time

enable

True to enable event generation; false to disable

Description

This enables the device as a wakeup event source, or disables it. When such events involves platform-specific hooks, those hooks are called automatically by this routine.

Devices with legacy power management (no standard PCI PM capabilities) always require such platform hooks.

RETURN VALUE

0 is returned on success -EINVAL is returned if device is not supposed to wake up the system Error code depending on the platform is returned if both the platform and the native mechanism fail to enable the generation of wake-up events

pci_wake_from_d3

LINUX

Kernel Hackers Manual September 2014

Name

`pci_wake_from_d3` — enable/disable device to wake up from D3_hot or D3_cold

Synopsis

```
int pci_wake_from_d3 (struct pci_dev * dev, bool enable);
```

Arguments

dev

PCI device to prepare

enable

True to enable wake-up event generation; false to disable

Description

Many drivers want the device to wake up the system from D3_hot or D3_cold and this function allows them to set that up cleanly - `pci_enable_wake` should not be

called twice in a row to enable wake-up due to PCI PM vs ACPI ordering constraints.

This function only returns error code if the device is not capable of generating PME# from both D3_hot and D3_cold, and the platform is unable to enable wake-up power for it.

pci_prepare_to_sleep

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_prepare_to_sleep` — prepare PCI device for system-wide transition into a sleep state

Synopsis

```
int pci_prepare_to_sleep (struct pci_dev * dev);
```

Arguments

dev

Device to handle.

Description

Choose the power state appropriate for the device depending on whether it can wake up the system and/or is power manageable by the platform (`PCI_D3hot` is the default) and put the device into that state.

pci_back_from_sleep

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_back_from_sleep` — turn PCI device on during system-wide transition into working state

Synopsis

```
int pci_back_from_sleep (struct pci_dev * dev);
```

Arguments

dev

Device to handle.

Description

Disable device's system wake-up capability and put it into D0.

pci_dev_run_wake

LINUX

Name

`pci_dev_run_wake` — Check if device can generate run-time wake-up events.

Synopsis

```
bool pci_dev_run_wake (struct pci_dev * dev);
```

Arguments

dev

Device to check.

Description

Return true if the device itself is capable of generating wake-up events (through the platform or using the native PCIe PME) or if the device supports PME and one of its upstream bridges can generate wake-up events.

pci_release_region

LINUX

Name

`pci_release_region` — Release a PCI bar

Synopsis

```
void pci_release_region (struct pci_dev * pdev, int bar);
```

Arguments

pdev

PCI device whose resources were previously reserved by `pci_request_region`

bar

BAR to release

Description

Releases the PCI I/O and memory resources previously reserved by a successful call to `pci_request_region`. Call this function only after all use of the PCI regions has ceased.

pci_request_region

LINUX

Kernel Hackers Manual September 2014

Name

`pci_request_region` — Reserve PCI I/O and memory resource

Synopsis

```
int pci_request_region (struct pci_dev * pdev, int bar, const  
char * res_name);
```

Arguments

pdev

PCI device whose resources are to be reserved

bar

BAR to be reserved

res_name

Name to be associated with resource

Description

Mark the PCI region associated with PCI device *pdev* BAR *bar* as being reserved by owner *res_name*. Do not access any address inside the PCI regions unless this call returns successfully.

Returns 0 on success, or `EBUSY` on error. A warning message is also printed on failure.

pci_request_region_exclusive

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_request_region_exclusive` — Reserved PCI I/O and memory resource

Synopsis

```
int pci_request_region_exclusive (struct pci_dev * pdev, int
bar, const char * res_name);
```

Arguments

pdev

PCI device whose resources are to be reserved

bar

BAR to be reserved

res_name

Name to be associated with resource.

Description

Mark the PCI region associated with PCI device *pdev* BR *bar* as being reserved by owner *res_name*. Do not access any address inside the PCI regions unless this call returns successfully.

Returns 0 on success, or `EBUSY` on error. A warning message is also printed on failure.

The key difference that `_exclusive` makes it that userspace is explicitly not allowed to map the resource via `/dev/mem` or `sysfs`.

pci_release_selected_regions

LINUX

Name

`pci_release_selected_regions` — Release selected PCI I/O and memory resources

Synopsis

```
void pci_release_selected_regions (struct pci_dev * pdev, int  
bars);
```

Arguments

pdev

PCI device whose resources were previously reserved

bars

Bitmask of BARs to be released

Description

Release selected PCI I/O and memory resources previously reserved. Call this function only after all use of the PCI regions has ceased.

pci_request_selected_regions

LINUX

Name

`pci_request_selected_regions` — Reserve selected PCI I/O and memory resources

Synopsis

```
int pci_request_selected_regions (struct pci_dev * pdev, int  
bars, const char * res_name);
```

Arguments

pdev

PCI device whose resources are to be reserved

bars

Bitmask of BARs to be requested

res_name

Name to be associated with resource

`pci_release_regions`

LINUX

Name

`pci_release_regions` — Release reserved PCI I/O and memory resources

Synopsis

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

Arguments

pdev

PCI device whose resources were previously reserved by `pci_request_regions`

Description

Releases all PCI I/O and memory resources previously reserved by a successful call to `pci_request_regions`. Call this function only after all use of the PCI regions has ceased.

pci_request_regions

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_request_regions` — Reserved PCI I/O and memory resources

Synopsis

```
int pci_request_regions (struct pci_dev * pdev, const char *  
res_name);
```


Arguments

pdev

PCI device whose resources are to be reserved

res_name

Name to be associated with resource.

Description

Mark all PCI regions associated with PCI device *pdev* as being reserved by owner *res_name*. Do not access any address inside the PCI regions unless this call returns successfully.

Returns 0 on success, or `EBUSY` on error. A warning message is also printed on failure.

pci_request_regions_exclusive

LINUX

Kernel Hackers Manual September 2014

Name

`pci_request_regions_exclusive` — Reserved PCI I/O and memory resources

Synopsis

```
int pci_request_regions_exclusive (struct pci_dev * pdev,
const char * res_name);
```

Arguments

pdev

PCI device whose resources are to be reserved

res_name

Name to be associated with resource.

Description

Mark all PCI regions associated with PCI device *pdev* as being reserved by owner *res_name*. Do not access any address inside the PCI regions unless this call returns successfully.

`pci_request_regions_exclusive` will mark the region so that `/dev/mem` and the sysfs MMIO access will not be allowed.

Returns 0 on success, or `EBUSY` on error. A warning message is also printed on failure.

pci_set_master

LINUX

Kernel Hackers Manual September 2014

Name

`pci_set_master` — enables bus-mastering for device `dev`

Synopsis

```
void pci_set_master (struct pci_dev * dev);
```

Arguments

dev

the PCI device to enable

Description

Enables bus-mastering on the device and calls `pcibios_set_master` to do the needed arch specific settings.

pci_clear_master

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_clear_master` — disables bus-mastering for device `dev`

Synopsis

```
void pci_clear_master (struct pci_dev * dev);
```

Arguments

dev

the PCI device to disable

pci_set_cacheline_size

LINUX

Kernel Hackers Manual September 2014

Name

`pci_set_cacheline_size` — ensure the `CACHE_LINE_SIZE` register is programmed

Synopsis

```
int pci_set_cacheline_size (struct pci_dev * dev);
```

Arguments

dev

the PCI device for which MWI is to be enabled

Description

Helper function for `pci_set_mwi`. Originally copied from `drivers/net/acenic.c`.
Copyright 1998-2001 by Jes Sorensen, <jes@trained-monkey.org>.

RETURNS

An appropriate `-ERRNO` error value on error, or zero for success.

pci_set_mwi

LINUX

Kernel Hackers Manual September 2014

Name

`pci_set_mwi` — enables memory-write-invalidate PCI transaction

Synopsis

```
int pci_set_mwi (struct pci_dev * dev);
```

Arguments

dev

the PCI device for which MWI is enabled

Description

Enables the Memory-Write-Invalidate transaction in `PCI_COMMAND`.

RETURNS

An appropriate `-ERRNO` error value on error, or zero for success.

pci_try_set_mwi

LINUX

Name

`pci_try_set_mwi` — enables memory-write-invalidate PCI transaction

Synopsis

```
int pci_try_set_mwi (struct pci_dev * dev);
```

Arguments

dev

the PCI device for which MWI is enabled

Description

Enables the Memory-Write-Invalidate transaction in `PCI_COMMAND`. Callers are not required to check the return value.

RETURNS

An appropriate `-ERRNO` error value on error, or zero for success.

`pci_clear_mwi`

LINUX

Name

`pci_clear_mwi` — disables Memory-Write-Invalidate for device `dev`

Synopsis

```
void pci_clear_mwi (struct pci_dev * dev);
```

Arguments

dev

the PCI device to disable

Description

Disables PCI Memory-Write-Invalidate transaction on the device

pci_intx

LINUX

Name

`pci_intx` — enables/disables PCI INTx for device `dev`

Synopsis

```
void pci_intx (struct pci_dev * pdev, int enable);
```

Arguments

pdev

the PCI device to operate on

enable

boolean: whether to enable or disable PCI INTx

Description

Enables/disables PCI INTx for device *dev*

pci_intx_mask_supported

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_intx_mask_supported` — probe for INTx masking support

Synopsis

```
bool pci_intx_mask_supported (struct pci_dev * dev);
```


Arguments

dev

the PCI device to operate on

Description

Check if the device *dev* support INTx masking via the config space command word.

pci_check_and_mask_intx

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_check_and_mask_intx` — mask INTx on pending interrupt

Synopsis

```
bool pci_check_and_mask_intx (struct pci_dev * dev);
```

Arguments

dev

the PCI device to operate on

Description

Check if the device `dev` has its INTx line asserted, mask it and return true in that case. False is returned if not interrupt was pending.

pci_check_and_unmask_intx

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_check_and_unmask_intx` — unmask INTx if no interrupt is pending

Synopsis

```
bool pci_check_and_unmask_intx (struct pci_dev * dev);
```

Arguments

dev

the PCI device to operate on

Description

Check if the device `dev` has its INTx line asserted, unmask it if not and return true. False is returned and the mask remains active if there was still an interrupt pending.

pci_msi_off

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_msi_off` — disables any MSI or MSI-X capabilities

Synopsis

```
void pci_msi_off (struct pci_dev * dev);
```

Arguments

dev

the PCI device to operate on

Description

If you want to use MSI, see `pci_enable_msi` and friends. This is a lower-level primitive that allows us to disable MSI operation at the device level.

pci_wait_for_pending_transaction

LINUX

Name

`pci_wait_for_pending_transaction` — waits for pending transaction

Synopsis

```
int pci_wait_for_pending_transaction (struct pci_dev * dev);
```

Arguments

dev

the PCI device to operate on

Description

Return 0 if transaction is pending 1 otherwise.

pci_reset_bridge_secondary_bus

LINUX

Name

`pci_reset_bridge_secondary_bus` — Reset the secondary bus on a PCI bridge.

Synopsis

```
void pci_reset_bridge_secondary_bus (struct pci_dev * dev);
```

Arguments

dev

Bridge device

Description

Use the bridge control register to assert reset on the secondary bus. Devices on the secondary bus are left in power-on state.

__pci_reset_function

LINUX

Kernel Hackers Manual September 2014

Name

`__pci_reset_function` — reset a PCI device function

Synopsis

```
int __pci_reset_function (struct pci_dev * dev);
```

Arguments

dev

PCI device to reset

Description

Some devices allow an individual function to be reset without affecting other functions in the same device. The PCI device must be responsive to PCI config space in order to use this function.

The device function is presumed to be unused when this function is called. Resetting the device will make the contents of PCI configuration space random, so any caller of this must be prepared to reinitialise the device including MSI, bus mastering, BARs, decoding IO and memory spaces, etc.

Returns 0 if the device function was successfully reset or negative if the device doesn't support resetting a single function.

__pci_reset_function_locked

LINUX

Kernel Hackers Manual September 2014

Name

`__pci_reset_function_locked` — reset a PCI device function while holding the *dev* mutex lock.

Synopsis

```
int __pci_reset_function_locked (struct pci_dev * dev);
```

Arguments

dev

PCI device to reset

Description

Some devices allow an individual function to be reset without affecting other functions in the same device. The PCI device must be responsive to PCI config space in order to use this function.

The device function is presumed to be unused and the caller is holding the device mutex lock when this function is called. Resetting the device will make the contents of PCI configuration space random, so any caller of this must be prepared to reinitialise the device including MSI, bus mastering, BARs, decoding IO and memory spaces, etc.

Returns 0 if the device function was successfully reset or negative if the device doesn't support resetting a single function.

pci_reset_function

LINUX

Kernel Hackers Manual September 2014

Name

`pci_reset_function` — quiesce and reset a PCI device function

Synopsis

```
int pci_reset_function (struct pci_dev * dev);
```

Arguments

dev

PCI device to reset

Description

Some devices allow an individual function to be reset without affecting other functions in the same device. The PCI device must be responsive to PCI config space in order to use this function.

This function does not just reset the PCI portion of a device, but clears all the state associated with the device. This function differs from `__pci_reset_function` in that it saves and restores device state over the reset.

Returns 0 if the device function was successfully reset or negative if the device doesn't support resetting a single function.

pci_try_reset_function

LINUX

Kernel Hackers Manual September 2014

Name

`pci_try_reset_function` — quiesce and reset a PCI device function

Synopsis

```
int pci_try_reset_function (struct pci_dev * dev);
```


Arguments

dev

PCI device to reset

Description

Same as above, except return -EAGAIN if unable to lock device.

pci_probe_reset_slot

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_probe_reset_slot` — probe whether a PCI slot can be reset

Synopsis

```
int pci_probe_reset_slot (struct pci_slot * slot);
```

Arguments

slot

PCI slot to probe

Description

Return 0 if slot can be reset, negative if a slot reset is not supported.

pci_reset_slot

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_reset_slot` — reset a PCI slot

Synopsis

```
int pci_reset_slot (struct pci_slot * slot);
```

Arguments

slot

PCI slot to reset

Description

A PCI bus may host multiple slots, each slot may support a reset mechanism independent of other slots. For instance, some slots may support slot power control. In the case of a 1:1 bus to slot architecture, this function may wrap the bus reset to avoid spurious slot related events such as hotplug. Generally a slot reset should be attempted before a bus reset. All of the function of the slot and any subordinate buses behind the slot are reset through this function. PCI config space of all devices in the slot and behind the slot is saved before and restored after reset.

Return 0 on success, non-zero on error.

pci_try_reset_slot

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_try_reset_slot` — Try to reset a PCI slot

Synopsis

```
int pci_try_reset_slot (struct pci_slot * slot);
```

Arguments

slot

PCI slot to reset

Description

Same as above except return -EAGAIN if the slot cannot be locked

pci_probe_reset_bus

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_probe_reset_bus` — probe whether a PCI bus can be reset

Synopsis

```
int pci_probe_reset_bus (struct pci_bus * bus);
```

Arguments

bus

PCI bus to probe

Description

Return 0 if bus can be reset, negative if a bus reset is not supported.

pci_reset_bus

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_reset_bus` — reset a PCI bus

Synopsis

```
int pci_reset_bus (struct pci_bus * bus);
```

Arguments

bus

top level PCI bus to reset

Description

Do a bus reset on the given bus and any subordinate buses, saving and restoring state of all devices.

Return 0 on success, non-zero on error.

pci_try_reset_bus

LINUX

Kernel Hackers Manual September 2014

Name

`pci_try_reset_bus` — Try to reset a PCI bus

Synopsis

```
int pci_try_reset_bus (struct pci_bus * bus);
```

Arguments

bus

top level PCI bus to reset

Description

Same as above except return -EAGAIN if the bus cannot be locked

pcix_get_max_mmrbc

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pcix_get_max_mmrbc` — get PCI-X maximum designed memory read byte count

Synopsis

```
int pcix_get_max_mmrbc (struct pci_dev * dev);
```

Arguments

dev

PCI device to query

Returns mmrbc

maximum designed memory read count in bytes or appropriate error value.

pcix_get_mmrbc

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pcix_get_mmrbc` — get PCI-X maximum memory read byte count

Synopsis

```
int pcix_get_mmrbc (struct pci_dev * dev);
```

Arguments

dev

PCI device to query

Returns mmrbc

maximum memory read count in bytes or appropriate error value.

pcix_set_mmrbc

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pcix_set_mmrbc` — set PCI-X maximum memory read byte count

Synopsis

```
int pcix_set_mmrbc (struct pci_dev * dev, int mmrbc);
```

Arguments

dev

PCI device to query

mmrbc

maximum memory read count in bytes valid values are 512, 1024, 2048, 4096

Description

If possible sets maximum memory read byte count, some bridges have erratas that prevent this.

pcie_get_readrq

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pcie_get_readrq` — get PCI Express read request size

Synopsis

```
int pcie_get_readrq (struct pci_dev * dev);
```


Arguments

dev

PCI device to query

Description

Returns maximum memory read request in bytes or appropriate error value.

pcie_set_readrq

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pcie_set_readrq` — set PCI Express maximum memory read request

Synopsis

```
int pcie_set_readrq (struct pci_dev * dev, int rq);
```

Arguments

dev

PCI device to query

rq

maximum memory read count in bytes valid values are 128, 256, 512, 1024, 2048, 4096

Description

If possible sets maximum memory read request in bytes

pcie_get_mps

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pcie_get_mps` — get PCI Express maximum payload size

Synopsis

```
int pcie_get_mps (struct pci_dev * dev);
```

Arguments

dev

PCI device to query

Description

Returns maximum payload size in bytes

pcie_set_mps

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pcie_set_mps` — set PCI Express maximum payload size

Synopsis

```
int pcie_set_mps (struct pci_dev * dev, int mps);
```

Arguments

dev

PCI device to query

mps

maximum payload size in bytes valid values are 128, 256, 512, 1024, 2048, 4096

Description

If possible sets maximum payload size

pcie_get_minimum_link

LINUX

Name

`pcie_get_minimum_link` — determine minimum link settings of a PCI device

Synopsis

```
int pcie_get_minimum_link (struct pci_dev * dev, enum
pci_bus_speed * speed, enum pcie_link_width * width);
```

Arguments

dev

PCI device to query

speed

storage for minimum speed

width

storage for minimum width

Description

This function will walk up the PCI device chain and determine the minimum link width and speed of the device.

`pci_selectBars`

LINUX

Name

`pci_select_bars` — Make BAR mask from the type of resource

Synopsis

```
int pci_select_bars (struct pci_dev * dev, unsigned long
flags);
```

Arguments

dev

the PCI device for which BAR mask is made

flags

resource type mask to be selected

Description

This helper routine makes bar mask from the type of resource.

`pci_add_dynid`

LINUX

Name

`pci_add_dynid` — add a new PCI device ID to this driver and re-probe devices

Synopsis

```
int pci_add_dynid (struct pci_driver * drv, unsigned int  
vendor, unsigned int device, unsigned int subvendor, unsigned  
int subdevice, unsigned int class, unsigned int class_mask,  
unsigned long driver_data);
```

Arguments

drv

target pci driver

vendor

PCI vendor ID

device

PCI device ID

subvendor

PCI subvendor ID

subdevice

PCI subdevice ID

class

PCI class

class_mask

PCI class mask

driver_data

private driver data

Description

Adds a new dynamic pci device ID to this driver and causes the driver to probe for all devices again. *drv* must have been registered prior to calling this function.

CONTEXT

Does GFP_KERNEL allocation.

RETURNS

0 on success, -errno on failure.

pci_match_id

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_match_id` — See if a pci device matches a given pci_id table

Synopsis

```
const struct pci_device_id * pci_match_id (const struct
pci_device_id * ids, struct pci_dev * dev);
```

Arguments

ids

array of PCI device id structures to search in

dev

the PCI device structure to match against.

Description

Used by a driver to check whether a PCI device present in the system is in its list of supported devices. Returns the matching `pci_device_id` structure or `NULL` if there is no match.

Deprecated, don't use this as it will not catch any dynamic ids that a driver might want to check for.

__pci_register_driver

LINUX

Kernel Hackers Manual September 2014

Name

`__pci_register_driver` — register a new pci driver

Synopsis

```
int __pci_register_driver (struct pci_driver * drv, struct
module * owner, const char * mod_name);
```

Arguments

drv

the driver structure to register

owner

owner module of drv

mod_name

module name string

Description

Adds the driver structure to the list of registered drivers. Returns a negative value on error, otherwise 0. If no error occurred, the driver remains registered even if no device was claimed during registration.

pci_unregister_driver

LINUX

Kernel Hackers Manual September 2014

Name

`pci_unregister_driver` — unregister a pci driver

Synopsis

```
void pci_unregister_driver (struct pci_driver * drv);
```

Arguments

drv

the driver structure to unregister

Description

Deletes the driver structure from the list of registered PCI drivers, gives it a chance to clean up by calling its `remove` function for each device it was responsible for, and marks those devices as driverless.

pci_dev_driver

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_dev_driver` — get the `pci_driver` of a device

Synopsis

```
struct pci_driver * pci_dev_driver (const struct pci_dev *  
dev);
```

Arguments

dev

the device to query

Description

Returns the appropriate `pci_driver` structure or `NULL` if there is no registered driver for the device.

pci_dev_get

LINUX

Name

`pci_dev_get` — increments the reference count of the pci device structure

Synopsis

```
struct pci_dev * pci_dev_get (struct pci_dev * dev);
```

Arguments

dev

the device being referenced

Description

Each live reference to a device should be refcounted.

Drivers for PCI devices should normally record such references in their `probe` methods, when they bind to a device, and release them by calling `pci_dev_put`, in their `disconnect` methods.

A pointer to the device with the incremented reference counter is returned.

`pci_dev_put`

LINUX

Name

`pci_dev_put` — release a use of the pci device structure

Synopsis

```
void pci_dev_put (struct pci_dev * dev);
```

Arguments

dev

device that's been disconnected

Description

Must be called when a user of a device is finished with it. When the last user of the device calls this function, the memory of the device is freed.

pci_stop_and_remove_bus_device

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_stop_and_remove_bus_device` — remove a PCI device and any children

Synopsis

```
void pci_stop_and_remove_bus_device (struct pci_dev * dev);
```

Arguments

dev

the device to remove

Description

Remove a PCI device from the device lists, informing the drivers that the device has been removed. We also remove any subordinate buses and children in a depth-first manner.

For each device we remove, delete the device structure from the device lists, remove the /proc entry, and notify userspace (/sbin/hotplug).

pci_find_bus

LINUX

Kernel Hackers Manual September 2014

Name

`pci_find_bus` — locate PCI bus from a given domain and bus number

Synopsis

```
struct pci_bus * pci_find_bus (int domain, int busnr);
```

Arguments

domain

number of PCI domain to search

busnr

number of desired PCI bus

Description

Given a PCI bus number and domain number, the desired PCI bus is located in the global list of PCI buses. If the bus is found, a pointer to its data structure is returned. If no bus is found, `NULL` is returned.

pci_find_next_bus

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_find_next_bus` — begin or continue searching for a PCI bus

Synopsis

```
struct pci_bus * pci_find_next_bus (const struct pci_bus *  
from);
```

Arguments

from

Previous PCI bus found, or `NULL` for new search.

Description

Iterates through the list of known PCI buses. A new search is initiated by passing `NULL` as the *from* argument. Otherwise if *from* is not `NULL`, searches continue from next device on the global list.

pci_get_slot

LINUX

Kernel Hackers Manual September 2014

Name

`pci_get_slot` — locate PCI device for a given PCI slot

Synopsis

```
struct pci_dev * pci_get_slot (struct pci_bus * bus, unsigned
int devfn);
```

Arguments

bus

PCI bus on which desired PCI device resides

devfn

encodes number of PCI slot in which the desired PCI device resides and the logical device number within that slot in case of multi-function devices.

Description

Given a PCI bus and slot/function number, the desired PCI device is located in the list of PCI devices. If the device is found, its reference count is increased and this function returns a pointer to its data structure. The caller must decrement the reference count by calling `pci_dev_put`. If no device is found, `NULL` is returned.

pci_get_domain_bus_and_slot

LINUX

Kernel Hackers Manual September 2014

Name

`pci_get_domain_bus_and_slot` — locate PCI device for a given PCI domain (segment), bus, and slot

Synopsis

```
struct pci_dev * pci_get_domain_bus_and_slot (int domain,  
unsigned int bus, unsigned int devfn);
```

Arguments

domain

PCI domain/segment on which the PCI device resides.

bus

PCI bus on which desired PCI device resides

devfn

encodes number of PCI slot in which the desired PCI device resides and the logical device number within that slot in case of multi-function devices.

Description

Given a PCI domain, bus, and slot/function number, the desired PCI device is located in the list of PCI devices. If the device is found, its reference count is increased and this function returns a pointer to its data structure. The caller must decrement the reference count by calling `pci_dev_put`. If no device is found, `NULL` is returned.

pci_get_subsys

LINUX

Kernel Hackers Manual September 2014

Name

`pci_get_subsys` — begin or continue searching for a PCI device by vendor/subvendor/device/subdevice id

Synopsis

```
struct pci_dev * pci_get_subsys (unsigned int vendor, unsigned
int device, unsigned int ss_vendor, unsigned int ss_device,
struct pci_dev * from);
```

Arguments

vendor

PCI vendor id to match, or `PCI_ANY_ID` to match all vendor ids

device

PCI device id to match, or `PCI_ANY_ID` to match all device ids

ss_vendor

PCI subsystem vendor id to match, or `PCI_ANY_ID` to match all vendor ids

ss_device

PCI subsystem device id to match, or `PCI_ANY_ID` to match all device ids

from

Previous PCI device found in search, or `NULL` for new search.

Description

Iterates through the list of known PCI devices. If a PCI device is found with a matching *vendor*, *device*, *ss_vendor* and *ss_device*, a pointer to its device structure is returned, and the reference count to the device is incremented.

Otherwise, `NULL` is returned. A new search is initiated by passing `NULL` as the *from* argument. Otherwise if *from* is not `NULL`, searches continue from next device on the global list. The reference count for *from* is always decremented if it is not `NULL`.

pci_get_device

LINUX

Kernel Hackers Manual September 2014

Name

`pci_get_device` — begin or continue searching for a PCI device by vendor/device id

Synopsis

```
struct pci_dev * pci_get_device (unsigned int vendor, unsigned  
int device, struct pci_dev * from);
```

Arguments

vendor

PCI vendor id to match, or `PCI_ANY_ID` to match all vendor ids

device

PCI device id to match, or `PCI_ANY_ID` to match all device ids

from

Previous PCI device found in search, or `NULL` for new search.

Description

Iterates through the list of known PCI devices. If a PCI device is found with a matching *vendor* and *device*, the reference count to the device is incremented and a pointer to its device structure is returned. Otherwise, `NULL` is returned. A new search is initiated by passing `NULL` as the *from* argument. Otherwise if *from* is not `NULL`, searches continue from next device on the global list. The reference count for *from* is always decremented if it is not `NULL`.

pci_get_class

LINUX

Kernel Hackers Manual September 2014

Name

`pci_get_class` — begin or continue searching for a PCI device by class

Synopsis

```
struct pci_dev * pci_get_class (unsigned int class, struct
pci_dev * from);
```

Arguments

class

search for a PCI device with this class designation

from

Previous PCI device found in search, or `NULL` for new search.

Description

Iterates through the list of known PCI devices. If a PCI device is found with a matching *class*, the reference count to the device is incremented and a pointer to its device structure is returned. Otherwise, `NULL` is returned. A new search is initiated by passing `NULL` as the *from* argument. Otherwise if *from* is not `NULL`, searches continue from next device on the global list. The reference count for *from* is always decremented if it is not `NULL`.

pci_dev_present

LINUX

Kernel Hackers Manual September 2014

Name

`pci_dev_present` — Returns 1 if device matching the device list is present, 0 if not.

Synopsis

```
int pci_dev_present (const struct pci_device_id * ids);
```

Arguments

ids

A pointer to a null terminated list of struct `pci_device_id` structures that describe the type of PCI device the caller is trying to find.

Obvious fact

You do not have a reference to any device that might be found by this function, so if that device is removed from the system right after this function is finished, the value will be stale. Use this function to find devices that are usually built into a system, or for a general hint as to if another device happens to be present at this specific moment in time.

pci_msi_vec_count

LINUX

Kernel Hackers Manual September 2014

Name

`pci_msi_vec_count` — Return the number of MSI vectors a device can send

Synopsis

```
int pci_msi_vec_count (struct pci_dev * dev);
```

Arguments

dev

device to report about

Description

This function returns the number of MSI vectors a device requested via Multiple Message Capable register. It returns a negative errno if the device is not capable sending MSI interrupts. Otherwise, the call succeeds and returns a power of two, up to a maximum of 2^5 (32), according to the MSI specification.

pci_msix_vec_count

LINUX

Kernel Hackers Manual September 2014

Name

`pci_msix_vec_count` — return the number of device's MSI-X table entries

Synopsis

```
int pci_msix_vec_count (struct pci_dev * dev);
```

Arguments

dev

pointer to the `pci_dev` data structure of MSI-X device function This function returns the number of device's MSI-X table entries and therefore the number of MSI-X vectors device is capable of sending. It returns a negative errno if the device is not capable of sending MSI-X interrupts.

pci_enable_msix

LINUX

Kernel Hackers Manual September 2014

Name

`pci_enable_msix` — configure device's MSI-X capability structure

Synopsis

```
int pci_enable_msix (struct pci_dev * dev, struct msix_entry *
entries, int nvec);
```

Arguments

dev

pointer to the `pci_dev` data structure of MSI-X device function

entries

pointer to an array of MSI-X entries

nvec

number of MSI-X irqs requested for allocation by device driver

Description

Setup the MSI-X capability structure of device function with the number of requested irqs upon its software driver call to request for MSI-X mode enabled on its hardware device function. A return of zero indicates the successful configuration of MSI-X capability structure with new allocated MSI-X irqs. A return of `< 0` indicates a failure. Or a return of `> 0` indicates that driver request is exceeding the number of irqs or MSI-X vectors available. Driver should use the returned value to re-send its request.

pci_msi_enabled

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_msi_enabled` — is MSI enabled?

Synopsis

```
int pci_msi_enabled ( void );
```

Arguments

void

no arguments

Description

Returns true if MSI has not been disabled by the command-line option `pci=noms`.

pci_enable_msi_range

LINUX

Name

`pci_enable_msi_range` — configure device's MSI capability structure

Synopsis

```
int pci_enable_msi_range (struct pci_dev * dev, int minvec,  
int maxvec);
```

Arguments

dev

device to configure

minvec

minimal number of interrupts to configure

maxvec

maximum number of interrupts to configure

Description

This function tries to allocate a maximum possible number of interrupts in a range between *minvec* and *maxvec*. It returns a negative `errno` if an error occurs. If it succeeds, it returns the actual number of interrupts allocated and updates the *dev*'s `irq` member to the lowest new interrupt number; the other interrupt numbers allocated to this device are consecutive.

pci_enable_msix_range

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_enable_msix_range` — configure device's MSI-X capability structure

Synopsis

```
int pci_enable_msix_range (struct pci_dev * dev, struct
msix_entry * entries, int minvec, int maxvec);
```

Arguments

dev

pointer to the `pci_dev` data structure of MSI-X device function

entries

pointer to an array of MSI-X entries

minvec

minimum number of MSI-X irqs requested

maxvec

maximum number of MSI-X irqs requested

Description

Setup the MSI-X capability structure of device function with a maximum possible number of interrupts in the range between *minvec* and *maxvec* upon its software driver call to request for MSI-X mode enabled on its hardware device function. It returns a negative `errno` if an error occurs. If it succeeds, it returns the actual

number of interrupts allocated and indicates the successful configuration of MSI-X capability structure with new allocated MSI-X interrupts.

pci_bus_alloc_resource

LINUX

Kernel Hackers Manual September 2014

Name

`pci_bus_alloc_resource` — allocate a resource from a parent bus

Synopsis

```
int pci_bus_alloc_resource (struct pci_bus * bus, struct
resource * res, resource_size_t size, resource_size_t align,
resource_size_t min, unsigned long type_mask, resource_size_t
(*alignf) (void *, const struct resource *, resource_size_t,
resource_size_t), void * alignf_data);
```

Arguments

bus

PCI bus

res

resource to allocate

size

size of resource to allocate

align

alignment of resource to allocate

min

minimum /proc/iomem address to allocate

type_mask

IORESOURCE_* type flags

alignf

resource alignment function

alignf_data

data argument for resource alignment function

Description

Given the PCI bus a device resides on, the size, minimum address, alignment and type, try to find an acceptable resource allocation for a specific device resource.

pci_bus_add_device

LINUX

Kernel Hackers ManualSeptember 2014

Name

pci_bus_add_device — start driver for a single device

Synopsis

```
void pci_bus_add_device (struct pci_dev * dev);
```

Arguments

dev

device to add

Description

This adds add sysfs entries and start device drivers

pci_bus_add_devices

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_bus_add_devices` — start driver for PCI devices

Synopsis

```
void pci_bus_add_devices (const struct pci_bus * bus);
```

Arguments

bus

bus to check for new devices

Description

Start driver for PCI devices and add some sysfs entries.

pci_bus_set_ops

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_bus_set_ops` — Set raw operations of pci bus

Synopsis

```
struct pci_ops * pci_bus_set_ops (struct pci_bus * bus, struct  
pci_ops * ops);
```

Arguments

bus

pci bus struct

ops

new raw operations

Description

Return previous raw operations

pci_read_vpd

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_read_vpd` — Read one entry from Vital Product Data

Synopsis

```
ssize_t pci_read_vpd (struct pci_dev * dev, loff_t pos, size_t
count, void * buf);
```

Arguments

dev

pci device struct

pos

offset in vpd space

count

number of bytes to read

buf

pointer to where to store result

pci_write_vpd

LINUX

Name

`pci_write_vpd` — Write entry to Vital Product Data

Synopsis

```
ssize_t pci_write_vpd (struct pci_dev * dev, loff_t pos,  
size_t count, const void * buf);
```

Arguments

dev

pci device struct

pos

offset in vpd space

count

number of bytes to write

buf

buffer containing write data

`pci_cfg_access_lock`

LINUX

Name

`pci_cfg_access_lock` — Lock PCI config reads/writes

Synopsis

```
void pci_cfg_access_lock (struct pci_dev * dev);
```

Arguments

dev

pci device struct

Description

When access is locked, any userspace reads or writes to config space and concurrent lock requests will sleep until access is allowed via `pci_cfg_access_unlocked` again.

pci_cfg_access_trylock

LINUX

Name

`pci_cfg_access_trylock` — try to lock PCI config reads/writes

Synopsis

```
bool pci_cfg_access_trylock (struct pci_dev * dev);
```

Arguments

dev

pci device struct

Description

Same as `pci_cfg_access_lock`, but will return 0 if access is already locked, 1 otherwise. This function can be used from atomic contexts.

pci_cfg_access_unlock

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_cfg_access_unlock` — Unlock PCI config reads/writes

Synopsis

```
void pci_cfg_access_unlock (struct pci_dev * dev);
```

Arguments

dev

pci device struct

Description

This function allows PCI config accesses to resume.

pci_lost_interrupt

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_lost_interrupt` — reports a lost PCI interrupt

Synopsis

```
enum pci_lost_interrupt_reason pci_lost_interrupt (struct  
pci_dev * pdev);
```

Arguments

pdev

device whose interrupt is lost

Description

The primary function of this routine is to report a lost interrupt in a standard way which users can recognise (instead of blaming the driver).

Returns

a suggestion for fixing it (although the driver is not required to act on this).

__ht_create_irq

LINUX

Kernel Hackers ManualSeptember 2014

Name

`__ht_create_irq` — create an irq and attach it to a device.

Synopsis

```
int __ht_create_irq (struct pci_dev * dev, int idx,  
ht_irq_update_t * update);
```

Arguments

dev

The hypertransport device to find the irq capability on.

idx

Which of the possible irqs to attach to.

update

Function to be called when changing the htirq message

Description

The irq number of the new irq or a negative error value is returned.

ht_create_irq

LINUX

Kernel Hackers ManualSeptember 2014

Name

`ht_create_irq` — create an irq and attach it to a device.

Synopsis

```
int ht_create_irq (struct pci_dev * dev, int idx);
```

Arguments

dev

The hypertransport device to find the irq capability on.

idx

Which of the possible irqs to attach to.

Description

`ht_create_irq` needs to be called for all hypertransport devices that generate irqs.

The irq number of the new irq or a negative error value is returned.

ht_destroy_irq

LINUX

Kernel Hackers ManualSeptember 2014

Name

`ht_destroy_irq` — destroy an irq created with `ht_create_irq`

Synopsis

```
void ht_destroy_irq (unsigned int irq);
```

Arguments

irq

irq to be destroyed

Description

This reverses `ht_create_irq` removing the specified irq from existence. The irq should be free before this happens.

pci_scan_slot

LINUX

Kernel Hackers Manual September 2014

Name

`pci_scan_slot` — scan a PCI slot on a bus for devices.

Synopsis

```
int pci_scan_slot (struct pci_bus * bus, int devfn);
```

Arguments

bus

PCI bus to scan

devfn

slot number to scan (must have zero function.)

Description

Scan a PCI slot on the specified PCI bus for devices, adding discovered devices to the *bus->devices* list. New devices will not have *is_added* set.

Returns the number of new devices found.

pci_rescan_bus

LINUX

Name

`pci_rescan_bus` — scan a PCI bus for devices.

Synopsis

```
unsigned int pci_rescan_bus (struct pci_bus * bus);
```

Arguments

bus

PCI bus to scan

Description

Scan a PCI bus and child buses for new devices, adds them, and enables them.

Returns the max number of subordinate bus discovered.

pci_create_slot

LINUX

Name

`pci_create_slot` — create or increment refcount for physical PCI slot

Synopsis

```
struct pci_slot * pci_create_slot (struct pci_bus * parent,
int slot_nr, const char * name, struct hotplug_slot *
hotplug);
```

Arguments

parent

struct pci_bus of parent bridge

slot_nr

PCI_SLOT(pci_dev->devfn) or -1 for placeholder

name

user visible string presented in /sys/bus/pci/slots/<name>

hotplug

set if caller is hotplug driver, NULL otherwise

Description

PCI slots have first class attributes such as address, speed, width, and a struct pci_slot is used to manage them. This interface will either return a new struct pci_slot to the caller, or if the pci_slot already exists, its refcount will be incremented.

Slots are uniquely identified by a *pci_bus*, *slot_nr* tuple.

There are known platforms with broken firmware that assign the same name to multiple slots. Workaround these broken platforms by renaming the slots on behalf of the caller. If firmware assigns name N to

multiple slots

The first slot is assigned N The second slot is assigned N-1 The third slot is assigned N-2 etc.

Placeholder slots

In most cases, `pci_bus`, `slot_nr` will be sufficient to uniquely identify a slot. There is one notable exception - pSeries (rpaphp), where the `slot_nr` cannot be determined until a device is actually inserted into the slot. In this scenario, the caller may pass -1 for `slot_nr`.

The following semantics are imposed when the caller passes `slot_nr == -1`. First, we no longer check for an existing `struct pci_slot`, as there may be many slots with `slot_nr` of -1. The other change in semantics is user-visible, which is the 'address' parameter presented in sysfs will

consist solely of a dddd

bb tuple, where dddd is the PCI domain of the `struct pci_bus` and bb is the bus number. In other words, the devfn of the 'placeholder' slot will not be displayed.

pci_destroy_slot

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_destroy_slot` — decrement refcount for physical PCI slot

Synopsis

```
void pci_destroy_slot (struct pci_slot * slot);
```

Arguments

slot

struct pci_slot to decrement

Description

struct pci_slot is refcounted, so destroying them is really easy; we just call kobject_put on its kobj and let our release methods do the rest.

pci_hp_create_module_link

LINUX

Kernel Hackers Manual September 2014

Name

pci_hp_create_module_link — create symbolic link to the hotplug driver module.

Synopsis

```
void pci_hp_create_module_link (struct pci_slot * pci_slot);
```

Arguments

pci_slot

struct pci_slot

Description

Helper function for `pci_hotplug_core.c` to create symbolic link to the hotplug driver module.

pci_hp_remove_module_link

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_hp_remove_module_link` — remove symbolic link to the hotplug driver module.

Synopsis

```
void pci_hp_remove_module_link (struct pci_slot * pci_slot);
```

Arguments

pci_slot

struct pci_slot

Description

Helper function for `pci_hotplug_core.c` to remove symbolic link to the hotplug driver module.

pci_enable_rom

LINUX

Kernel Hackers Manual September 2014

Name

`pci_enable_rom` — enable ROM decoding for a PCI device

Synopsis

```
int pci_enable_rom (struct pci_dev *pdev);
```

Arguments

pdev

PCI device to enable

Description

Enable ROM decoding on *dev*. This involves simply turning on the last bit of the PCI ROM BAR. Note that some cards may share address decoders between the ROM and other resources, so enabling it may disable access to MMIO registers or other card memory.

pci_disable_rom

LINUX

Name

`pci_disable_rom` — disable ROM decoding for a PCI device

Synopsis

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

Arguments

pdev

PCI device to disable

Description

Disable ROM decoding on a PCI device by turning off the last bit in the ROM BAR.

pci_map_rom

LINUX

Name

`pci_map_rom` — map a PCI ROM to kernel space

Synopsis

```
void __iomem * pci_map_rom (struct pci_dev * pdev, size_t *
size);
```

Arguments

pdev

pointer to pci device struct

size

pointer to receive size of pci window over ROM

Return

kernel virtual pointer to image of ROM

Map a PCI ROM into kernel space. If ROM is boot video ROM, the shadow BIOS copy will be returned instead of the actual ROM.

pci_unmap_rom

LINUX

Kernel Hackers Manual September 2014

Name

`pci_unmap_rom` — unmap the ROM from kernel space

Synopsis

```
void pci_unmap_rom (struct pci_dev * pdev, void __iomem *  
rom);
```

Arguments

pdev

pointer to pci device struct

rom

virtual address of the previous mapping

Description

Remove a mapping of a previously mapped ROM

pci_platform_rom

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_platform_rom` — provides a pointer to any ROM image provided by the platform

Synopsis

```
void __iomem * pci_platform_rom (struct pci_dev * pdev, size_t  
* size);
```


Arguments

pdev

pointer to pci device struct

size

pointer to receive size of pci window over ROM

pci_enable_sriov

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_enable_sriov` — enable the SR-IOV capability

Synopsis

```
int pci_enable_sriov (struct pci_dev * dev, int nr_virtfn);
```

Arguments

dev

the PCI device

nr_virtfn

number of virtual functions to enable

Description

Returns 0 on success, or negative on failure.

pci_disable_sriov

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_disable_sriov` — disable the SR-IOV capability

Synopsis

```
void pci_disable_sriov (struct pci_dev * dev);
```

Arguments

dev

the PCI device

pci_num_vf

LINUX

Name

`pci_num_vf` — return number of VFs associated with a PF device_release_driver

Synopsis

```
int pci_num_vf (struct pci_dev * dev);
```

Arguments

dev

the PCI device

Description

Returns number of VFs, or 0 if SR-IOV is not enabled.

pci_vfs_assigned

LINUX

Name

`pci_vfs_assigned` — returns number of VFs are assigned to a guest

Synopsis

```
int pci_vfs_assigned (struct pci_dev * dev);
```

Arguments

dev

the PCI device

Description

Returns number of VFs belonging to this device that are assigned to a guest. If device is not a physical function returns 0.

pci_sriov_set_totalvfs

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_sriov_set_totalvfs` — - reduce the TotalVFs available

Synopsis

```
int pci_sriov_set_totalvfs (struct pci_dev * dev, u16 numvfs);
```

Arguments

dev

the PCI PF device

numvfs

number that should be used for TotalVFs supported

Description

Should be called from PF driver's probe routine with device's mutex held.

Returns 0 if PF is an SRIOV-capable device and value of numvfs valid. If not a PF return -ENOSYS; if numvfs is invalid return -EINVAL; if VFs already enabled, return -EBUSY.

pci_sriov_get_totalvfs

LINUX

Kernel Hackers Manual September 2014

Name

`pci_sriov_get_totalvfs` — - get total VFs supported on this device

Synopsis

```
int pci_sriov_get_totalvfs (struct pci_dev * dev);
```

Arguments

dev

the PCI PF device

Description

For a PCIe device with SRIOV support, return the PCIe SRIOV capability value of TotalVFs or the value of driver_max_VFs if the driver reduced it. Otherwise 0.

pci_read_legacy_io

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_read_legacy_io` — read byte(s) from legacy I/O port space

Synopsis

```
ssize_t pci_read_legacy_io (struct file * filp, struct kobject  
* kobj, struct bin_attribute * bin_attr, char * buf, loff_t  
off, size_t count);
```

Arguments

filp

open sysfs file

kobj

kobject corresponding to file to read from

bin_attr

struct bin_attribute for this file

buf

buffer to store results

off

offset into legacy I/O port space

count

number of bytes to read

Description

Reads 1, 2, or 4 bytes from legacy I/O port space using an arch specific callback routine (`pci_legacy_read`).

pci_write_legacy_io

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_write_legacy_io` — write byte(s) to legacy I/O port space

Synopsis

```
ssize_t pci_write_legacy_io (struct file * filp, struct
kobject * kobj, struct bin_attribute * bin_attr, char * buf,
loff_t off, size_t count);
```

Arguments

filp

open sysfs file

kobj

kobject corresponding to file to read from

bin_attr

struct bin_attribute for this file

buf

buffer containing value to be written

off

offset into legacy I/O port space

count

number of bytes to write

Description

Writes 1, 2, or 4 bytes from legacy I/O port space using an arch specific callback routine (`pci_legacy_write`).

pci_mmap_legacy_mem

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_mmap_legacy_mem` — map legacy PCI memory into user memory space

Synopsis

```
int pci_mmap_legacy_mem (struct file * filp, struct kobject *
kobj, struct bin_attribute * attr, struct vm_area_struct *
vma);
```

Arguments

filp

open sysfs file

kobj

kobject corresponding to device to be mapped

attr

struct bin_attribute for this file

vma

struct vm_area_struct passed to mmap

Description

Uses an arch specific callback, `pci_mmap_legacy_mem_page_range`, to mmap legacy memory space (first meg of bus space) into application virtual memory space.

pci_mmap_legacy_io

LINUX

Name

`pci_mmap_legacy_io` — map legacy PCI IO into user memory space

Synopsis

```
int pci_mmap_legacy_io (struct file * filp, struct kobject *  
kobj, struct bin_attribute * attr, struct vm_area_struct *  
vma);
```

Arguments

filp

open sysfs file

kobj

kobject corresponding to device to be mapped

attr

struct bin_attribute for this file

vma

struct vm_area_struct passed to mmap

Description

Uses an arch specific callback, `pci_mmap_legacy_io_page_range`, to mmap legacy IO space (first meg of bus space) into application virtual memory space. Returns `-ENOSYS` if the operation isn't supported

pci_adjust_legacy_attr

LINUX

Kernel Hackers Manual September 2014

Name

`pci_adjust_legacy_attr` — adjustment of legacy file attributes

Synopsis

```
void pci_adjust_legacy_attr (struct pci_bus * b, enum
pci_mmap_state mmap_type);
```

Arguments

b

bus to create files under

mmap_type

I/O port or memory

Description

Stub implementation. Can be overridden by arch if necessary.

pci_create_legacy_files

LINUX

Name

`pci_create_legacy_files` — create legacy I/O port and memory files

Synopsis

```
void pci_create_legacy_files (struct pci_bus * b);
```

Arguments

b

bus to create files under

Description

Some platforms allow access to legacy I/O port and ISA memory space on a per-bus basis. This routine creates the files and ties them into their associated read, write and mmap files from `pci-sysfs.c`

On error unwind, but don't propagate the error to the caller as it is ok to set up the PCI bus without these files.

pci_mmap_resource

LINUX

Name

`pci_mmap_resource` — map a PCI resource into user memory space

Synopsis

```
int pci_mmap_resource (struct kobject * kobj, struct
bin_attribute * attr, struct vm_area_struct * vma, int
write_combine);
```

Arguments

kobj

kobject for mapping

attr

struct bin_attribute for the file being mapped

vma

struct vm_area_struct passed into the mmap

write_combine

1 for write_combine mapping

Description

Use the regular PCI mapping routines to map a PCI resource into userspace.

pci_remove_resource_files

LINUX

Kernel Hackers Manual September 2014

Name

pci_remove_resource_files — cleanup resource files

Synopsis

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

Arguments

pdev

dev to cleanup

Description

If we created resource files for *pdev*, remove them from sysfs and free their resources.

pci_create_resource_files

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_create_resource_files` — create resource files in sysfs for *dev*

Synopsis

```
int pci_create_resource_files (struct pci_dev * pdev);
```

Arguments

pdev

dev in question

Description

Walk the resources in *pdev* creating files for each resource available.

pci_write_rom

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_write_rom` — used to enable access to the PCI ROM display

Synopsis

```
ssize_t pci_write_rom (struct file * filp, struct kobject *  
kobj, struct bin_attribute * bin_attr, char * buf, loff_t  
off, size_t count);
```

Arguments

filp

sysfs file

kobj

kernel object handle

bin_attr

struct bin_attribute for this file

buf

user input

off

file offset

count

number of byte in input

Description

writing anything except 0 enables it

pci_read_rom

LINUX

Kernel Hackers ManualSeptember 2014

Name

pci_read_rom — read a PCI ROM

Synopsis

```
ssize_t pci_read_rom (struct file * filp, struct kobject *  
kobj, struct bin_attribute * bin_attr, char * buf, loff_t  
off, size_t count);
```


Arguments

filp

sysfs file

kobj

kernel object handle

bin_attr

struct bin_attribute for this file

buf

where to put the data we read from the ROM

off

file offset

count

number of bytes to read

Description

Put *count* bytes starting at *off* into *buf* from the ROM in the PCI device corresponding to *kobj*.

pci_remove_sysfs_dev_files

LINUX

Kernel Hackers ManualSeptember 2014

Name

`pci_remove_sysfs_dev_files` — cleanup PCI specific sysfs files

Synopsis

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

Arguments

pdev

device whose entries we should free

Description

Cleanup when *pdev* is removed from sysfs.

9.6. PCI Hotplug Support Library

__pci_hp_register

LINUX

Kernel Hackers Manual September 2014

Name

`__pci_hp_register` — register a hotplug_slot with the PCI hotplug subsystem

Synopsis

```
int __pci_hp_register (struct hotplug_slot * slot, struct  
pci_bus * bus, int devnr, const char * name, struct module *  
owner, const char * mod_name);
```

Arguments

slot

pointer to the struct `hotplug_slot` to register

bus

bus this slot is on

devnr

device number

name

name registered with kobject core

owner

caller module owner

mod_name

caller module name

Description

Registers a hotplug slot with the pci hotplug subsystem, which will allow userspace interaction to the slot.

Returns 0 if successful, anything else for an error.

pci_hp_deregister

LINUX

Name

`pci_hp_deregister` — deregister a `hotplug_slot` with the PCI hotplug subsystem

Synopsis

```
int pci_hp_deregister (struct hotplug_slot * hotplug);
```

Arguments

hotplug

pointer to the struct `hotplug_slot` to deregister

Description

The *slot* must have been registered with the pci hotplug subsystem previously with a call to `pci_hp_register`.

Returns 0 if successful, anything else for an error.

pci_hp_change_slot_info

LINUX

Name

`pci_hp_change_slot_info` — changes the slot's information structure in the core

Synopsis

```
int pci_hp_change_slot_info (struct hotplug_slot * hotplug,  
struct hotplug_slot_info * info);
```

Arguments

hotplug

pointer to the slot whose info has changed

info

pointer to the info copy into the slot's info structure

Description

slot must have been registered with the pci hotplug subsystem previously with a call to `pci_hp_register`.

Returns 0 if successful, anything else for an error.

Chapter 10. Firmware Interfaces

10.1. DMI Interfaces

dmi_check_system

LINUX

Kernel Hackers Manual September 2014

Name

`dmi_check_system` — check system DMI data

Synopsis

```
int dmi_check_system (const struct dmi_system_id * list);
```

Arguments

list

array of `dmi_system_id` structures to match against All non-null elements of the list must match their slot's (field index's) data (i.e., each list string must be a substring of the specified DMI slot's string data) to be considered a successful match.

Description

Walk the blacklist table running matching functions until someone returns non zero or we hit the end. Callback function is called for each successful match. Returns the number of matches.

dmi_first_match

LINUX

Kernel Hackers ManualSeptember 2014

Name

`dmi_first_match` — find `dmi_system_id` structure matching system DMI data

Synopsis

```
const struct dmi_system_id * dmi_first_match (const struct
dmi_system_id * list);
```

Arguments

list

array of `dmi_system_id` structures to match against All non-null elements of the list must match their slot's (field index's) data (i.e., each list string must be a substring of the specified DMI slot's string data) to be considered a successful match.

Description

Walk the blacklist table until the first match is found. Return the pointer to the matching entry or NULL if there's no match.

dmi_get_system_info

LINUX

Kernel Hackers ManualSeptember 2014

Name

`dmi_get_system_info` — return DMI data value

Synopsis

```
const char * dmi_get_system_info (int field);
```

Arguments

field

data index (see enum `dmi_field`)

Description

Returns one DMI data value, can be used to perform complex DMI data checks.

dmi_name_in_vendors

LINUX

Name

`dmi_name_in_vendors` — Check if string is in the DMI system or board vendor name

Synopsis

```
int dmi_name_in_vendors (const char * str);
```

Arguments

str

Case sensitive Name

dmi_find_device

LINUX

Name

`dmi_find_device` — find onboard device by type/name

Synopsis

```
const struct dmi_device * dmi_find_device (int type, const  
char * name, const struct dmi_device * from);
```

Arguments

type

device type or `DMI_DEV_TYPE_ANY` to match all device types

name

device name string or `NULL` to match all

from

previous device found in search, or `NULL` for new search.

Description

Iterates through the list of known onboard devices. If a device is found with a matching *vendor* and *device*, a pointer to its device structure is returned. Otherwise, `NULL` is returned. A new search is initiated by passing `NULL` as the *from* argument. If *from* is not `NULL`, searches continue from next device.

dmi_get_date

LINUX

Kernel Hackers Manual September 2014

Name

`dmi_get_date` — parse a DMI date

Synopsis

```
bool dmi_get_date (int field, int * yearp, int * monthp, int *
dayp);
```

Arguments

field

data index (see enum dmi_field)

yearp

optional out parameter for the year

monthp

optional out parameter for the month

dayp

optional out parameter for the day

Description

The date field is assumed to be in the form resembling [mm[/dd]]/yy[yy] and the result is stored in the out parameters any or all of which can be omitted.

If the field doesn't exist, all out parameters are set to zero and false is returned. Otherwise, true is returned with any invalid part of date set to zero.

On return, year, month and day are guaranteed to be in the range of [0,9999], [0,12] and [0,31] respectively.

dmi_walk

LINUX

Kernel Hackers ManualSeptember 2014

Name

dmi_walk — Walk the DMI table and get called back for every record

Synopsis

```
int dmi_walk (void (*decode) (const struct dmi_header *, void
*), void * private_data);
```

Arguments

decode

Callback function

private_data

Private data to be passed to the callback function

Description

Returns -1 when the DMI table can't be reached, 0 on success.

dmi_match

LINUX

Kernel Hackers Manual September 2014

Name

`dmi_match` — compare a string to the dmi field (if exists)

Synopsis

```
bool dmi_match (enum dmi_field f, const char * str);
```

Arguments

f

DMI field identifier

str

string to compare the DMI field to

Description

Returns true if the requested field equals to the str (including NULL).

10.2. EDD Interfaces

edd_show_raw_data

LINUX

Kernel Hackers ManualSeptember 2014

Name

edd_show_raw_data — copies raw data to buffer for userspace to parse

Synopsis

```
ssize_t edd_show_raw_data (struct edd_device * edev, char *  
buf);
```

Arguments

edev

target edd_device

buf

output buffer

Returns

number of bytes written, or -EINVAL on failure

edd_release

LINUX

Kernel Hackers ManualSeptember 2014

Name

edd_release — free edd structure

Synopsis

```
void edd_release (struct kobject * kobj);
```

Arguments

kobj

kobject of edd structure

Description

This is called when the refcount of the edd structure reaches 0. This should happen right after we unregister, but just in case, we use the release callback anyway.

edd_dev_is_type

LINUX

Kernel Hackers ManualSeptember 2014

Name

`edd_dev_is_type` — is this EDD device a 'type' device?

Synopsis

```
int edd_dev_is_type (struct edd_device * edev, const char *  
type);
```

Arguments

edev

target edd_device

type

a host bus or interface identifier string per the EDD spec

Description

Returns 1 (TRUE) if it is a 'type' device, 0 otherwise.

edd_get_pci_dev

LINUX

Kernel Hackers ManualSeptember 2014

Name

`edd_get_pci_dev` — finds `pci_dev` that matches `edev`

Synopsis

```
struct pci_dev * edd_get_pci_dev (struct edd_device * edev);
```

Arguments

`edev`

`edd_device`

Description

Returns `pci_dev` if found, or NULL

edd_init

LINUX

Kernel Hackers ManualSeptember 2014

Name

`edd_init` — creates sysfs tree of EDD data

Synopsis

```
int edd_init ( void );
```

Arguments

void

no arguments

Chapter 11. Security Framework

security_init

LINUX

Kernel Hackers ManualSeptember 2014

Name

`security_init` — initializes the security framework

Synopsis

```
int security_init ( void );
```

Arguments

void

no arguments

Description

This should be called early in the kernel initialization sequence.

security_module_enable

LINUX

Name

`security_module_enable` — Load given security module on boot ?

Synopsis

```
int security_module_enable (struct security_operations * ops);
```

Arguments

ops

a pointer to the struct `security_operations` that is to be checked.

Description

Each LSM must pass this method before registering its own operations to avoid security registration races. This method may also be used to check if your LSM is currently loaded during kernel initialization.

Return true if

-The passed LSM is the one chosen by user at boot time, -or the passed LSM is configured as the default and the user did not choose an alternate LSM at boot time. Otherwise, return false.

register_security

LINUX

Name

`register_security` — registers a security framework with the kernel

Synopsis

```
int register_security (struct security_operations * ops);
```

Arguments

ops

a pointer to the struct `security_options` that is to be registered

Description

This function allows a security module to register itself with the kernel security subsystem. Some rudimentary checking is done on the *ops* value passed to this function. You'll need to check first if your LSM is allowed to register its *ops* by calling `security_module_enable(ops)`.

If there is already a security module registered with the kernel, an error will be returned. Otherwise 0 is returned on success.

securityfs_create_file

LINUX

Name

`securityfs_create_file` — create a file in the securityfs filesystem

Synopsis

```
struct dentry * securityfs_create_file (const char * name,
umode_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 securityfs 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 securityfs. It allows for a wide range of flexibility in creating a file, or a directory (if you want to create a directory, the

`securityfs_create_dir` function is recommended to be used instead).

This function returns a pointer to a dentry if it succeeds. This pointer must be passed to the `securityfs_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, the function will return the error value (via `ERR_PTR`).

If `securityfs` is not enabled in the kernel, the value `-ENODEV` is returned.

securityfs_create_dir

LINUX

Kernel Hackers Manual September 2014

Name

`securityfs_create_dir` — create a directory in the `securityfs` filesystem

Synopsis

```
struct dentry * securityfs_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 `securityfs` filesystem.

Description

This function creates a directory in `securityfs` with the given *name*.

This function returns a pointer to a `dentry` if it succeeds. This pointer must be passed to the `securityfs_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 `securityfs` is not enabled in the kernel, the value `-ENODEV` is 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.

securityfs_remove

LINUX

Kernel Hackers Manual September 2014

Name

`securityfs_remove` — removes a file or directory from the `securityfs` filesystem

Synopsis

```
void securityfs_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 securityfs that was previously created with a call to another securityfs function (like `securityfs_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.

Chapter 12. Audit Interfaces

audit_log_start

LINUX

Kernel Hackers Manual September 2014

Name

`audit_log_start` — obtain an audit buffer

Synopsis

```
struct audit_buffer * audit_log_start (struct audit_context *  
ctx, gfp_t gfp_mask, int type);
```

Arguments

ctx

audit_context (may be NULL)

gfp_mask

type of allocation

type

audit message type

Description

Returns `audit_buffer` pointer on success or NULL on error.

Obtain an audit buffer. This routine does locking to obtain the audit buffer, but then no locking is required for calls to `audit_log_*format`. If the task (*ctx*) is a task that is

currently in a syscall, then the syscall is marked as auditable and an audit record will be written at syscall exit. If there is no associated task, then task context (ctx) should be NULL.

audit_log_format

LINUX

Kernel Hackers Manual September 2014

Name

`audit_log_format` — format a message into the audit buffer.

Synopsis

```
void audit_log_format (struct audit_buffer * ab, const char *  
fmt, ...);
```

Arguments

ab

audit_buffer

fmt

format string @...: optional parameters matching *fmt* string

...

variable arguments

Description

All the work is done in `audit_log_vformat`.

audit_log_end

LINUX

Kernel Hackers ManualSeptember 2014

Name

`audit_log_end` — end one audit record

Synopsis

```
void audit_log_end (struct audit_buffer * ab);
```

Arguments

ab

the `audit_buffer`

Description

`netlink_unicast` cannot be called inside an irq context because it blocks (last arg, flags, is not set to `MSG_DONTWAIT`), so the audit buffer is placed on a queue and a tasklet is scheduled to remove them from the queue outside the irq context. May be called in any context.

audit_log

LINUX

Kernel Hackers ManualSeptember 2014

Name

`audit_log` — Log an audit record

Synopsis

```
void audit_log (struct audit_context * ctx, gfp_t gfp_mask,  
int type, const char * fmt, ...);
```

Arguments

ctx

audit context

gfp_mask

type of allocation

type

audit message type

fmt

format string to use @...: variable parameters matching the format string

...

variable arguments

Description

This is a convenience function that calls `audit_log_start`, `audit_log_vformat`, and `audit_log_end`. It may be called in any context.

audit_log_secctx

LINUX

Kernel Hackers ManualSeptember 2014

Name

`audit_log_secctx` — Converts and logs SELinux context

Synopsis

```
void audit_log_secctx (struct audit_buffer * ab, u32 secid);
```

Arguments

ab

`audit_buffer`

secid

security number

Description

This is a helper function that calls `security_secid_to_secctx` to convert `secid` to `secctx` and then adds the (converted) SELinux context to the audit log by calling `audit_log_format`, thus also preventing leak of internal `secid` to userspace. If `secid` cannot be converted `audit_panic` is called.

audit_alloc

LINUX

Kernel Hackers ManualSeptember 2014

Name

`audit_alloc` — allocate an audit context block for a task

Synopsis

```
int audit_alloc (struct task_struct * tsk);
```

Arguments

tsk

task

Description

Filter on the task information and allocate a per-task audit context if necessary. Doing so turns on system call auditing for the specified task. This is called from `copy_process`, so no lock is needed.

__audit_free

LINUX

Name

`__audit_free` — free a per-task audit context

Synopsis

```
void __audit_free (struct task_struct * tsk);
```

Arguments

tsk

task whose audit context block to free

Description

Called from `copy_process` and `do_exit`

__audit_syscall_entry

LINUX

Name

`__audit_syscall_entry` — fill in an audit record at syscall entry

Synopsis

```
void __audit_syscall_entry (int arch, int major, unsigned long  
a1, unsigned long a2, unsigned long a3, unsigned long a4);
```

Arguments

arch

architecture type

major

major syscall type (function)

a1

additional syscall register 1

a2

additional syscall register 2

a3

additional syscall register 3

a4

additional syscall register 4

Description

Fill in audit context at syscall entry. This only happens if the audit context was created when the task was created and the state or filters demand the audit context be built. If the state from the per-task filter or from the per-syscall filter is `AUDIT_RECORD_CONTEXT`, then the record will be written at syscall exit time (otherwise, it will only be written if another part of the kernel requests that it be written).

__audit_syscall_exit

LINUX

Kernel Hackers Manual September 2014

Name

`__audit_syscall_exit` — deallocate audit context after a system call

Synopsis

```
void __audit_syscall_exit (int success, long return_code);
```

Arguments

success

success value of the syscall

return_code

return value of the syscall

Description

Tear down after system call. If the audit context has been marked as auditable (either because of the `AUDIT_RECORD_CONTEXT` state from filtering, or because some other part of the kernel wrote an audit message), then write out the syscall information. In call cases, free the names stored from `getname`.

__audit_reusename

LINUX

Name

`__audit_reuse_name` — fill out filename with info from existing entry

Synopsis

```
struct filename * __audit_reuse_name (const __user char *  
uptr);
```

Arguments

uptr

userland ptr to pathname

Description

Search the `audit_names` list for the current audit context. If there is an existing entry with a matching “`uptr`” then return the filename associated with that `audit_name`. If not, return `NULL`.

`__audit_getname`

LINUX

Name

`__audit_getname` — add a name to the list

Synopsis

```
void __audit_getname (struct filename * name);
```

Arguments

name

name to add

Description

Add a name to the list of audit names for this context. Called from fs/namei.c:getname.

__audit_inode

LINUX

Kernel Hackers Manual September 2014

Name

__audit_inode — store the inode and device from a lookup

Synopsis

```
void __audit_inode (struct filename * name, const struct  
dentry * dentry, unsigned int flags);
```

Arguments

name

name being audited

dentry

dentry being audited

flags

attributes for this particular entry

auditsc_get_stamp

LINUX

Kernel Hackers Manual September 2014

Name

`auditsc_get_stamp` — get local copies of `audit_context` values

Synopsis

```
int auditsc_get_stamp (struct audit_context * ctx, struct  
timespec * t, unsigned int * serial);
```

Arguments

ctx

`audit_context` for the task

t

timespec to store time recorded in the audit_context

serial

serial value that is recorded in the audit_context

Description

Also sets the context as auditable.

audit_set_loginuid

LINUX

Kernel Hackers ManualSeptember 2014

Name

audit_set_loginuid — set current task's audit_context loginuid

Synopsis

```
int audit_set_loginuid (kuid_t loginuid);
```

Arguments

loginuid

loginuid value

Description

Returns 0.

Called (set) from fs/proc/base.c::proc_loginuid_write.

__audit_mq_open

LINUX

Kernel Hackers ManualSeptember 2014

Name

`__audit_mq_open` — record audit data for a POSIX MQ open

Synopsis

```
void __audit_mq_open (int oflag, umode_t mode, struct mq_attr
* attr);
```

Arguments

oflag

open flag

mode

mode bits

attr

queue attributes

__audit_mq_sendrecv

LINUX

Kernel Hackers Manual September 2014

Name

`__audit_mq_sendrecv` — record audit data for a POSIX MQ timed send/receive

Synopsis

```
void __audit_mq_sendrecv (mqd_t mqdes, size_t msg_len,  
unsigned int msg_prio, const struct timespec * abs_timeout);
```

Arguments

mqdes

MQ descriptor

msg_len

Message length

msg_prio

Message priority

abs_timeout

Message timeout in absolute time

__audit_mq_notify

LINUX

Kernel Hackers ManualSeptember 2014

Name

`__audit_mq_notify` — record audit data for a POSIX MQ notify

Synopsis

```
void __audit_mq_notify (mqd_t mqdes, const struct sigevent *  
notification);
```

Arguments

mqdes

MQ descriptor

notification

Notification event

__audit_mq_getsetattr

LINUX

Kernel Hackers ManualSeptember 2014

Name

`__audit_mq_getsetattr` — record audit data for a POSIX MQ get/set attribute

Synopsis

```
void __audit_mq_getsetattr (mqd_t mqdes, struct mq_attr *  
mqstat);
```

Arguments

mqdes

MQ descriptor

mqstat

MQ flags

__audit_ipc_obj

LINUX

Kernel Hackers Manual September 2014

Name

__audit_ipc_obj — record audit data for ipc object

Synopsis

```
void __audit_ipc_obj (struct kern_ipc_perm * ipcp);
```

Arguments

ipcp

ipc permissions

__audit_ipc_set_perm

LINUX

Kernel Hackers ManualSeptember 2014

Name

__audit_ipc_set_perm — record audit data for new ipc permissions

Synopsis

```
void __audit_ipc_set_perm (unsigned long qbytes, uid_t uid,  
gid_t gid, umode_t mode);
```

Arguments

qbytes

msgq bytes

uid

msgq user id

gid

msgq group id

mode

msgq mode (permissions)

Description

Called only after `audit_ipc_obj`.

__audit_socketcall

LINUX

Kernel Hackers ManualSeptember 2014

Name

`__audit_socketcall` — record audit data for `sys_socketcall`

Synopsis

```
int __audit_socketcall (int nargs, unsigned long * args);
```

Arguments

*nargs*number of args, which should not be more than `AUDITSC_ARGS`.*args*

args array

__audit_fd_pair

LINUX

Kernel Hackers ManualSeptember 2014

Name

`__audit_fd_pair` — record audit data for pipe and socketpair

Synopsis

```
void __audit_fd_pair (int fd1, int fd2);
```

Arguments

fd1

the first file descriptor

fd2

the second file descriptor

__audit_sockaddr

LINUX

Kernel Hackers ManualSeptember 2014

Name

`__audit_sockaddr` — record audit data for `sys_bind`, `sys_connect`, `sys_sendto`

Synopsis

```
int __audit_sockaddr (int len, void * a);
```

Arguments

len

data length in user space

a

data address in kernel space

Description

Returns 0 for success or NULL context or < 0 on error.

__audit_signal_info

LINUX

Kernel Hackers Manual September 2014

Name

__audit_signal_info — record signal info for shutting down audit subsystem

Synopsis

```
int __audit_signal_info (int sig, struct task_struct * t);
```

Arguments

sig

signal value

t

task being signaled

Description

If the audit subsystem is being terminated, record the task (pid) and uid that is doing that.

__audit_log_bprm_fcaps

LINUX

Kernel Hackers ManualSeptember 2014

Name

`__audit_log_bprm_fcaps` — store information about a loading bprm and relevant fcaps

Synopsis

```
int __audit_log_bprm_fcaps (struct linux_binprm * bprm, const
struct cred * new, const struct cred * old);
```


Arguments

bprm

pointer to the bprm being processed

new

the proposed new credentials

old

the old credentials

Description

Simply check if the proc already has the caps given by the file and if not store the priv escalation info for later auditing at the end of the syscall

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__audit_log_capset

LINUX

Kernel Hackers ManualSeptember 2014

Name

`__audit_log_capset` — store information about the arguments to the capset syscall

Synopsis

```
void __audit_log_capset (const struct cred * new, const struct
cred * old);
```

Arguments

new

the new credentials

old

the old (current) credentials

Description

Record the arguments userspace sent to `sys_capset` for later printing by the audit system if applicable

audit_core_dumps

LINUX

Kernel Hackers ManualSeptember 2014

Name

`audit_core_dumps` — record information about processes that end abnormally

Synopsis

```
void audit_core_dumps (long signr);
```

Arguments

signr

signal value

Description

If a process ends with a core dump, something fishy is going on and we should record the event for investigation.

audit_rule_change

LINUX

Kernel Hackers ManualSeptember 2014

Name

`audit_rule_change` — apply all rules to the specified message type

Synopsis

```
int audit_rule_change (int type, __u32 portid, int seq, void *  
data, size_t datasz);
```

Arguments

type

audit message type

portid

target port id for netlink audit messages

seq

netlink audit message sequence (serial) number

data

payload data

datasz

size of payload data

audit_list_rules_send

LINUX

Kernel Hackers ManualSeptember 2014

Name

`audit_list_rules_send` — list the audit rules

Synopsis

```
int audit_list_rules_send (struct sk_buff * request_skb, int
seq);
```

Arguments

request_skb

skb of request we are replying to (used to target the reply)

seq

netlink audit message sequence (serial) number

parent_len

LINUX

Name

`parent_len` — find the length of the parent portion of a pathname

Synopsis

```
int parent_len (const char * path);
```

Arguments

path

pathname of which to determine length

audit_compare_dname_path

LINUX

Name

`audit_compare_dname_path` — compare given dentry name with last component in given path. Return of 0 indicates a match.

Synopsis

```
int audit_compare_dname_path (const char * dname, const char *  
path, int parentlen);
```

Arguments

dname

dentry name that we're comparing

path

full pathname that we're comparing

parentlen

length of the parent if known. Passing in AUDIT_NAME_FULL here indicates that we must compute this value.

Chapter 13. Accounting Framework

sys_acct

LINUX

Kernel Hackers Manual September 2014

Name

`sys_acct` — enable/disable process accounting

Synopsis

```
long sys_acct (const char __user * name);
```

Arguments

name

file name for accounting records or NULL to shutdown accounting

Description

Returns 0 for success or negative errno values for failure.

`sys_acct` is the only system call needed to implement process accounting. It takes the name of the file where accounting records should be written. If the filename is NULL, accounting will be shutdown.

acct_auto_close_mnt

LINUX

Kernel Hackers ManualSeptember 2014

Name

`acct_auto_close_mnt` — turn off a filesystem’s accounting if it is on

Synopsis

```
void acct_auto_close_mnt (struct vfsmount * m);
```

Arguments

m

vfsmount being shut down

Description

If the accounting is turned on for a file in the subtree pointed to to by *m*, turn accounting off. Done when *m* is about to die.

acct_auto_close

LINUX

Name

`acct_auto_close` — turn off a filesystem's accounting if it is on

Synopsis

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

Arguments

sb

super block for the filesystem

Description

If the accounting is turned on for a file in the filesystem pointed to by *sb*, turn accounting off.

acct_collect

LINUX

Name

`acct_collect` — collect accounting information into `pacct_struct`

Synopsis

```
void acct_collect (long exitcode, int group_dead);
```

Arguments

exitcode

task exit code

group_dead

not 0, if this thread is the last one in the process.

acct_process

LINUX

Kernel Hackers ManualSeptember 2014

Name

`acct_process` — now just a wrapper around `acct_process_in_ns`, which in turn is a wrapper around `do_acct_process`.

Synopsis

```
void acct_process ( void);
```

Arguments

void

no arguments

Description

handles process accounting for an exiting task

Chapter 14. Block Devices

blk_get_backing_dev_info

LINUX

Kernel Hackers Manual September 2014

Name

`blk_get_backing_dev_info` — get the address of a queue's `backing_dev_info`

Synopsis

```
struct backing_dev_info * blk_get_backing_dev_info (struct  
block_device * bdev);
```

Arguments

bdev
device

Description

Locates the passed device's request queue and returns the address of its `backing_dev_info`

Will return NULL if the request queue cannot be located.

blk_delay_queue

LINUX

Kernel Hackers ManualSeptember 2014

Name

`blk_delay_queue` — restart queueing after defined interval

Synopsis

```
void blk_delay_queue (struct request_queue * q, unsigned long  
msecs);
```

Arguments

q

The struct `request_queue` in question

msecs

Delay in msecs

Description

Sometimes queueing needs to be postponed for a little while, to allow resources to come back. This function will make sure that queueing is restarted around the specified time. Queue lock must be held.

blk_start_queue

LINUX

Name

`blk_start_queue` — restart a previously stopped queue

Synopsis

```
void blk_start_queue (struct request_queue * q);
```

Arguments

q

The struct `request_queue` in question

Description

`blk_start_queue` will clear the stop flag on the queue, and call the `request_fn` for the queue if it was in a stopped state when entered. Also see `blk_stop_queue`.

Queue lock must be held.

blk_stop_queue

LINUX

Name

`blk_stop_queue` — stop a queue

Synopsis

```
void blk_stop_queue (struct request_queue * q);
```

Arguments

q

The struct request_queue in question

Description

The Linux block layer assumes that a block driver will consume all entries on the request queue when the request_fn strategy is called. Often this will not happen, because of hardware limitations (queue depth settings). If a device driver gets a 'queue full' response, or if it simply chooses not to queue more I/O at one point, it can call this function to prevent the request_fn from being called until the driver has signalled it's ready to go again. This happens by calling blk_start_queue to restart queue operations. Queue lock must be held.

blk_sync_queue

LINUX

Kernel Hackers Manual September 2014

Name

blk_sync_queue — cancel any pending callbacks on a queue

Synopsis

```
void blk_sync_queue (struct request_queue * q);
```


Arguments

q

the queue

Description

The block layer may perform asynchronous callback activity on a queue, such as calling the unplug function after a timeout. A block device may call `blk_sync_queue` to ensure that any such activity is cancelled, thus allowing it to release resources that the callbacks might use. The caller must already have made sure that its `->make_request_fn` will not re-add plugging prior to calling this function.

This function does not cancel any asynchronous activity arising out of elevator or throttling code. That would require `elevator_exit` and `blkcg_exit_queue` to be called with queue lock initialized.

`__blk_run_queue`

LINUX

Kernel Hackers Manual September 2014

Name

`__blk_run_queue` — run a single device queue

Synopsis

```
void __blk_run_queue (struct request_queue * q);
```

Arguments

q

The queue to run

Description

See *blk_run_queue*. This variant must be called with the queue lock held and interrupts disabled.

blk_run_queue_async

LINUX

Kernel Hackers ManualSeptember 2014

Name

`blk_run_queue_async` — run a single device queue in workqueue context

Synopsis

```
void blk_run_queue_async (struct request_queue * q);
```

Arguments

q

The queue to run

Description

Tells kblockd to perform the equivalent of *blk_run_queue* on behalf of us. The caller must hold the queue lock.

blk_run_queue

LINUX

Kernel Hackers ManualSeptember 2014

Name

`blk_run_queue` — run a single device queue

Synopsis

```
void blk_run_queue (struct request_queue * q);
```

Arguments

q

The queue to run

Description

Invoke request handling on this queue, if it has pending work to do. May be used to restart queueing when a request has completed.

blk_queue_bypass_start

LINUX

Kernel Hackers ManualSeptember 2014

Name

`blk_queue_bypass_start` — enter queue bypass mode

Synopsis

```
void blk_queue_bypass_start (struct request_queue * q);
```

Arguments

q
queue of interest

Description

In bypass mode, only the dispatch FIFO queue of *q* is used. This function makes *q* enter bypass mode and drains all requests which were throttled or issued before. On return, it's guaranteed that no request is being throttled or has ELVPRIV set and `blk_queue_bypass` true inside queue or RCU read lock.

blk_queue_bypass_end

LINUX

Name

`blk_queue_bypass_end` — leave queue bypass mode

Synopsis

```
void blk_queue_bypass_end (struct request_queue * q);
```

Arguments

q
queue of interest

Description

Leave bypass mode and restore the normal queueing behavior.

blk_cleanup_queue

LINUX

Name

`blk_cleanup_queue` — shutdown a request queue

Synopsis

```
void blk_cleanup_queue (struct request_queue * q);
```

Arguments

q

request queue to shutdown

Description

Mark *q* DYING, drain all pending requests, mark *q* DEAD, destroy and put it. All future requests will be failed immediately with -ENODEV.

blk_init_queue

LINUX

Kernel Hackers ManualSeptember 2014

Name

blk_init_queue — prepare a request queue for use with a block device

Synopsis

```
struct request_queue * blk_init_queue (request_fn_proc * rfn,  
spinlock_t * lock);
```

Arguments

rfn

The function to be called to process requests that have been placed on the queue.

lock

Request queue spin lock

Description

If a block device wishes to use the standard request handling procedures, which sorts requests and coalesces adjacent requests, then it must call `blk_init_queue`. The function *rfn* will be called when there are requests on the queue that need to be processed. If the device supports plugging, then *rfn* may not be called immediately when requests are available on the queue, but may be called at some time later instead. Plugged queues are generally unplugged when a buffer belonging to one of the requests on the queue is needed, or due to memory pressure.

rfn is not required, or even expected, to remove all requests off the queue, but only as many as it can handle at a time. If it does leave requests on the queue, it is responsible for arranging that the requests get dealt with eventually.

The queue spin lock must be held while manipulating the requests on the request queue; this lock will be taken also from interrupt context, so irq disabling is needed for it.

Function returns a pointer to the initialized request queue, or `NULL` if it didn't succeed.

Note

`blk_init_queue` must be paired with a `blk_cleanup_queue` call when the block device is deactivated (such as at module unload).

blk_make_request

LINUX

Name

`blk_make_request` — given a bio, allocate a corresponding struct request.

Synopsis

```
struct request * blk_make_request (struct request_queue * q,  
struct bio * bio, gfp_t gfp_mask);
```

Arguments

q

target request queue

bio

The bio describing the memory mappings that will be submitted for IO. It may be a chained-bio properly constructed by block/bio layer.

gfp_mask

gfp flags to be used for memory allocation

Description

`blk_make_request` is the parallel of `generic_make_request` for `BLOCK_PC` type commands. Where the struct request needs to be farther initialized by the caller. It is passed a struct bio, which describes the memory info of the I/O transfer.

The caller of `blk_make_request` must make sure that `bi_io_vec` are set to describe the memory buffers. That `bio_data_dir` will return the needed direction of the request. (And all bio's in the passed bio-chain are properly set accordingly)

If called under none-sleepable conditions, mapped bio buffers must not need bouncing, by calling the appropriate masked or flagged allocator, suitable for the target device. Otherwise the call to `blk_queue_bounce` will BUG.

WARNING

When allocating/cloning a bio-chain, careful consideration should be given to how you allocate bios. In particular, you cannot use `__GFP_WAIT` for anything but the first bio in the chain. Otherwise you risk waiting for IO completion of a bio that hasn't been submitted yet, thus resulting in a deadlock. Alternatively bios should be allocated using `bio_kmalloc` instead of `bio_alloc`, as that avoids the mempool deadlock. If possible a big IO should be split into smaller parts when allocation fails. Partial allocation should not be an error, or you risk a live-lock.

blk_rq_set_block_pc

LINUX

Kernel Hackers Manual September 2014

Name

`blk_rq_set_block_pc` — initialize a request to type `BLOCK_PC`

Synopsis

```
void blk_rq_set_block_pc (struct request * rq);
```

Arguments

rq

request to be initialized

blk_requeue_request

LINUX

Kernel Hackers ManualSeptember 2014

Name

`blk_requeue_request` — put a request back on queue

Synopsis

```
void blk_requeue_request (struct request_queue * q, struct  
request * rq);
```

Arguments

q

request queue where request should be inserted

rq

request to be inserted

Description

Drivers often keep queueing requests until the hardware cannot accept more, when that condition happens we need to put the request back on the queue. Must be called with queue lock held.

part_round_stats

LINUX

Name

`part_round_stats` — Round off the performance stats on a struct `disk_stats`.

Synopsis

```
void part_round_stats (int cpu, struct hd_struct * part);
```

Arguments

cpu

cpu number for stats access

part

target partition

Description

The average IO queue length and utilisation statistics are maintained by observing the current state of the queue length and the amount of time it has been in this state for.

Normally, that accounting is done on IO completion, but that can result in more than a second's worth of IO being accounted for within any one second, leading to >100% utilisation. To deal with that, we call this function to do a round-off before returning the results when reading `/proc/diskstats`. This accounts immediately for all queue usage up to the current jiffies and restarts the counters again.

`blk_add_request_payload`

LINUX

Name

`blk_add_request_payload` — add a payload to a request

Synopsis

```
void blk_add_request_payload (struct request * rq, struct page  
* page, unsigned int len);
```

Arguments

rq

request to update

page

page backing the payload

len

length of the payload.

Description

This allows to later add a payload to an already submitted request by a block driver. The driver needs to take care of freeing the payload itself.

Note that this is a quite horrible hack and nothing but handling of discard requests should ever use it.

generic_make_request

LINUX

Name

`generic_make_request` — hand a buffer to its device driver for I/O

Synopsis

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

Arguments

bio

The bio describing the location in memory and on the device.

Description

`generic_make_request` is used to make I/O requests of block devices. It is passed a struct bio, which describes the I/O that needs to be done.

`generic_make_request` does not return any status. The success/failure status of the request, along with notification of completion, is delivered asynchronously through the `bio->bi_end_io` function described (one day) else where.

The caller of `generic_make_request` must make sure that `bi_io_vec` are set to describe the memory buffer, and that `bi_dev` and `bi_sector` are set to describe the device address, and the `bi_end_io` and optionally `bi_private` are set to describe how completion notification should be signaled.

`generic_make_request` and the drivers it calls may use `bi_next` if this bio happens to be merged with someone else, and may resubmit the bio to a lower device by calling into `generic_make_request` recursively, which means the bio should NOT be touched after the call to `->make_request_fn`.

submit_bio

LINUX

Kernel Hackers ManualSeptember 2014

Name

`submit_bio` — submit a bio to the block device layer for I/O

Synopsis

```
void submit_bio (int rw, struct bio * bio);
```

Arguments

rw

whether to READ or WRITE, or maybe to READA (read ahead)

bio

The struct bio which describes the I/O

Description

`submit_bio` is very similar in purpose to `generic_make_request`, and uses that function to do most of the work. Both are fairly rough interfaces; *bio* must be presetup and ready for I/O.

blk_rq_check_limits

LINUX

Name

`blk_rq_check_limits` — Helper function to check a request for the queue limit

Synopsis

```
int blk_rq_check_limits (struct request_queue * q, struct  
request * rq);
```

Arguments

q

the queue

rq

the request being checked

Description

rq may have been made based on weaker limitations of upper-level queues in request stacking drivers, and it may violate the limitation of *q*. Since the block layer and the underlying device driver trust *rq* after it is inserted to *q*, it should be checked against *q* before the insertion using this generic function.

This function should also be useful for request stacking drivers in some cases below, so export this function. Request stacking drivers like request-based dm may change the queue limits while requests are in the queue (e.g. dm's table swapping). Such request stacking drivers should check those requests against the new queue limits again when they dispatch those requests, although such checkings are also done against the old queue limits when submitting requests.

blk_insert_cloned_request

LINUX

Kernel Hackers ManualSeptember 2014

Name

`blk_insert_cloned_request` — Helper for stacking drivers to submit a request

Synopsis

```
int blk_insert_cloned_request (struct request_queue * q,  
struct request * rq);
```

Arguments

q
the queue to submit the request

rq
the request being queued

blk_rq_err_bytes

LINUX

Kernel Hackers ManualSeptember 2014

Name

`blk_rq_err_bytes` — determine number of bytes till the next failure boundary

Synopsis

```
unsigned int blk_rq_err_bytes (const struct request * rq);
```

Arguments

rq

request to examine

Description

A request could be merge of IOs which require different failure handling. This function determines the number of bytes which can be failed from the beginning of the request without crossing into area which need to be retried further.

Return

The number of bytes to fail.

Context

queue_lock must be held.

blk_peek_request

LINUX

Kernel Hackers ManualSeptember 2014

Name

blk_peek_request — peek at the top of a request queue

Synopsis

```
struct request * blk_peek_request (struct request_queue * q);
```

Arguments

q

request queue to peek at

Description

Return the request at the top of *q*. The returned request should be started using `blk_start_request` before LLD starts processing it.

Return

Pointer to the request at the top of *q* if available. Null otherwise.

Context

`queue_lock` must be held.

blk_start_request

LINUX

Kernel Hackers Manual September 2014

Name

`blk_start_request` — start request processing on the driver

Synopsis

```
void blk_start_request (struct request * req);
```

Arguments

req

request to dequeue

Description

Dequeue *req* and start timeout timer on it. This hands off the request to the driver.

Block internal functions which don't want to start timer should call `blk_dequeue_request`.

Context

`queue_lock` must be held.

blk_fetch_request

LINUX

Kernel Hackers ManualSeptember 2014

Name

`blk_fetch_request` — fetch a request from a request queue

Synopsis

```
struct request * blk_fetch_request (struct request_queue * q);
```

Arguments

q

request queue to fetch a request from

Description

Return the request at the top of *q*. The request is started on return and LLD can start processing it immediately.

Return

Pointer to the request at the top of *q* if available. Null otherwise.

Context

queue_lock must be held.

blk_update_request

LINUX

Kernel Hackers ManualSeptember 2014

Name

blk_update_request — Special helper function for request stacking drivers

Synopsis

```
bool blk_update_request (struct request * req, int error,
unsigned int nr_bytes);
```

Arguments

req

the request being processed

error

0 for success, < 0 for error

nr_bytes

number of bytes to complete *req*

Description

Ends I/O on a number of bytes attached to *req*, but doesn't complete the request structure even if *req* doesn't have leftover. If *req* has leftover, sets it up for the next range of segments.

This special helper function is only for request stacking drivers (e.g. request-based dm) so that they can handle partial completion. Actual device drivers should use `blk_end_request` instead.

Passing the result of `blk_rq_bytes` as *nr_bytes* guarantees `false` return from this function.

Return

`false` - this request doesn't have any more data `true` - this request has more data

blk_unprep_request

LINUX

Kernel Hackers Manual September 2014

Name

`blk_unprep_request` — unprepare a request

Synopsis

```
void blk_unprep_request (struct request * req);
```

Arguments

req

the request

Description

This function makes a request ready for complete resubmission (or completion). It happens only after all error handling is complete, so represents the appropriate moment to deallocate any resources that were allocated to the request in the `prep_rq_fn`. The queue lock is held when calling this.

blk_end_request

LINUX

Name

`blk_end_request` — Helper function for drivers to complete the request.

Synopsis

```
bool blk_end_request (struct request * rq, int error, unsigned  
int nr_bytes);
```

Arguments

rq

the request being processed

error

0 for success, < 0 for error

nr_bytes

number of bytes to complete

Description

Ends I/O on a number of bytes attached to *rq*. If *rq* has leftover, sets it up for the next range of segments.

Return

`false` - we are done with this request `true` - still buffers pending for this request

blk_end_request_all

LINUX

Kernel Hackers ManualSeptember 2014

Name

`blk_end_request_all` — Helper function for drives to finish the request.

Synopsis

```
void blk_end_request_all (struct request * rq, int error);
```

Arguments

rq

the request to finish

error

0 for success, < 0 for error

Description

Completely finish *rq*.

blk_end_request_cur

LINUX

Name

`blk_end_request_cur` — Helper function to finish the current request chunk.

Synopsis

```
bool blk_end_request_cur (struct request * rq, int error);
```

Arguments

rq

the request to finish the current chunk for

error

0 for success, < 0 for error

Description

Complete the current consecutively mapped chunk from *rq*.

Return

`false` - we are done with this request `true` - still buffers pending for this request

blk_end_request_err

LINUX

Name

`blk_end_request_err` — Finish a request till the next failure boundary.

Synopsis

```
bool blk_end_request_err (struct request * rq, int error);
```

Arguments

rq

the request to finish till the next failure boundary for

error

must be negative errno

Description

Complete *rq* till the next failure boundary.

Return

`false` - we are done with this request `true` - still buffers pending for this request

__blk_end_request

LINUX

Name

`__blk_end_request` — Helper function for drivers to complete the request.

Synopsis

```
bool __blk_end_request (struct request * rq, int error,  
unsigned int nr_bytes);
```

Arguments

rq

the request being processed

error

0 for success, < 0 for error

nr_bytes

number of bytes to complete

Description

Must be called with queue lock held unlike `blk_end_request`.

Return

`false` - we are done with this request `true` - still buffers pending for this request

__blk_end_request_all

LINUX

Kernel Hackers ManualSeptember 2014

Name

`__blk_end_request_all` — Helper function for drives to finish the request.

Synopsis

```
void __blk_end_request_all (struct request * rq, int error);
```

Arguments

rq

the request to finish

error

0 for success, < 0 for error

Description

Completely finish *rq*. Must be called with queue lock held.

__blk_end_request_cur

LINUX

Name

`__blk_end_request_cur` — Helper function to finish the current request chunk.

Synopsis

```
bool __blk_end_request_cur (struct request * rq, int error);
```

Arguments

rq

the request to finish the current chunk for

error

0 for success, < 0 for error

Description

Complete the current consecutively mapped chunk from *rq*. Must be called with queue lock held.

Return

`false` - we are done with this request `true` - still buffers pending for this request

`__blk_end_request_err`

LINUX

Name

`__blk_end_request_err` — Finish a request till the next failure boundary.

Synopsis

```
bool __blk_end_request_err (struct request * rq, int error);
```

Arguments

rq

the request to finish till the next failure boundary for

error

must be negative errno

Description

Complete *rq* till the next failure boundary. Must be called with queue lock held.

Return

`false` - we are done with this request `true` - still buffers pending for this request

rq_flush_dcache_pages

LINUX

Name

`rq_flush_dcache_pages` — Helper function to flush all pages in a request

Synopsis

```
void rq_flush_dcache_pages (struct request * rq);
```

Arguments

rq

the request to be flushed

Description

Flush all pages in *rq*.

blk_lld_busy

LINUX

Name

`blk_lld_busy` — Check if underlying low-level drivers of a device are busy

Synopsis

```
int blk_lld_busy (struct request_queue * q);
```

Arguments

q

the queue of the device being checked

Description

Check if underlying low-level drivers of a device are busy. If the drivers want to export their busy state, they must set own exporting function using `blk_queue_lld_busy` first.

Basically, this function is used only by request stacking drivers to stop dispatching requests to underlying devices when underlying devices are busy. This behavior helps more I/O merging on the queue of the request stacking driver and prevents I/O throughput regression on burst I/O load.

Return

0 - Not busy (The request stacking driver should dispatch request) 1 - Busy (The request stacking driver should stop dispatching request)

blk_rq_unprep_clone

LINUX

Name

`blk_rq_unprep_clone` — Helper function to free all bios in a cloned request

Synopsis

```
void blk_rq_unprep_clone (struct request * rq);
```

Arguments

rq

the clone request to be cleaned up

Description

Free all bios in *rq* for a cloned request.

blk_rq_prep_clone

LINUX

Name

`blk_rq_prep_clone` — Helper function to setup clone request

Synopsis

```
int blk_rq_prep_clone (struct request * rq, struct request *
rq_src, struct bio_set * bs, gfp_t gfp_mask, int (*bio_ctr)
(struct bio *, struct bio *, void *), void * data);
```

Arguments

rq

the request to be setup

rq_src

original request to be cloned

bs

bio_set that bios for clone are allocated from

gfp_mask

memory allocation mask for bio

bio_ctr

setup function to be called for each clone bio. Returns 0 for success, non 0 for failure.

data

private data to be passed to *bio_ctr*

Description

Clones bios in *rq_src* to *rq*, and copies attributes of *rq_src* to *rq*. The actual data parts of *rq_src* (e.g. ->cmd, ->sense) are not copied, and copying such parts is the caller's responsibility. Also, pages which the original bios are pointing to are not copied and the cloned bios just point same pages. So cloned bios must be completed before original bios, which means the caller must complete *rq* before *rq_src*.

blk_start_plug

LINUX

Kernel Hackers Manual September 2014

Name

`blk_start_plug` — initialize `blk_plug` and track it inside the `task_struct`

Synopsis

```
void blk_start_plug (struct blk_plug * plug);
```

Arguments

plug

The struct `blk_plug` that needs to be initialized

Description

Tracking `blk_plug` inside the `task_struct` will help with auto-flushing the pending I/O should the task end up blocking between `blk_start_plug` and `blk_finish_plug`. This is important from a performance perspective, but also ensures that we don't deadlock. For instance, if the task is blocking for a memory allocation, memory reclaim could end up wanting to free a page belonging to that request that is currently residing in our private plug. By flushing the pending I/O when the process goes to sleep, we avoid this kind of deadlock.

blk_pm_runtime_init

LINUX

Name

`blk_pm_runtime_init` — Block layer runtime PM initialization routine

Synopsis

```
void blk_pm_runtime_init (struct request_queue * q, struct  
device * dev);
```

Arguments

q

the queue of the device

dev

the device the queue belongs to

Description

Initialize runtime-PM-related fields for *q* and start auto suspend for *dev*. Drivers that want to take advantage of request-based runtime PM should call this function after *dev* has been initialized, and its request queue *q* has been allocated, and runtime PM for it can not happen yet (either due to disabled/forbidden or its `usage_count > 0`). In most cases, driver should call this function before any I/O has taken place.

This function takes care of setting up using auto suspend for the device, the autosuspend delay is set to -1 to make runtime suspend impossible until an updated value is either set by user or by driver. Drivers do not need to touch other autosuspend settings.

The block layer runtime PM is request based, so only works for drivers that use request as their IO unit instead of those directly use bio's.

blk_pre_runtime_suspend

LINUX

Kernel Hackers Manual September 2014

Name

`blk_pre_runtime_suspend` — Pre runtime suspend check

Synopsis

```
int blk_pre_runtime_suspend (struct request_queue * q);
```

Arguments

q

the queue of the device

Description

This function will check if runtime suspend is allowed for the device by examining if there are any requests pending in the queue. If there are requests pending, the device can not be runtime suspended; otherwise, the queue's status will be updated to SUSPENDING and the driver can proceed to suspend the device.

For the not allowed case, we mark last busy for the device so that runtime PM core will try to autosuspend it some time later.

This function should be called near the start of the device's `runtime_suspend` callback.

Return

0 - OK to runtime suspend the device -EBUSY - Device should not be runtime suspended

blk_post_runtime_suspend

LINUX

Kernel Hackers ManualSeptember 2014

Name

`blk_post_runtime_suspend` — Post runtime suspend processing

Synopsis

```
void blk_post_runtime_suspend (struct request_queue * q, int  
err);
```

Arguments

q

the queue of the device

err

return value of the device's `runtime_suspend` function

Description

Update the queue's runtime status according to the return value of the device's runtime suspend function and mark last busy for the device so that PM core will try to auto suspend the device at a later time.

This function should be called near the end of the device's `runtime_suspend` callback.

blk_pre_runtime_resume

LINUX

Kernel Hackers ManualSeptember 2014

Name

blk_pre_runtime_resume — Pre runtime resume processing

Synopsis

```
void blk_pre_runtime_resume (struct request_queue * q);
```

Arguments

q

the queue of the device

Description

Update the queue's runtime status to RESUMING in preparation for the runtime resume of the device.

This function should be called near the start of the device's runtime_resume callback.

blk_post_runtime_resume

LINUX

Name

`blk_post_runtime_resume` — Post runtime resume processing

Synopsis

```
void blk_post_runtime_resume (struct request_queue * q, int err);
```

Arguments

q

the queue of the device

err

return value of the device's `runtime_resume` function

Description

Update the queue's runtime status according to the return value of the device's `runtime_resume` function. If it is successfully resumed, process the requests that are queued into the device's queue when it is resuming and then mark last busy and initiate autosuspend for it.

This function should be called near the end of the device's `runtime_resume` callback.

`__blk_run_queue_uncond`

LINUX

Name

`__blk_run_queue_uncond` — run a queue whether or not it has been stopped

Synopsis

```
void __blk_run_queue_uncond (struct request_queue * q);
```

Arguments

q

The queue to run

Description

Invoke request handling on a queue if there are any pending requests. May be used to restart request handling after a request has completed. This variant runs the queue whether or not the queue has been stopped. Must be called with the queue lock held and interrupts disabled. See also *blk_run_queue*.

`__blk_drain_queue`

LINUX

Name

`__blk_drain_queue` — drain requests from request_queue

Synopsis

```
void __blk_drain_queue (struct request_queue * q, bool  
drain_all);
```

Arguments

q

queue to drain

drain_all

whether to drain all requests or only the ones w/ ELVPRIV

Description

Drain requests from *q*. If *drain_all* is set, all requests are drained. If not, only ELVPRIV requests are drained. The caller is responsible for ensuring that no new requests which need to be drained are queued.

rq_ioc

LINUX

Kernel Hackers Manual September 2014

Name

`rq_ioc` — determine `io_context` for request allocation

Synopsis

```
struct io_context * rq_ioc (struct bio * bio);
```

Arguments

bio

request being allocated is for this bio (can be `NULL`)

Description

Determine `io_context` to use for request allocation for *bio*. May return `NULL` if `current->io_context` doesn't exist.

__get_request

LINUX

Kernel Hackers Manual September 2014

Name

`__get_request` — get a free request

Synopsis

```
struct request * __get_request (struct request_list * rl, int
rw_flags, struct bio * bio, gfp_t gfp_mask);
```

Arguments

rl

request list to allocate from

rw_flags

RW and SYNC flags

bio

bio to allocate request for (can be NULL)

gfp_mask

allocation mask

Description

Get a free request from *q*. This function may fail under memory pressure or if *q* is dead.

Must be called with *q->queue_lock* held and, Returns NULL on failure, with *q->queue_lock* held. Returns !NULL on success, with *q->queue_lock* *not held*.

get_request

LINUX

Kernel Hackers ManualSeptember 2014

Name

get_request — get a free request

Synopsis

```
struct request * get_request (struct request_queue * q, int
rw_flags, struct bio * bio, gfp_t gfp_mask);
```

Arguments

<i>q</i>	request_queue to allocate request from
<i>rw_flags</i>	RW and SYNC flags
<i>bio</i>	bio to allocate request for (can be NULL)
<i>gfp_mask</i>	allocation mask

Description

Get a free request from *q*. If `__GFP_WAIT` is set in *gfp_mask*, this function keeps retrying under memory pressure and fails iff *q* is dead.

Must be called with *q*->queue_lock held and, Returns NULL on failure, with *q*->queue_lock held. Returns !NULL on success, with *q*->queue_lock *not held*.

blk_attempt_plug_merge

LINUX

Kernel Hackers ManualSeptember 2014

Name

blk_attempt_plug_merge — try to merge with current's plugged list

Synopsis

```
bool blk_attempt_plug_merge (struct request_queue * q, struct
bio * bio, unsigned int * request_count);
```

Arguments

q

request_queue new bio is being queued at

bio

new bio being queued

request_count

out parameter for number of traversed plugged requests

Description

Determine whether *bio* being queued on *q* can be merged with a request on current's plugged list. Returns `true` if merge was successful, otherwise `false`.

Plugging coalesces IOs from the same issuer for the same purpose without going through *q->queue_lock*. As such it's more of an issuing mechanism than scheduling, and the request, while may have `elvpriv` data, is not added on the elevator at this point. In addition, we don't have reliable access to the elevator outside queue lock. Only check basic merging parameters without querying the elevator.

Caller must ensure `!blk_queue_nomerges(q)` beforehand.

blk_end_bidi_request

LINUX

Kernel Hackers Manual September 2014

Name

`blk_end_bidi_request` — Complete a bidi request

Synopsis

```
bool blk_end_bidi_request (struct request * rq, int error,
unsigned int nr_bytes, unsigned int bidi_bytes);
```

Arguments

rq

the request to complete

error

0 for success, < 0 for error

nr_bytes

number of bytes to complete *rq*

bidi_bytes

number of bytes to complete *rq->next_rq*

Description

Ends I/O on a number of bytes attached to *rq* and *rq->next_rq*. Drivers that supports bidi can safely call this member for any type of request, bidi or uni. In the later case *bidi_bytes* is just ignored.

Return

false - we are done with this request true - still buffers pending for this request

__blk_end_bidi_request

LINUX

Name

`__blk_end_bidi_request` — Complete a bidi request with queue lock held

Synopsis

```
bool __blk_end_bidi_request (struct request * rq, int error,
unsigned int nr_bytes, unsigned int bidi_bytes);
```

Arguments

rq

the request to complete

error

0 for success, < 0 for error

nr_bytes

number of bytes to complete *rq*

bidi_bytes

number of bytes to complete *rq->next_rq*

Description

Identical to `blk_end_bidi_request` except that queue lock is assumed to be locked on entry and remains so on return.

Return

`false` - we are done with this request `true` - still buffers pending for this request

blk_rq_map_user

LINUX

Kernel Hackers Manual September 2014

Name

`blk_rq_map_user` — map user data to a request, for REQ_TYPE_BLOCK_PC
usage

Synopsis

```
int blk_rq_map_user (struct request_queue * q, struct request
* rq, struct rq_map_data * map_data, void __user * ubuf,
unsigned long len, gfp_t gfp_mask);
```

Arguments

q

request queue where request should be inserted

rq

request structure to fill

map_data

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

ubuf

the user buffer

len

length of user data

gfp_mask

memory allocation flags

Description

Data will be mapped directly for zero copy I/O, if possible. Otherwise a kernel bounce buffer is used.

A matching `blk_rq_unmap_user` must be issued at the end of I/O, while still in process context.

Note

The mapped bio may need to be bounced through `blk_queue_bounce` before being submitted to the device, as pages mapped may be out of reach. It's the callers responsibility to make sure this happens. The original bio must be passed back in to `blk_rq_unmap_user` for proper unmapping.

blk_rq_map_user_iov

LINUX

Kernel Hackers Manual September 2014

Name

`blk_rq_map_user_iov` — map user data to a request, for `REQ_TYPE_BLOCK_PC` usage

Synopsis

```
int blk_rq_map_user_iov (struct request_queue * q, struct
request * rq, struct rq_map_data * map_data, const struct
sg_iovec * iov, int iov_count, unsigned int len, gfp_t
gfp_mask);
```

Arguments

q

request queue where request should be inserted

rq

request to map data to

map_data

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

iov

pointer to the `iovec`

iov_count

number of elements in the `iovec`

len

I/O byte count

gfp_mask

memory allocation flags

Description

Data will be mapped directly for zero copy I/O, if possible. Otherwise a kernel bounce buffer is used.

A matching `blk_rq_unmap_user` must be issued at the end of I/O, while still in process context.

Note

The mapped bio may need to be bounced through `blk_queue_bounce` before being submitted to the device, as pages mapped may be out of reach. It's the callers responsibility to make sure this happens. The original bio must be passed back in to `blk_rq_unmap_user` for proper unmapping.

blk_rq_unmap_user

LINUX

Kernel Hackers ManualSeptember 2014

Name

`blk_rq_unmap_user` — unmap a request with user data

Synopsis

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

Arguments

bio

start of bio list

Description

Unmap a rq previously mapped by `blk_rq_map_user`. The caller must supply the original `rq->bio` from the `blk_rq_map_user` return, since the I/O completion may have changed `rq->bio`.

blk_rq_map_kern

LINUX

Name

`blk_rq_map_kern` — map kernel data to a request, for `REQ_TYPE_BLOCK_PC` usage

Synopsis

```
int blk_rq_map_kern (struct request_queue * q, struct request  
* rq, void * kbuf, unsigned int len, gfp_t gfp_mask);
```

Arguments

q
request queue where request should be inserted

rq
request to fill

kbuf
the kernel buffer

len
length of user data

gfp_mask
memory allocation flags

Description

Data will be mapped directly if possible. Otherwise a bounce buffer is used. Can be called multiple times to append multiple buffers.

blk_release_queue

LINUX

Kernel Hackers ManualSeptember 2014

Name

`blk_release_queue` — release a struct `request_queue` when it is no longer needed

Synopsis

```
void blk_release_queue (struct kobject * kobj);
```

Arguments

kobj

the *kobj* belonging to the request queue to be released

Description

`blk_release_queue` is the pair to `blk_init_queue` or `blk_queue_make_request`. It should be called when a request queue is being released; typically when a block device is being de-registered. Currently, its primary task is to free all the struct request structures that were allocated to the queue and the queue itself.

Caveat

Hopefully the low level driver will have finished any outstanding requests first...

blk_queue_prep_rq

LINUX

Kernel Hackers Manual September 2014

Name

`blk_queue_prep_rq` — set a `prepare_request` function for queue

Synopsis

```
void blk_queue_prep_rq (struct request_queue * q, prep_rq_fn *  
pfn);
```

Arguments

q

queue

pfn

`prepare_request` function

Description

It's possible for a queue to register a `prepare_request` callback which is invoked before the request is handed to the `request_fn`. The goal of the function is to prepare a request for I/O, it can be used to build a `cdb` from the request data for instance.

blk_queue_unprep_rq

LINUX

Name

`blk_queue_unprep_rq` — set an `unprepare_request` function for queue

Synopsis

```
void blk_queue_unprep_rq (struct request_queue * q,  
unprep_rq_fn * ufn);
```

Arguments

q

queue

ufn

`unprepare_request` function

Description

It's possible for a queue to register an `unprepare_request` callback which is invoked before the request is finally completed. The goal of the function is to deallocate any data that was allocated in the `prepare_request` callback.

`blk_queue_merge_bvec`

LINUX

Name

`blk_queue_merge_bvec` — set a `merge_bvec` function for queue

Synopsis

```
void blk_queue_merge_bvec (struct request_queue * q,  
merge_bvec_fn * mbfn);
```

Arguments

q

queue

mbfn

`merge_bvec_fn`

Description

Usually queues have static limitations on the max sectors or segments that we can put in a request. Stacking drivers may have some settings that are dynamic, and thus we have to query the queue whether it is ok to add a new `bio_vec` to a `bio` at a given offset or not. If the block device has such limitations, it needs to register a `merge_bvec_fn` to control the size of `bio`'s sent to it. Note that a block device *must* allow a single page to be added to an empty `bio`. The block device driver may want to use the `bio_split` function to deal with these `bio`'s. By default no `merge_bvec_fn` is defined for a queue, and only the fixed limits are honored.

blk_set_default_limits

LINUX

Kernel Hackers ManualSeptember 2014

Name

`blk_set_default_limits` — reset limits to default values

Synopsis

```
void blk_set_default_limits (struct queue_limits * lim);
```

Arguments

lim

the `queue_limits` structure to reset

Description

Returns a `queue_limit` struct to its default state.

blk_set_stacking_limits

LINUX

Kernel Hackers ManualSeptember 2014

Name

`blk_set_stacking_limits` — set default limits for stacking devices

Synopsis

```
void blk_set_stacking_limits (struct queue_limits * lim);
```

Arguments

lim

the queue_limits structure to reset

Description

Returns a queue_limit struct to its default state. Should be used by stacking drivers like DM that have no internal limits.

blk_queue_make_request

LINUX

Kernel Hackers ManualSeptember 2014

Name

blk_queue_make_request — define an alternate make_request function for a device

Synopsis

```
void blk_queue_make_request (struct request_queue * q,  
make_request_fn * mfn);
```

Arguments

q

the request queue for the device to be affected

mfn

the alternate `make_request` function

Description

The normal way for struct `bios` to be passed to a device driver is for them to be collected into requests on a request queue, and then to allow the device driver to select requests off that queue when it is ready. This works well for many block devices. However some block devices (typically virtual devices such as `md` or `lvm`) do not benefit from the processing on the request queue, and are served best by having the requests passed directly to them. This can be achieved by providing a function to `blk_queue_make_request`.

Caveat

The driver that does this *must* be able to deal appropriately with buffers in “highmemory”. This can be accomplished by either calling `__bio_kmap_atomic` to get a temporary kernel mapping, or by calling `blk_queue_bounce` to create a buffer in normal memory.

`blk_queue_bounce_limit`

LINUX

Kernel Hackers Manual September 2014

Name

`blk_queue_bounce_limit` — set bounce buffer limit for queue

Synopsis

```
void blk_queue_bounce_limit (struct request_queue * q, u64
max_addr);
```

Arguments

q

the request queue for the device

max_addr

the maximum address the device can handle

Description

Different hardware can have different requirements as to what pages it can do I/O directly to. A low level driver can call `blk_queue_bounce_limit` to have lower memory pages allocated as bounce buffers for doing I/O to pages residing above *max_addr*.

blk_limits_max_hw_sectors

LINUX

Kernel Hackers ManualSeptember 2014

Name

`blk_limits_max_hw_sectors` — set hard and soft limit of max sectors for request

Synopsis

```
void blk_limits_max_hw_sectors (struct queue_limits * limits,  
unsigned int max_hw_sectors);
```

Arguments

limits

the queue limits

max_hw_sectors

max hardware sectors in the usual 512b unit

Description

Enables a low level driver to set a hard upper limit, `max_hw_sectors`, on the size of requests. `max_hw_sectors` is set by the device driver based upon the combined capabilities of I/O controller and storage device.

`max_sectors` is a soft limit imposed by the block layer for filesystem type requests. This value can be overridden on a per-device basis in `/sys/block/<device>/queue/max_sectors_kb`. The soft limit can not exceed `max_hw_sectors`.

blk_queue_max_hw_sectors

LINUX

Kernel Hackers Manual September 2014

Name

`blk_queue_max_hw_sectors` — set max sectors for a request for this queue

Synopsis

```
void blk_queue_max_hw_sectors (struct request_queue * q,
unsigned int max_hw_sectors);
```

Arguments

q

the request queue for the device

max_hw_sectors

max hardware sectors in the usual 512b unit

Description

See description for `blk_limits_max_hw_sectors`.

blk_queue_chunk_sectors

LINUX

Kernel Hackers ManualSeptember 2014

Name

`blk_queue_chunk_sectors` — set size of the chunk for this queue

Synopsis

```
void blk_queue_chunk_sectors (struct request_queue * q,
unsigned int chunk_sectors);
```

Arguments

q

the request queue for the device

chunk_sectors

chunk sectors in the usual 512b unit

Description

If a driver doesn't want IOs to cross a given chunk size, it can set this limit and prevent merging across chunks. Note that the chunk size must currently be a power-of-2 in sectors. Also note that the block layer must accept a page worth of data at any offset. So if the crossing of chunks is a hard limitation in the driver, it must still be prepared to split single page bios.

blk_queue_max_discard_sectors

LINUX

Kernel Hackers ManualSeptember 2014

Name

`blk_queue_max_discard_sectors` — set max sectors for a single discard

Synopsis

```
void blk_queue_max_discard_sectors (struct request_queue * q,  
unsigned int max_discard_sectors);
```


Arguments

q

the request queue for the device

max_discard_sectors

maximum number of sectors to discard

blk_queue_max_write_same_sectors

LINUX

Kernel Hackers Manual September 2014

Name

`blk_queue_max_write_same_sectors` — set max sectors for a single write same

Synopsis

```
void blk_queue_max_write_same_sectors (struct request_queue *  
q, unsigned int max_write_same_sectors);
```

Arguments

q

the request queue for the device

max_write_same_sectors

maximum number of sectors to write per command

blk_queue_max_segments

LINUX

Kernel Hackers ManualSeptember 2014

Name

`blk_queue_max_segments` — set max hw segments for a request for this queue

Synopsis

```
void blk_queue_max_segments (struct request_queue * q,  
unsigned short max_segments);
```

Arguments

q

the request queue for the device

max_segments

max number of segments

Description

Enables a low level driver to set an upper limit on the number of hw data segments in a request.

blk_queue_max_segment_size

LINUX

Kernel Hackers Manual September 2014

Name

`blk_queue_max_segment_size` — set max segment size for `blk_rq_map_sg`

Synopsis

```
void blk_queue_max_segment_size (struct request_queue * q,
unsigned int max_size);
```

Arguments

q

the request queue for the device

max_size

max size of segment in bytes

Description

Enables a low level driver to set an upper limit on the size of a coalesced segment

blk_queue_logical_block_size

LINUX

Name

`blk_queue_logical_block_size` — set logical block size for the queue

Synopsis

```
void blk_queue_logical_block_size (struct request_queue * q,  
unsigned short size);
```

Arguments

q
the request queue for the device

size
the logical block size, in bytes

Description

This should be set to the lowest possible block size that the storage device can address. The default of 512 covers most hardware.

blk_queue_physical_block_size

LINUX

Name

`blk_queue_physical_block_size` — set physical block size for the queue

Synopsis

```
void blk_queue_physical_block_size (struct request_queue * q,  
unsigned int size);
```

Arguments

q

the request queue for the device

size

the physical block size, in bytes

Description

This should be set to the lowest possible sector size that the hardware can operate on without reverting to read-modify-write operations.

blk_queue_alignment_offset

LINUX

Name

`blk_queue_alignment_offset` — set physical block alignment offset

Synopsis

```
void blk_queue_alignment_offset (struct request_queue * q,  
unsigned int offset);
```

Arguments

q

the request queue for the device

offset

alignment offset in bytes

Description

Some devices are naturally misaligned to compensate for things like the legacy DOS partition table 63-sector offset. Low-level drivers should call this function for devices whose first sector is not naturally aligned.

`blk_limits_io_min`

LINUX

Name

`blk_limits_io_min` — set minimum request size for a device

Synopsis

```
void blk_limits_io_min (struct queue_limits * limits, unsigned  
int min);
```

Arguments

limits

the queue limits

min

smallest I/O size in bytes

Description

Some devices have an internal block size bigger than the reported hardware sector size. This function can be used to signal the smallest I/O the device can perform without incurring a performance penalty.

`blk_queue_io_min`

LINUX

Name

`blk_queue_io_min` — set minimum request size for the queue

Synopsis

```
void blk_queue_io_min (struct request_queue * q, unsigned int  
min);
```

Arguments

q

the request queue for the device

min

smallest I/O size in bytes

Description

Storage devices may report a granularity or preferred minimum I/O size which is the smallest request the device can perform without incurring a performance penalty. For disk drives this is often the physical block size. For RAID arrays it is often the stripe chunk size. A properly aligned multiple of `minimum_io_size` is the preferred request size for workloads where a high number of I/O operations is desired.

`blk_limits_io_opt`

LINUX

Name

`blk_limits_io_opt` — set optimal request size for a device

Synopsis

```
void blk_limits_io_opt (struct queue_limits * limits, unsigned  
int opt);
```

Arguments

limits

the queue limits

opt

smallest I/O size in bytes

Description

Storage devices may report an optimal I/O size, which is the device's preferred unit for sustained I/O. This is rarely reported for disk drives. For RAID arrays it is usually the stripe width or the internal track size. A properly aligned multiple of `optimal_io_size` is the preferred request size for workloads where sustained throughput is desired.

`blk_queue_io_opt`

LINUX

Name

`blk_queue_io_opt` — set optimal request size for the queue

Synopsis

```
void blk_queue_io_opt (struct request_queue * q, unsigned int  
opt);
```

Arguments

q
the request queue for the device

opt
optimal request size in bytes

Description

Storage devices may report an optimal I/O size, which is the device's preferred unit for sustained I/O. This is rarely reported for disk drives. For RAID arrays it is usually the stripe width or the internal track size. A properly aligned multiple of `optimal_io_size` is the preferred request size for workloads where sustained throughput is desired.

`blk_queue_stack_limits`

LINUX

Name

`blk_queue_stack_limits` — inherit underlying queue limits for stacked drivers

Synopsis

```
void blk_queue_stack_limits (struct request_queue * t, struct  
request_queue * b);
```

Arguments

t

the stacking driver (top)

b

the underlying device (bottom)

`blk_stack_limits`

LINUX

Name

`blk_stack_limits` — adjust queue_limits for stacked devices

Synopsis

```
int blk_stack_limits (struct queue_limits * t, struct  
queue_limits * b, sector_t start);
```

Arguments

t

the stacking driver limits (top device)

b

the underlying queue limits (bottom, component device)

start

first data sector within component device

Description

This function is used by stacking drivers like MD and DM to ensure that all component devices have compatible block sizes and alignments. The stacking driver must provide a `queue_limits` struct (top) and then iteratively call the stacking function for all component (bottom) devices. The stacking function will attempt to combine the values and ensure proper alignment.

Returns 0 if the top and bottom `queue_limits` are compatible. The top device's block sizes and alignment offsets may be adjusted to ensure alignment with the bottom device. If no compatible sizes and alignments exist, -1 is returned and the resulting top `queue_limits` will have the `misaligned` flag set to indicate that the `alignment_offset` is undefined.

bdev_stack_limits

LINUX

Name

`bdev_stack_limits` — adjust queue limits for stacked drivers

Synopsis

```
int bdev_stack_limits (struct queue_limits * t, struct  
block_device * bdev, sector_t start);
```

Arguments

t

the stacking driver limits (top device)

bdev

the component `block_device` (bottom)

start

first data sector within component device

Description

Merges queue limits for a top device and a `block_device`. Returns 0 if alignment didn't change. Returns -1 if adding the bottom device caused misalignment.

`disk_stack_limits`

LINUX

Name

`disk_stack_limits` — adjust queue limits for stacked drivers

Synopsis

```
void disk_stack_limits (struct gendisk * disk, struct  
block_device * bdev, sector_t offset);
```

Arguments

disk

MD/DM gendisk (top)

bdev

the underlying block device (bottom)

offset

offset to beginning of data within component device

Description

Merges the limits for a top level gendisk and a bottom level block_device.

blk_queue_dma_pad

LINUX

Name

`blk_queue_dma_pad` — set pad mask

Synopsis

```
void blk_queue_dma_pad (struct request_queue * q, unsigned int  
mask);
```

Arguments

q
the request queue for the device

mask
pad mask

Description

Set dma pad mask.

Appending pad buffer to a request modifies the last entry of a scatter list such that it includes the pad buffer.

blk_queue_update_dma_pad

LINUX

Name

`blk_queue_update_dma_pad` — update pad mask

Synopsis

```
void blk_queue_update_dma_pad (struct request_queue * q,  
unsigned int mask);
```

Arguments

q

the request queue for the device

mask

pad mask

Description

Update dma pad mask.

Appending pad buffer to a request modifies the last entry of a scatter list such that it includes the pad buffer.

`blk_queue_dma_drain`

LINUX

Name

`blk_queue_dma_drain` — Set up a drain buffer for excess dma.

Synopsis

```
int blk_queue_dma_drain (struct request_queue * q,  
dma_drain_needed_fn * dma_drain_needed, void * buf, unsigned  
int size);
```

Arguments

q

the request queue for the device

dma_drain_needed

fn which returns non-zero if drain is necessary

buf

physically contiguous buffer

size

size of the buffer in bytes

Description

Some devices have excess DMA problems and can't simply discard (or zero fill) the unwanted piece of the transfer. They have to have a real area of memory to transfer it into. The use case for this is ATAPI devices in DMA mode. If the packet command causes a transfer bigger than the transfer size some HBAs will lock up if there aren't DMA elements to contain the excess transfer. What this API does is adjust the queue so that the *buf* is always appended silently to the scatterlist.

Note

This routine adjusts `max_hw_segments` to make room for appending the drain buffer. If you call `blk_queue_max_segments` after calling this routine, you must set the limit to one fewer than your device can support otherwise there won't be room for the drain buffer.

blk_queue_segment_boundary

LINUX

Kernel Hackers ManualSeptember 2014

Name

`blk_queue_segment_boundary` — set boundary rules for segment merging

Synopsis

```
void blk_queue_segment_boundary (struct request_queue * q,  
unsigned long mask);
```

Arguments

q

the request queue for the device

mask

the memory boundary mask

blk_queue_dma_alignment

LINUX

Kernel Hackers Manual September 2014

Name

`blk_queue_dma_alignment` — set dma length and memory alignment

Synopsis

```
void blk_queue_dma_alignment (struct request_queue * q, int
mask);
```

Arguments

q

the request queue for the device

mask

alignment mask

description

set required memory and length alignment for direct dma transactions. this is used when building direct io requests for the queue.

blk_queue_update_dma_alignment

LINUX

Name

`blk_queue_update_dma_alignment` — update dma length and memory alignment

Synopsis

```
void blk_queue_update_dma_alignment (struct request_queue * q,  
int mask);
```

Arguments

q

the request queue for the device

mask

alignment mask

description

update required memory and length alignment for direct dma transactions. If the requested alignment is larger than the current alignment, then the current queue alignment is updated to the new value, otherwise it is left alone. The design of this is to allow multiple objects (driver, device, transport etc) to set their respective alignments without having them interfere.

`blk_queue_flush`

LINUX

Name

`blk_queue_flush` — configure queue's cache flush capability

Synopsis

```
void blk_queue_flush (struct request_queue * q, unsigned int  
flush);
```

Arguments

q

the request queue for the device

flush

0, REQ_FLUSH or REQ_FLUSH | REQ_FUA

Description

Tell block layer cache flush capability of *q*. If it supports flushing, REQ_FLUSH should be set. If it supports bypassing write cache for individual writes, REQ_FUA should be set.

blk_execute_rq_nowait

LINUX

Name

`blk_execute_rq_nowait` — insert a request into queue for execution

Synopsis

```
void blk_execute_rq_nowait (struct request_queue * q, struct  
gendisk * bd_disk, struct request * rq, int at_head,  
rq_end_io_fn * done);
```

Arguments

q

queue to insert the request in

bd_disk

matching gendisk

rq

request to insert

at_head

insert request at head or tail of queue

done

I/O completion handler

Description

Insert a fully prepared request at the back of the I/O scheduler queue for execution. Don't wait for completion.

Note

This function will invoke *done* directly if the queue is dead.

blk_execute_rq

LINUX

Kernel Hackers ManualSeptember 2014

Name

`blk_execute_rq` — insert a request into queue for execution

Synopsis

```
int blk_execute_rq (struct request_queue * q, struct gendisk *  
bd_disk, struct request * rq, int at_head);
```

Arguments

q

queue to insert the request in

bd_disk

matching gendisk

rq

request to insert

at_head

insert request at head or tail of queue

Description

Insert a fully prepared request at the back of the I/O scheduler queue for execution and wait for completion.

blkdev_issue_flush

LINUX

Kernel Hackers ManualSeptember 2014

Name

`blkdev_issue_flush` — queue a flush

Synopsis

```
int blkdev_issue_flush (struct block_device * bdev, gfp_t
gfp_mask, sector_t * error_sector);
```

Arguments

bdev

blockdev to issue flush for

gfp_mask

memory allocation flags (for `bio_alloc`)

error_sector

error sector

Description

Issue a flush for the block device in question. Caller can supply room for storing the error offset in case of a flush error, if they wish to. If WAIT flag is not passed then caller may check only what request was pushed in some internal queue for later handling.

blkdev_issue_discard

LINUX

Kernel Hackers Manual September 2014

Name

`blkdev_issue_discard` — queue a discard

Synopsis

```
int blkdev_issue_discard (struct block_device * bdev, sector_t
sector, sector_t nr_sects, gfp_t gfp_mask, unsigned long
flags);
```

Arguments

bdev

blockdev to issue discard for

sector

start sector

nr_sects

number of sectors to discard

gfp_mask

memory allocation flags (for `bio_alloc`)

flags

`BLKDEV_IFL_*` flags to control behaviour

Description

Issue a discard request for the sectors in question.

blkdev_issue_write_same

LINUX

Kernel Hackers ManualSeptember 2014

Name

`blkdev_issue_write_same` — queue a write same operation

Synopsis

```
int blkdev_issue_write_same (struct block_device * bdev,  
sector_t sector, sector_t nr_sects, gfp_t gfp_mask, struct  
page * page);
```

Arguments

bdev

target blockdev

sector

start sector

nr_sects

number of sectors to write

gfp_mask

memory allocation flags (for bio_alloc)

page

page containing data to write

Description

Issue a write same request for the sectors in question.

blkdev_issue_zeroout

LINUX

Kernel Hackers ManualSeptember 2014

Name

blkdev_issue_zeroout — zero-fill a block range

Synopsis

```
int blkdev_issue_zeroout (struct block_device * bdev, sector_t
sector, sector_t nr_sects, gfp_t gfp_mask);
```

Arguments

bdev

blockdev to write

sector

start sector

nr_sects

number of sectors to write

gfp_mask

memory allocation flags (for bio_alloc)

Description

Generate and issue number of bios with zeroed pages.

blk_queue_find_tag

LINUX

Kernel Hackers ManualSeptember 2014

Name

`blk_queue_find_tag` — find a request by its tag and queue

Synopsis

```
struct request * blk_queue_find_tag (struct request_queue * q,  
int tag);
```

Arguments

q

The request queue for the device

tag

The tag of the request

Notes

Should be used when a device returns a tag and you want to match it with a request.
no locks need be held.

blk_free_tags

LINUX

Kernel Hackers ManualSeptember 2014

Name

`blk_free_tags` — release a given set of tag maintenance info

Synopsis

```
void blk_free_tags (struct blk_queue_tag * bqt);
```

Arguments

bqt

the tag map to free

Description

Drop the reference count on *bqt* and frees it when the last reference is dropped.

blk_queue_free_tags

LINUX

Kernel Hackers ManualSeptember 2014

Name

`blk_queue_free_tags` — release tag maintenance info

Synopsis

```
void blk_queue_free_tags (struct request_queue * q);
```

Arguments

q
the request queue for the device

Notes

This is used to disable tagged queuing to a device, yet leave queue in function.

blk_init_tags

LINUX

Kernel Hackers ManualSeptember 2014

Name

`blk_init_tags` — initialize the tag info for an external tag map

Synopsis

```
struct blk_queue_tag * blk_init_tags (int depth);
```

Arguments

depth

the maximum queue depth supported

blk_queue_init_tags

LINUX

Kernel Hackers ManualSeptember 2014

Name

`blk_queue_init_tags` — initialize the queue tag info

Synopsis

```
int blk_queue_init_tags (struct request_queue * q, int depth,  
struct blk_queue_tag * tags);
```

Arguments

q
the request queue for the device

depth
the maximum queue depth supported

tags
the tag to use

Description

Queue lock must be held here if the function is called to resize an existing map.

blk_queue_resize_tags

LINUX

Kernel Hackers ManualSeptember 2014

Name

`blk_queue_resize_tags` — change the queueing depth

Synopsis

```
int blk_queue_resize_tags (struct request_queue * q, int
new_depth);
```

Arguments

q

the request queue for the device

new_depth

the new max command queueing depth

Notes

Must be called with the queue lock held.

blk_queue_end_tag

LINUX

Kernel Hackers ManualSeptember 2014

Name

blk_queue_end_tag — end tag operations for a request

Synopsis

```
void blk_queue_end_tag (struct request_queue * q, struct
request * rq);
```

Arguments

q

the request queue for the device

rq

the request that has completed

Description

Typically called when `end_that_request_first` returns 0, meaning all transfers have been done for a request. It's important to call this function before `end_that_request_last`, as that will put the request back on the free list thus corrupting the internal tag list.

Notes

queue lock must be held.

blk_queue_start_tag

LINUX

Kernel Hackers ManualSeptember 2014

Name

`blk_queue_start_tag` — find a free tag and assign it

Synopsis

```
int blk_queue_start_tag (struct request_queue * q, struct
request * rq);
```

Arguments

q

the request queue for the device

rq

the block request that needs tagging

Description

This can either be used as a stand-alone helper, or possibly be assigned as the queue `prep_rq_fn` (in which case struct request automatically gets a tag assigned). Note that this function assumes that any type of request can be queued! if this is not true for your device, you must check the request type before calling this function. The request will also be removed from the request queue, so it's the drivers responsibility to read it if it should need to be restarted for some reason.

Notes

queue lock must be held.

blk_queue_invalidate_tags

LINUX

Name

`blk_queue_invalidate_tags` — invalidate all pending tags

Synopsis

```
void blk_queue_invalidate_tags (struct request_queue * q);
```

Arguments

q

the request queue for the device

Description

Hardware conditions may dictate a need to stop all pending requests. In this case, we will safely clear the block side of the tag queue and readd all requests to the request queue in the right order.

Notes

queue lock must be held.

__blk_queue_free_tags

LINUX

Name

`__blk_queue_free_tags` — release tag maintenance info

Synopsis

```
void __blk_queue_free_tags (struct request_queue * q);
```

Arguments

q

the request queue for the device

Notes

`blk_cleanup_queue` will take care of calling this function, if tagging has been used. So there's no need to call this directly.

blk_rq_count_integrity_sg

LINUX

Name

`blk_rq_count_integrity_sg` — Count number of integrity scatterlist elements

Synopsis

```
int blk_rq_count_integrity_sg (struct request_queue * q,  
struct bio * bio);
```

Arguments

q

request queue

bio

bio with integrity metadata attached

Description

Returns the number of elements required in a scatterlist corresponding to the integrity metadata in a bio.

blk_rq_map_integrity_sg

LINUX

Kernel Hackers ManualSeptember 2014

Name

blk_rq_map_integrity_sg — Map integrity metadata into a scatterlist

Synopsis

```
int blk_rq_map_integrity_sg (struct request_queue * q, struct  
bio * bio, struct scatterlist * sglist);
```

Arguments

q

request queue

bio

bio with integrity metadata attached

sglist

target scatterlist

Description

Map the integrity vectors in request into a scatterlist. The scatterlist must be big enough to hold all elements. I.e. sized using `blk_rq_count_integrity_sg`.

blk_integrity_compare

LINUX

Kernel Hackers Manual September 2014

Name

`blk_integrity_compare` — Compare integrity profile of two disks

Synopsis

```
int blk_integrity_compare (struct gendisk * gd1, struct
gendisk * gd2);
```

Arguments

gd1

Disk to compare

gd2

Disk to compare

Description

Meta-devices like DM and MD need to verify that all sub-devices use the same integrity format before advertising to upper layers that they can send/receive integrity metadata. This function can be used to check whether two gendisk devices have compatible integrity formats.

blk_integrity_register

LINUX

Kernel Hackers ManualSeptember 2014

Name

`blk_integrity_register` — Register a gendisk as being integrity-capable

Synopsis

```
int blk_integrity_register (struct gendisk * disk, struct  
blk_integrity * template);
```


Arguments

disk

struct gendisk pointer to make integrity-aware

template

optional integrity profile to register

Description

When a device needs to advertise itself as being able to send/receive integrity metadata it must use this function to register the capability with the block layer. The *template* is a `blk_integrity` struct with values appropriate for the underlying hardware. If *template* is `NULL` the new profile is allocated but not filled out. See [Documentation/block/data-integrity.txt](#).

blk_integrity_unregister

LINUX

Kernel Hackers ManualSeptember 2014

Name

`blk_integrity_unregister` — Remove block integrity profile

Synopsis

```
void blk_integrity_unregister (struct gendisk * disk);
```

Arguments

disk

disk whose integrity profile to deallocate

Description

This function frees all memory used by the block integrity profile. To be called at device teardown.

blk_trace_ioctl

LINUX

Kernel Hackers ManualSeptember 2014

Name

`blk_trace_ioctl` — handle the ioctls associated with tracing

Synopsis

```
int blk_trace_ioctl (struct block_device * bdev, unsigned cmd,  
char __user * arg);
```

Arguments

bdev

the block device

cmd

the ioctl cmd

arg

the argument data, if any

blk_trace_shutdown

LINUX

Kernel Hackers ManualSeptember 2014

Name

blk_trace_shutdown — stop and cleanup trace structures

Synopsis

```
void blk_trace_shutdown (struct request_queue * q);
```

Arguments

q

the request queue associated with the device

blk_add_trace_rq

LINUX

Name

`blk_add_trace_rq` — Add a trace for a request oriented action

Synopsis

```
void blk_add_trace_rq (struct request_queue * q, struct  
request * rq, unsigned int nr_bytes, u32 what);
```

Arguments

q

queue the io is for

rq

the source request

nr_bytes

number of completed bytes

what

the action

Description

Records an action against a request. Will log the bio offset + size.

`blk_add_trace_bio`

LINUX

Name

`blk_add_trace_bio` — Add a trace for a bio oriented action

Synopsis

```
void blk_add_trace_bio (struct request_queue * q, struct bio *  
bio, u32 what, int error);
```

Arguments

q

queue the io is for

bio

the source bio

what

the action

error

error, if any

Description

Records an action against a bio. Will log the bio offset + size.

`blk_add_trace_bio_remap`

LINUX

Name

`blk_add_trace_bio_remap` — Add a trace for a bio-remap operation

Synopsis

```
void blk_add_trace_bio_remap (void * ignore, struct  
request_queue * q, struct bio * bio, dev_t dev, sector_t  
from);
```

Arguments

ignore

trace callback data parameter (not used)

q

queue the io is for

bio

the source bio

dev

target device

from

source sector

Description

Device mapper or raid target sometimes need to split a bio because it spans a stripe (or similar). Add a trace for that action.

blk_add_trace_rq_remap

LINUX

Kernel Hackers Manual September 2014

Name

`blk_add_trace_rq_remap` — Add a trace for a request-remap operation

Synopsis

```
void blk_add_trace_rq_remap (void * ignore, struct
request_queue * q, struct request * rq, dev_t dev, sector_t
from);
```

Arguments

ignore

trace callback data parameter (not used)

q

queue the io is for

rq

the source request

dev

target device

from

source sector

Description

Device mapper remaps request to other devices. Add a trace for that action.

blk_mangle_minor

LINUX

Kernel Hackers ManualSeptember 2014

Name

`blk_mangle_minor` — scatter minor numbers apart

Synopsis

```
int blk_mangle_minor (int minor);
```

Arguments

minor

minor number to mangle

Description

Scatter consecutively allocated *minor* number apart if MANGLE_DEVT is enabled. Mangling twice gives the original value.

RETURNS

Mangled value.

CONTEXT

Don't care.

blk_alloc_devt

LINUX

Kernel Hackers Manual September 2014

Name

`blk_alloc_devt` — allocate a `dev_t` for a partition

Synopsis

```
int blk_alloc_devt (struct hd_struct * part, dev_t * devt);
```

Arguments

part

partition to allocate `dev_t` for

devt

out parameter for resulting `dev_t`

Description

Allocate a `dev_t` for block device.

RETURNS

0 on success, allocated `dev_t` is returned in `*devt`. -errno on failure.

CONTEXT

Might sleep.

blk_free_devt

LINUX

Kernel Hackers ManualSeptember 2014

Name

`blk_free_devt` — free a `dev_t`

Synopsis

```
void blk_free_devt (dev_t devt);
```

Arguments

devt

`dev_t` to free

Description

Free *devt* which was allocated using `blk_alloc_devt`.

CONTEXT

Might sleep.

disk_replace_part_tbl

LINUX

Kernel Hackers Manual September 2014

Name

`disk_replace_part_tbl` — replace `disk->part_tbl` in RCU-safe way

Synopsis

```
void disk_replace_part_tbl (struct gendisk * disk, struct  
disk_part_tbl * new_ptbl);
```

Arguments

disk

disk to replace `part_tbl` for

new_ptbl

new `part_tbl` to install

Description

Replace `disk->part_tbl` with *new_ptbl* in RCU-safe way. The original `ptbl` is freed using RCU callback.

LOCKING

Matching `bd_mutex` locked.

disk_expand_part_tbl

LINUX

Kernel Hackers ManualSeptember 2014

Name

`disk_expand_part_tbl` — expand `disk->part_tbl`

Synopsis

```
int disk_expand_part_tbl (struct gendisk * disk, int partno);
```

Arguments

disk

disk to expand `part_tbl` for

partno

expand such that this `partno` can fit in

Description

Expand `disk->part_tbl` such that *partno* can fit in. `disk->part_tbl` uses RCU to allow unlocked dereferencing for stats and other stuff.

LOCKING

Matching `bd_mutex` locked, might sleep.

RETURNS

0 on success, `-errno` on failure.

disk_block_events

LINUX

Kernel Hackers ManualSeptember 2014

Name

`disk_block_events` — block and flush disk event checking

Synopsis

```
void disk_block_events (struct gendisk * disk);
```

Arguments

disk

disk to block events for

Description

On return from this function, it is guaranteed that event checking isn't in progress and won't happen until unblocked by `disk_unblock_events`. Events blocking is counted and the actual unblocking happens after the matching number of unblocks are done.

Note that this intentionally does not block event checking from `disk_clear_events`.

CONTEXT

Might sleep.

disk_unblock_events

LINUX

Kernel Hackers ManualSeptember 2014

Name

`disk_unblock_events` — unblock disk event checking

Synopsis

```
void disk_unblock_events (struct gendisk * disk);
```

Arguments

disk

disk to unblock events for

Description

Undo `disk_block_events`. When the block count reaches zero, it starts events polling if configured.

CONTEXT

Don't care. Safe to call from irq context.

disk_flush_events

LINUX

Kernel Hackers Manual September 2014

Name

`disk_flush_events` — schedule immediate event checking and flushing

Synopsis

```
void disk_flush_events (struct gendisk * disk, unsigned int  
mask);
```

Arguments

disk

disk to check and flush events for

mask

events to flush

Description

Schedule immediate event checking on *disk* if not blocked. Events in *mask* are scheduled to be cleared from the driver. Note that this doesn't clear the events from *disk->ev*.

CONTEXT

If *mask* is non-zero must be called with `bdev->bd_mutex` held.

disk_clear_events

LINUX

Kernel Hackers ManualSeptember 2014

Name

`disk_clear_events` — synchronously check, clear and return pending events

Synopsis

```
unsigned int disk_clear_events (struct gendisk * disk,  
unsigned int mask);
```

Arguments

disk

disk to fetch and clear events from

mask

mask of events to be fetched and cleared

Description

Disk events are synchronously checked and pending events in *mask* are cleared and returned. This ignores the block count.

CONTEXT

Might sleep.

disk_get_part

LINUX

Kernel Hackers Manual September 2014

Name

`disk_get_part` — get partition

Synopsis

```
struct hd_struct * disk_get_part (struct gendisk * disk, int
partno);
```

Arguments

disk

disk to look partition from

partno

partition number

Description

Look for partition *partno* from *disk*. If found, increment reference count and return it.

CONTEXT

Don't care.

RETURNS

Pointer to the found partition on success, NULL if not found.

disk_part_iter_init

LINUX

Kernel Hackers ManualSeptember 2014

Name

`disk_part_iter_init` — initialize partition iterator

Synopsis

```
void disk_part_iter_init (struct disk_part_iter * piter,  
struct gendisk * disk, unsigned int flags);
```

Arguments

piter

iterator to initialize

disk

disk to iterate over

flags

DISK_PITER_* flags

Description

Initialize *piter* so that it iterates over partitions of *disk*.

CONTEXT

Don't care.

disk_part_iter_next

LINUX

Kernel Hackers ManualSeptember 2014

Name

`disk_part_iter_next` — proceed iterator to the next partition and return it

Synopsis

```
struct hd_struct * disk_part_iter_next (struct disk_part_iter  
* piter);
```

Arguments

piter

iterator of interest

Description

Proceed *piter* to the next partition and return it.

CONTEXT

Don't care.

disk_part_iter_exit

LINUX

Kernel Hackers ManualSeptember 2014

Name

`disk_part_iter_exit` — finish up partition iteration

Synopsis

```
void disk_part_iter_exit (struct disk_part_iter * piter);
```

Arguments

piter

iter of interest

Description

Called when iteration is over. Cleans up *piter*.

CONTEXT

Don't care.

disk_map_sector_rcu

LINUX

Kernel Hackers Manual September 2014

Name

`disk_map_sector_rcu` — map sector to partition

Synopsis

```
struct hd_struct * disk_map_sector_rcu (struct gendisk * disk,
sector_t sector);
```

Arguments

disk

gendisk of interest

sector

sector to map

Description

Find out which partition *sector* maps to on *disk*. This is primarily used for stats accounting.

CONTEXT

RCU read locked. The returned partition pointer is valid only while preemption is disabled.

RETURNS

Found partition on success, part0 is returned if no partition matches

register_blkdev

LINUX

Kernel Hackers ManualSeptember 2014

Name

`register_blkdev` — register a new block device

Synopsis

```
int register_blkdev (unsigned int major, const char * name);
```

Arguments

major

the requested major device number [1..255]. If *major*=0, try to allocate any unused major number.

name

the name of the new block device as a zero terminated string

Description

The *name* must be unique within the system.

The return value depends on the *major* input parameter. - if a major device number was requested in range [1..255] then the function returns zero on success, or a

negative error code - if any unused major number was requested with *major*=0 parameter then the return value is the allocated major number in range [1..255] or a negative error code otherwise

add_disk

LINUX

Kernel Hackers Manual September 2014

Name

`add_disk` — add partitioning information to kernel list

Synopsis

```
void add_disk (struct gendisk * disk);
```

Arguments

disk

per-device partitioning information

Description

This function registers the partitioning information in *disk* with the kernel.

FIXME

error handling

get_gendisk

LINUX

Kernel Hackers ManualSeptember 2014

Name

`get_gendisk` — get partitioning information for a given device

Synopsis

```
struct gendisk * get_gendisk (dev_t devt, int * partno);
```

Arguments

devt

device to get partitioning information for

partno

returned partition index

Description

This function gets the structure containing partitioning information for the given device *devt*.

bdget_disk

LINUX

Name

`bdget_disk` — do `bdget` by gendisk and partition number

Synopsis

```
struct block_device * bdget_disk (struct gendisk * disk, int
partno);
```

Arguments

disk

gendisk of interest

partno

partition number

Description

Find partition *partno* from *disk*, do `bdget` on it.

CONTEXT

Don't care.

RETURNS

Resulting `block_device` on success, `NULL` on failure.

Chapter 15. Char devices

register_chrdev_region

LINUX

Kernel Hackers ManualSeptember 2014

Name

`register_chrdev_region` — register a range of device numbers

Synopsis

```
int register_chrdev_region (dev_t from, unsigned count, const  
char * name);
```

Arguments

from

the first in the desired range of device numbers; must include the major number.

count

the number of consecutive device numbers required

name

the name of the device or driver.

Description

Return value is zero on success, a negative error code on failure.

alloc_chrdev_region

LINUX

Kernel Hackers ManualSeptember 2014

Name

`alloc_chrdev_region` — register a range of char device numbers

Synopsis

```
int alloc_chrdev_region (dev_t * dev, unsigned baseminor,  
unsigned count, const char * name);
```

Arguments

dev

output parameter for first assigned number

baseminor

first of the requested range of minor numbers

count

the number of minor numbers required

name

the name of the associated device or driver

Description

Allocates a range of char device numbers. The major number will be chosen dynamically, and returned (along with the first minor number) in *dev*. Returns zero or a negative error code.

__register_chrdev

LINUX

Kernel Hackers Manual September 2014

Name

`__register_chrdev` — create and register a cdev occupying a range of minors

Synopsis

```
int __register_chrdev (unsigned int major, unsigned int
baseminor, unsigned int count, const char * name, const struct
file_operations * fops);
```

Arguments

major

major device number or 0 for dynamic allocation

baseminor

first of the requested range of minor numbers

count

the number of minor numbers required

name

name of this range of devices

fops

file operations associated with this devices

Description

If *major* == 0 this functions will dynamically allocate a major and return its number.

If *major* > 0 this function will attempt to reserve a device with the given major number and will return zero on success.

Returns a -ve errno on failure.

The name of this device has nothing to do with the name of the device in /dev. It only helps to keep track of the different owners of devices. If your module name has only one type of devices it's ok to use e.g. the name of the module here.

unregister_chrdev_region

LINUX

Kernel Hackers Manual September 2014

Name

`unregister_chrdev_region` — return a range of device numbers

Synopsis

```
void unregister_chrdev_region (dev_t from, unsigned count);
```

Arguments

from

the first in the range of numbers to unregister

count

the number of device numbers to unregister

Description

This function will unregister a range of *count* device numbers, starting with *from*. The caller should normally be the one who allocated those numbers in the first place...

__unregister_chrdev

LINUX

Kernel Hackers ManualSeptember 2014

Name

`__unregister_chrdev` — unregister and destroy a cdev

Synopsis

```
void __unregister_chrdev (unsigned int major, unsigned int
baseminor, unsigned int count, const char * name);
```

Arguments

major

major device number

baseminor

first of the range of minor numbers

count

the number of minor numbers this cdev is occupying

name

name of this range of devices

Description

Unregister and destroy the cdev occupying the region described by *major*, *baseminor* and *count*. This function undoes what `__register_chrdev` did.

cdev_add

LINUX

Kernel Hackers Manual September 2014

Name

`cdev_add` — add a char device to the system

Synopsis

```
int cdev_add (struct cdev * p, dev_t dev, unsigned count);
```


Arguments

p

the cdev structure for the device

dev

the first device number for which this device is responsible

count

the number of consecutive minor numbers corresponding to this device

Description

`cdev_add` adds the device represented by *p* to the system, making it live immediately. A negative error code is returned on failure.

cdev_del

LINUX

Kernel Hackers Manual September 2014

Name

`cdev_del` — remove a cdev from the system

Synopsis

```
void cdev_del (struct cdev * p);
```

Arguments

p

the cdev structure to be removed

Description

`cdev_del` removes *p* from the system, possibly freeing the structure itself.

cdev_alloc

LINUX

Kernel Hackers ManualSeptember 2014

Name

`cdev_alloc` — allocate a cdev structure

Synopsis

```
struct cdev * cdev_alloc ( void );
```

Arguments

void

no arguments

Description

Allocates and returns a `cdev` structure, or `NULL` on failure.

cdev_init

LINUX

Kernel Hackers ManualSeptember 2014

Name

`cdev_init` — initialize a `cdev` structure

Synopsis

```
void cdev_init (struct cdev * cdev, const struct  
file_operations * fops);
```

Arguments

cdev

the structure to initialize

fops

the `file_operations` for this device

Description

Initializes *cdev*, remembering *fops*, making it ready to add to the system with `cdev_add`.

Chapter 16. Miscellaneous Devices

misc_register

LINUX

Kernel Hackers Manual September 2014

Name

`misc_register` — register a miscellaneous device

Synopsis

```
int misc_register (struct miscdevice * misc);
```

Arguments

misc

device structure

Register a miscellaneous device with the kernel. If the minor number is set to `MISC_DYNAMIC_MINOR` a minor number is assigned and placed in the minor field of the structure. For other cases the minor number requested is used.

Description

The structure passed is linked into the kernel and may not be destroyed until it has been unregistered.

A zero is returned on success and a negative `errno` code for failure.

misc_deregister

LINUX

Kernel Hackers ManualSeptember 2014

Name

`misc_deregister` — unregister a miscellaneous device

Synopsis

```
int misc_deregister (struct miscdevice * misc);
```

Arguments

misc

device to unregister

Description

Unregister a miscellaneous device that was previously successfully registered with `misc_register`. Success is indicated by a zero return, a negative errno code indicates an error.

Chapter 17. Clock Framework

The clock framework defines programming interfaces to support software management of the system clock tree. This framework is widely used with System-On-Chip (SOC) platforms to support power management and various devices which may need custom clock rates. Note that these "clocks" don't relate to timekeeping or real time clocks (RTCs), each of which have separate frameworks. These struct clk instances may be used to manage for example a 96 MHz signal that is used to shift bits into and out of peripherals or busses, or otherwise trigger synchronous state machine transitions in system hardware.

Power management is supported by explicit software clock gating: unused clocks are disabled, so the system doesn't waste power changing the state of transistors that aren't in active use. On some systems this may be backed by hardware clock gating, where clocks are gated without being disabled in software. Sections of chips that are powered but not clocked may be able to retain their last state. This low power state is often called a *retention mode*. This mode still incurs leakage currents, especially with finer circuit geometries, but for CMOS circuits power is mostly used by clocked state changes.

Power-aware drivers only enable their clocks when the device they manage is in active use. Also, system sleep states often differ according to which clock domains are active: while a "standby" state may allow wakeup from several active domains, a "mem" (suspend-to-RAM) state may require a more wholesale shutdown of clocks derived from higher speed PLLs and oscillators, limiting the number of possible wakeup event sources. A driver's suspend method may need to be aware of system-specific clock constraints on the target sleep state.

Some platforms support programmable clock generators. These can be used by external chips of various kinds, such as other CPUs, multimedia codecs, and devices with strict requirements for interface clocking.

struct clk_notifier

LINUX

Kernel Hackers Manual September 2014

Name

struct clk_notifier — associate a clk with a notifier

Synopsis

```
struct clk_notifier {  
    struct clk * clk;  
    struct srcu_notifier_head notifier_head;  
    struct list_head node;  
};
```

Members

`clk`

struct `clk` * to associate the notifier with

`notifier_head`

a `blocking_notifier_head` for this `clk`

`node`

linked list pointers

Description

A list of struct `clk_notifier` is maintained by the notifier code. An entry is created whenever code registers the first notifier on a particular *clk*. Future notifiers on that *clk* are added to the *notifier_head*.

struct clk_notifier_data

LINUX

Kernel Hackers Manual September 2014

Name

struct `clk_notifier_data` — rate data to pass to the notifier callback

Synopsis

```
struct clk_notifier_data {
    struct clk * clk;
    unsigned long old_rate;
    unsigned long new_rate;
};
```

Members

clk

struct clk * being changed

old_rate

previous rate of this clk

new_rate

new rate of this clk

Description

For a pre-notifier, old_rate is the clk's rate before this rate change, and new_rate is what the rate will be in the future. For a post-notifier, old_rate and new_rate are both set to the clk's current rate (this was done to optimize the implementation).

clk_notifier_register

LINUX

Kernel Hackers Manual September 2014

Name

clk_notifier_register — change notifier callback

Synopsis

```
int clk_notifier_register (struct clk * clk, struct
notifier_block * nb);
```

Arguments

clk

clock whose rate we are interested in

nb

notifier block with callback function pointer

ProTip

debugging across notifier chains can be frustrating. Make sure that your notifier callback function prints a nice big warning in case of failure.

clk_notifier_unregister

LINUX

Kernel Hackers ManualSeptember 2014

Name

`clk_notifier_unregister` — change notifier callback

Synopsis

```
int clk_notifier_unregister (struct clk * clk, struct
notifier_block * nb);
```

Arguments

clk

clock whose rate we are no longer interested in

nb

notifier block which will be unregistered

clk_get_accuracy

LINUX

Kernel Hackers ManualSeptember 2014

Name

`clk_get_accuracy` — obtain the clock accuracy in ppb (parts per billion) for a clock source.

Synopsis

```
long clk_get_accuracy (struct clk * clk);
```

Arguments

clk

clock source

Description

This gets the clock source accuracy expressed in ppb. A perfect clock returns 0.

clk_prepare

LINUX

Kernel Hackers ManualSeptember 2014

Name

`clk_prepare` — prepare a clock source

Synopsis

```
int clk_prepare (struct clk * clk);
```

Arguments

clk

clock source

Description

This prepares the clock source for use.

Must not be called from within atomic context.

clk_unprepare

LINUX

Kernel Hackers ManualSeptember 2014

Name

`clk_unprepare` — undo preparation of a clock source

Synopsis

```
void clk_unprepare (struct clk * clk);
```

Arguments

clk

clock source

Description

This undoes a previously prepared clock. The caller must balance the number of prepare and unprepare calls.

Must not be called from within atomic context.

clk_get

LINUX

Name

`clk_get` — lookup and obtain a reference to a clock producer.

Synopsis

```
struct clk * clk_get (struct device * dev, const char * id);
```

Arguments

dev

device for clock “consumer”

id

clock consumer ID

Description

Returns a struct clk corresponding to the clock producer, or valid `IS_ERR` condition containing `errno`. The implementation uses *dev* and *id* to determine the clock consumer, and thereby the clock producer. (IOW, *id* may be identical strings, but `clk_get` may return different clock producers depending on *dev*.)

Drivers must assume that the clock source is not enabled.

`clk_get` should not be called from within interrupt context.

`devm_clk_get`

LINUX

Name

`devm_clk_get` — lookup and obtain a managed reference to a clock producer.

Synopsis

```
struct clk * devm_clk_get (struct device * dev, const char *  
id);
```

Arguments

dev

device for clock “consumer”

id

clock consumer ID

Description

Returns a `struct clk` corresponding to the clock producer, or valid `IS_ERR` condition containing `errno`. The implementation uses *dev* and *id* to determine the clock consumer, and thereby the clock producer. (IOW, *id* may be identical strings, but `clk_get` may return different clock producers depending on *dev*.)

Drivers must assume that the clock source is not enabled.

`devm_clk_get` should not be called from within interrupt context.

The clock will automatically be freed when the device is unbound from the bus.

clk_enable

LINUX

Kernel Hackers ManualSeptember 2014

Name

`clk_enable` — inform the system when the clock source should be running.

Synopsis

```
int clk_enable (struct clk * clk);
```

Arguments

clk

clock source

Description

If the clock can not be enabled/disabled, this should return success.

May be called from atomic contexts.

Returns success (0) or negative errno.

clk_disable

LINUX

Name

`clk_disable` — inform the system when the clock source is no longer required.

Synopsis

```
void clk_disable (struct clk * clk);
```

Arguments

clk

clock source

Description

Inform the system that a clock source is no longer required by a driver and may be shut down.

May be called from atomic contexts.

Implementation detail

if the clock source is shared between multiple drivers, `clk_enable` calls must be balanced by the same number of `clk_disable` calls for the clock source to be disabled.

`clk_get_rate`

LINUX

Name

`clk_get_rate` — obtain the current clock rate (in Hz) for a clock source. This is only valid once the clock source has been enabled.

Synopsis

```
unsigned long clk_get_rate (struct clk * clk);
```

Arguments

clk

clock source

clk_put

LINUX

Name

`clk_put` — "free" the clock source

Synopsis

```
void clk_put (struct clk * clk);
```

Arguments

clk

clock source

Note

drivers must ensure that all `clk_enable` calls made on this clock source are balanced by `clk_disable` calls prior to calling this function.

`clk_put` should not be called from within interrupt context.

devm_clk_put

LINUX

Kernel Hackers Manual September 2014

Name

`devm_clk_put` — "free" a managed clock source

Synopsis

```
void devm_clk_put (struct device * dev, struct clk * clk);
```

Arguments

dev

device used to acquire the clock

clk

clock source acquired with `devm_clk_get`

Note

drivers must ensure that all `clk_enable` calls made on this clock source are balanced by `clk_disable` calls prior to calling this function.

`clk_put` should not be called from within interrupt context.

clk_round_rate

LINUX

Kernel Hackers ManualSeptember 2014

Name

`clk_round_rate` — adjust a rate to the exact rate a clock can provide

Synopsis

```
long clk_round_rate (struct clk * clk, unsigned long rate);
```

Arguments

clk

clock source

rate

desired clock rate in Hz

Description

Returns rounded clock rate in Hz, or negative `errno`.

clk_set_rate

LINUX

Kernel Hackers ManualSeptember 2014

Name

`clk_set_rate` — set the clock rate for a clock source

Synopsis

```
int clk_set_rate (struct clk * clk, unsigned long rate);
```

Arguments

clk

clock source

rate

desired clock rate in Hz

Description

Returns success (0) or negative `errno`.

clk_set_parent

LINUX

Kernel Hackers ManualSeptember 2014

Name

`clk_set_parent` — set the parent clock source for this clock

Synopsis

```
int clk_set_parent (struct clk * clk, struct clk * parent);
```

Arguments

clk

clock source

parent

parent clock source

Description

Returns success (0) or negative errno.

clk_get_parent

LINUX

Name

`clk_get_parent` — get the parent clock source for this clock

Synopsis

```
struct clk * clk_get_parent (struct clk * clk);
```

Arguments

clk

clock source

Description

Returns struct clk corresponding to parent clock source, or valid `IS_ERR` condition containing `errno`.

clk_get_sys

LINUX

Name

`clk_get_sys` — get a clock based upon the device name

Synopsis

```
struct clk * clk_get_sys (const char * dev_id, const char *  
con_id);
```

Arguments

dev_id

device name

con_id

connection ID

Description

Returns a struct clk corresponding to the clock producer, or valid IS_ERR condition containing errno. The implementation uses *dev_id* and *con_id* to determine the clock consumer, and thereby the clock producer. In contrast to `clk_get` this function takes the device name instead of the device itself for identification.

Drivers must assume that the clock source is not enabled.

`clk_get_sys` should not be called from within interrupt context.

clk_add_alias

LINUX

Kernel Hackers Manual September 2014

Name

`clk_add_alias` — add a new clock alias

Synopsis

```
int clk_add_alias (const char * alias, const char *  
alias_dev_name, char * id, struct device * dev);
```

Arguments

alias

name for clock alias

alias_dev_name

device name

id

platform specific clock name

dev

device

Description

Allows using generic clock names for drivers by adding a new alias. Assumes clkdev, see clkdev.h for more info.

