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Subject: [PATCH -mm 3/3] i/o accounting and control  
Posted by [Andrea Righi](#) on Tue, 22 Jul 2008 20:58:59 GMT  
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Apply the io-throttle controller to the opportune kernel functions. Both accounting and throttling functionalities are performed by cgroup\_io\_throttle().

Signed-off-by: Andrea Righi <[righi.andrea@gmail.com](mailto:righi.andrea@gmail.com)>

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```
block/blk-core.c      | 9 ++++++++
fs/aio.c              | 31 ++++++++++++++++++++++++++++++++++++++
fs/buffer.c           | 20 ++++++++
fs/direct-io.c        | 4 +++++
include/linux/sched.h | 3 +++
kernel/fork.c         | 3 +++
mm/filemap.c          | 18 ++++++++
mm/page-writeback.c   | 30 ++++++++
mm/readahead.c        | 5 +++++
9 files changed, 115 insertions(+), 8 deletions(-)
```

diff --git a/block/blk-core.c b/block/blk-core.c

index 4c222ba..431294f 100644

--- a/block/blk-core.c

+++ b/block/blk-core.c

@@ -26,6 +26,7 @@

#include <linux/swap.h>

#include <linux/writeback.h>

#include <linux/task\_io\_accounting\_ops.h>

+#include <linux/blk-io-throttle.h>

#include <linux/interrupt.h>

#include <linux/cpu.h>

#include <linux/blktrace\_api.h>

@@ -1482,7 +1483,15 @@ void submit\_bio(int rw, struct bio \*bio)

if (rw & WRITE) {

count\_vm\_events(PGPGOUT, count);

} else {

+ struct page \*page = bio\_iovec\_idx(bio, 0)->bv\_page;

+

task\_io\_account\_read(bio->bi\_size);

+ /\*

+ \* Do not throttle page requests that need to be

+ \* urgently reclaimed.

+ \*/

+ cgroup\_io\_throttle(bio->bi\_bdev, bio->bi\_size,

+ !(PageReclaim(page) || PageSwapCache(page)));

count\_vm\_events(PGPGIN, count);

}

```

diff --git a/fs/aio.c b/fs/aio.c
index 0051fd9..1f3abb3 100644
--- a/fs/aio.c
+++ b/fs/aio.c
@@ -22,6 +22,7 @@
#include <linux/sched.h>
#include <linux/fs.h>
#include <linux/file.h>
+#include <linux/blk-io-throttle.h>
#include <linux/mm.h>
#include <linux/mman.h>
#include <linux/slab.h>
@@ -1558,6 +1559,8 @@ static int io_submit_one(struct kiocx *ctx, struct iocb __user
*user_iocb,
{
    struct kiocb *req;
    struct file *file;
+ struct block_device *bdev;
+ struct inode *inode;
    ssize_t ret;

    /* enforce forwards compatibility on users */
@@ -1580,10 +1583,26 @@ static int io_submit_one(struct kiocx *ctx, struct iocb __user
*user_iocb,
    if (unlikely(!file))
        return -EBADF;

+ /*
+  * Pre-account AIO activity: we over-account *all* the bytes here;
+  * bytes read from the page cache and bytes written in already dirtied
+  * pages (that do not generate real i/o on block devices) will be
+  * subtracted later, following the path of aio_run_iocb().
+  */
+ inode = file->f_mapping->host;
+ bdev = inode->i_sb->s_bdev;
+ ret = cgroup_io_throttle(bdev, iocb->aio_nbytes, 0);
+ if (unlikely(ret)) {
+     fput(file);
+     ret = -EAGAIN;
+     goto out_cgroup_io_throttle;
+ }
+
    req = aio_get_req(ctx); /* returns with 2 references to req */
    if (unlikely(!req)) {
        fput(file);
-     return -EAGAIN;
+     ret = -EAGAIN;
    }

```

```

+ goto out_cgroup_io_throttle;
}
req->ki_filp = file;
if (iocb->aio_flags & IOCB_FLAG_RESFD) {
@@ -1622,12 +1641,14 @@ static int io_submit_one(struct kiocx *ctx, struct iocb __user
*user_iocb,
goto out_put_req;

spin_lock_irq(&ctx->ctx_lock);
+ set_in_aio();
aio_run_iocb(req);
if (!list_empty(&ctx->run_list)) {
/* drain the run list */
while (___aio_run_iocbs(ctx))
;
}
+ unset_in_aio();
spin_unlock_irq(&ctx->ctx_lock);
aio_put_req(req); /* drop extra ref to req */
return 0;
@@ -1635,6 +1656,8 @@ static int io_submit_one(struct kiocx *ctx, struct iocb __user
*user_iocb,
out_put_req:
aio_put_req(req); /* drop extra ref to req */
aio_put_req(req); /* drop i/o ref to req */
+out_cgroup_io_throttle:
+ cgroup_io_throttle(bdev, -iocb->aio_nbytes, 0);
return ret;
}

@@ -1746,6 +1769,12 @@ asmlinkage long sys_io_cancel(aio_context_t ctx_id, struct iocb
__user *iocb,
ret = -EAGAIN;
kiocb = lookup_kiocb(ctx, iocb, key);
if (kiocb && kiocb->ki_cancel) {
+ struct block_device *bdev;
+ struct inode *inode = kiocb->ki_filp->f_mapping->host;
+
+ bdev = inode->i_sb->s_bdev;
+ cgroup_io_throttle(bdev, -kiocb->ki_nbytes, 0);
+
cancel = kiocb->ki_cancel;
kiocb->ki_users ++;
kiocbSetCancelled(kiocb);
diff --git a/fs/buffer.c b/fs/buffer.c
index 4ffb5bb..6d4bf2c 100644
--- a/fs/buffer.c
+++ b/fs/buffer.c

```

```

@@ -35,6 +35,7 @@
#include <linux/suspend.h>
#include <linux/buffer_head.h>
#include <linux/task_io_accounting_ops.h>
+#include <linux/blk-io-throttle.h>
#include <linux/bio.h>
#include <linux/notifier.h>
#include <linux/cpu.h>
@@ -708,11 +709,14 @@ EXPORT_SYMBOL(mark_buffer_dirty_inode);
static int __set_page_dirty(struct page *page,
    struct address_space *mapping, int warn)
{
+ ssize_t cgroup_io_acct = 0;
+ int ret = 0;
+
    if (unlikely(!mapping))
        return !TestSetPageDirty(page);

    if (TestSetPageDirty(page))
- return 0;
+ goto out;

    spin_lock_irq(&mapping->tree_lock);
    if (page->mapping) { /* Race with truncate? */
@@ -723,14 +727,24 @@ static int __set_page_dirty(struct page *page,
    __inc_bdi_stat(mapping->backing_dev_info,
        BDI_RECLAIMABLE);
    task_io_account_write(PAGE_CACHE_SIZE);
+ cgroup_io_acct = PAGE_CACHE_SIZE;
    }
    radix_tree_tag_set(&mapping->page_tree,
        page_index(page), PAGECACHE_TAG_DIRTY);
    }
    spin_unlock_irq(&mapping->tree_lock);
    __mark_inode_dirty(mapping->host, I_DIRTY_PAGES);
-
- return 1;
+ ret = 1;
+out:
+ if (is_in_aio() && !cgroup_io_acct)
+ cgroup_io_acct = -PAGE_CACHE_SIZE;
+ if (cgroup_io_acct) {
+ struct block_device *bdev = (mapping->host &&
+ mapping->host->i_sb->s_bdev) ?
+ mapping->host->i_sb->s_bdev : NULL;
+ cgroup_io_throttle(bdev, cgroup_io_acct, 0);
+ }
+ return ret;

```

```

}

/*
diff --git a/fs/direct-io.c b/fs/direct-io.c
index 9606ee8..f5dcb91 100644
--- a/fs/direct-io.c
+++ b/fs/direct-io.c
@@ -35,6 +35,7 @@
#include <linux/buffer_head.h>
#include <linux/rwsem.h>
#include <linux/uio.h>
+#include <linux/blk-io-throttle.h>
#include <asm/atomic.h>

/*
@@ -660,6 +661,9 @@ submit_page_section(struct dio *dio, struct page *page,
/*
 * Read accounting is performed in submit_bio()
 */
+ struct block_device *bdev = dio->bio ?
+   dio->bio->bi_bdev : NULL;
+ cgroup_io_throttle(bdev, len, 1);
+   task_io_account_write(len);
+ }

diff --git a/include/linux/sched.h b/include/linux/sched.h
index ba43675..9d4c755 100644
--- a/include/linux/sched.h
+++ b/include/linux/sched.h
@@ -1250,6 +1250,9 @@ struct task_struct {
    u64 rchar, wchar, syscr, syscw;
#endif
    struct task_io_accounting ioac;
+#ifdef CONFIG_CGROUP_IO_THROTTLE
+ atomic_t in_aio;
+#endif
    #if defined(CONFIG_TASK_XACCT)
    u64 acct_rss_mem1; /* accumulated rss usage */
    u64 acct_vm_mem1; /* accumulated virtual memory usage */
diff --git a/kernel/fork.c b/kernel/fork.c
index aed1ff7..f8cf5da 100644
--- a/kernel/fork.c
+++ b/kernel/fork.c
@@ -1029,6 +1029,9 @@ static struct task_struct *copy_process(unsigned long clone_flags,
    task_io_accounting_init(p);
    acct_clear_integrals(p);

+#ifdef CONFIG_CGROUP_IO_THROTTLE

```

```

+ atomic_set(&p->in_aio, 0);
+#endif
  p->it_virt_expires = cputime_zero;
  p->it_prof_expires = cputime_zero;
  p->it_sched_expires = 0;
diff --git a/mm/filemap.c b/mm/filemap.c
index 7567d86..bb80789 100644
--- a/mm/filemap.c
+++ b/mm/filemap.c
@@ -13,6 +13,7 @@
#include <linux/slab.h>
#include <linux/compiler.h>
#include <linux/fs.h>
+#include <linux/blk-io-throttle.h>
#include <linux/uaccess.h>
#include <linux/aio.h>
#include <linux/capability.h>
@@ -1011,6 +1012,7 @@ static void do_generic_file_read(struct file *filp, loff_t *ppos,
  pgoff_t prev_index;
  unsigned long offset;    /* offset into pagecache page */
  unsigned int prev_offset;
+ int was_page_ok = 0;
  int error;

  index = *ppos >> PAGE_CACHE_SHIFT;
@@ -1023,7 +1025,8 @@ static void do_generic_file_read(struct file *filp, loff_t *ppos,
  struct page *page;
  pgoff_t end_index;
  loff_t isize;
- unsigned long nr, ret;
+ ssize_t nr;
+ unsigned long ret;

  cond_resched();
find_page:
@@ -1051,6 +1054,8 @@ find_page:
  desc, offset))
  goto page_not_up_to_date_locked;
  unlock_page(page);
+ } else {
+  was_page_ok = 1;
  }
page_ok:
/*
@@ -1080,6 +1085,17 @@ page_ok:
  }
  nr = nr - offset;

```

```

+ /*
+  * De-account i/o in case of AIO read from the page cache.
+  * AIO accounting was performed in io_submit_one().
+  */
+ if (is_in_aio() && was_page_ok) {
+   struct block_device *bdev = (inode &&
+   inode->i_sb->s_bdev) ?
+   inode->i_sb->s_bdev : NULL;
+   cgroup_io_throttle(bdev, -nr, 0);
+ }
+
+ /* If users can be writing to this page using arbitrary
+  * virtual addresses, take care about potential aliasing
+  * before reading the page on the kernel side.
diff --git a/mm/page-writeback.c b/mm/page-writeback.c
index 29b1d1e..c6207de 100644
--- a/mm/page-writeback.c
+++ b/mm/page-writeback.c
@@ -23,6 +23,7 @@
#include <linux/init.h>
#include <linux/backing-dev.h>
#include <linux/task_io_accounting_ops.h>
+#include <linux/blk-io-throttle.h>
#include <linux/blkdev.h>
#include <linux/mpage.h>
#include <linux/rmap.h>
@@ -430,6 +431,9 @@ static void balance_dirty_pages(struct address_space *mapping)
    unsigned long write_chunk = sync_writeback_pages();

    struct backing_dev_info *bdi = mapping->backing_dev_info;
+ struct block_device *bdev = (mapping->host &&
+ mapping->host->i_sb->s_bdev) ?
+ mapping->host->i_sb->s_bdev : NULL;

    for (;;) {
        struct writeback_control wbc = {
@@ -512,6 +516,14 @@ static void balance_dirty_pages(struct address_space *mapping)
        return; /* pdflush is already working this queue */

    /*
+  * Apply the cgroup i/o throttling limitations. The accounting of write
+  * activity in page cache is performed in __set_page_dirty(), but since
+  * we cannot sleep there, 0 bytes are accounted here and the function
+  * is invoked only for throttling purpose.
+  */
+ cgroup_io_throttle(bdev, 0, 1);
+
+ /*

```

\* In laptop mode, we wait until hitting the higher threshold before  
 \* starting background writeout, and then write out all the way down  
 \* to the lower threshold. So slow writers cause minimal disk activity.

```
@@ -1074,8 +1086,11 @@ int __set_page_dirty_no_writeback(struct page *page)
  */
```

```
int __set_page_dirty_nobuffers(struct page *page)
{
+ struct address_space *mapping = page_mapping(page);
+ ssize_t cgroup_io_acct = 0;
+ int ret = 0;
+
  if (!TestSetPageDirty(page)) {
- struct address_space *mapping = page_mapping(page);
  struct address_space *mapping2;
```

```

  if (!mapping)
@@ -1091,6 +1106,7 @@ int __set_page_dirty_nobuffers(struct page *page)
    __inc_bdi_stat(mapping->backing_dev_info,
      BDI_RECLAIMABLE);
    task_io_account_write(PAGE_CACHE_SIZE);
+   cgroup_io_acct = PAGE_CACHE_SIZE;
  }
  radix_tree_tag_set(&mapping->page_tree,
    page_index(page), PAGECACHE_TAG_DIRTY);
@@ -1100,9 +1116,17 @@ int __set_page_dirty_nobuffers(struct page *page)
    /* !PageAnon && !swapper_space */
    __mark_inode_dirty(mapping->host, I_DIRTY_PAGES);
  }
- return 1;
+ ret = 1;
  }
- return 0;
+ if (is_in_aio() && !cgroup_io_acct)
+   cgroup_io_acct = -PAGE_CACHE_SIZE;
+ if (cgroup_io_acct) {
+   struct block_device *bdev = (mapping->host &&
+     mapping->host->i_sb->s_bdev) ?
+     mapping->host->i_sb->s_bdev : NULL;
+   cgroup_io_throttle(bdev, cgroup_io_acct, 0);
+ }
+ return ret;
  }
  EXPORT_SYMBOL(__set_page_dirty_nobuffers);
```

```
diff --git a/mm/readahead.c b/mm/readahead.c
index 137bc56..448f065 100644
--- a/mm/readahead.c
+++ b/mm/readahead.c
```



@@ -14,6 +14,7 @@

```
#include <linux/blkdev.h>
#include <linux/backing-dev.h>
#include <linux/task_io_accounting_ops.h>
+#include <linux/blk-io-throttle.h>
#include <linux/pagevec.h>
#include <linux/pagemap.h>
```

@@ -58,6 +59,9 @@ int read\_cache\_pages(struct address\_space \*mapping, struct list\_head \*pages,

```
    int (*filler)(void *, struct page *), void *data)
{
    struct page *page;
+ struct block_device *bdev =
+ (mapping->host && mapping->host->i_sb->s_bdev) ?
+ mapping->host->i_sb->s_bdev : NULL;
    int ret = 0;
```

```
    while (!list_empty(pages)) {
@@ -76,6 +80,7 @@ int read_cache_pages(struct address_space *mapping, struct list_head *pages,
```

```
        break;
    }
    task_io_account_read(PAGE_CACHE_SIZE);
+ cgroup_io_throttle(bdev, PAGE_CACHE_SIZE, 1);
}
return ret;
}
```

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1.5.4.3

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