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Subject: Re: [RFC] [PATCH] memory controller statistics  
Posted by [yamamoto](#) on Thu, 04 Oct 2007 05:13:32 GMT  
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> hi,  
>  
> i implemented some statistics for your memory controller.  
>  
> it's tested with 2.6.23-rc2-mm2 + memory controller v7.  
> i think it can be applied to 2.6.23-rc4-mm1 as well.  
>  
> YAMOMOTO Takshi  
>  
> todo: something like nr\_active/inactive in /proc/vmstat.

here's the version i'm working on currently. any comments?

changes from the previous version:

- adapt to 2.6.23-rc8-mm2, container -> cgroup rename.
- reflect some of comments on this list.
- rename some macros as suggested by balbir
- sprinkle some inlines as suggested by balbir.
- remove "isolate" statistics
- remove PAGE\_CONTAINER\_CACHE hack and add "flags" member to page\_container instead.
- make counters atomic\_long\_t.
- add some comments.
- coding style.
- implement nr\_active/nr\_inactive. they show numbers of pages on per-cgroup lru lists.

todo:

- consider to make counters per-cpu.
- more statistics.

YAMAMOTO Takashi

```
--- linux-2.6.23-rc8-mm2-stat/mm/memcontrol.c.BACKUP 2007-10-01 17:19:57.000000000 +0900
+++ linux-2.6.23-rc8-mm2-stat/mm/memcontrol.c 2007-10-04 12:42:05.000000000 +0900
@@ -25,6 +25,7 @@
#include <linux/backing-dev.h>
#include <linux/bit_spinlock.h>
#include <linux/rcupdate.h>
+#include <linux/seq_file.h>
#include <linux/swap.h>
#include <linux/spinlock.h>
```

```

#include <linux/fs.h>
@@ -34,6 +35,52 @@
struct cgroup_subsys mem_cgroup_subsys;
static const int MEM_CGROUP_RECLAIM_RETRIES = 5;

+enum mem_cgroup_stat_index {
+ /*
+ * for MEM_CONTAINER_TYPE_ALL, usage == pagecache + rss
+ */
+ MEM_CGROUP_STAT_PAGECACHE, /* # of pages charged as cache */
+ MEM_CGROUP_STAT_RSS, /* # of pages charged as rss */
+
+ /*
+ * redundant; usage == charge - uncharge
+ */
+ MEM_CGROUP_STAT_CHARGE, /* # of pages charged */
+ MEM_CGROUP_STAT_UNCHARGE, /* # of pages uncharged */
+
+ MEM_CGROUP_STAT_ACTIVE, /* # of pages on active_list */
+ MEM_CGROUP_STAT_INACTIVE, /* # of pages on inactive_list */
+
+ MEM_CGROUP_STAT_NSTATS,
+};
+
+static const char * const mem_cgroup_stat_desc[] = {
+ [MEM_CGROUP_STAT_PAGECACHE] = "page_cache",
+ [MEM_CGROUP_STAT_RSS] = "rss",
+ [MEM_CGROUP_STAT_CHARGE] = "charge",
+ [MEM_CGROUP_STAT_UNCHARGE] = "uncharge",
+ [MEM_CGROUP_STAT_ACTIVE] = "nr_active",
+ [MEM_CGROUP_STAT_INACTIVE] = "nr_inactive",
+};
+
+struct mem_cgroup_stat {
+ atomic_long_t count[MEM_CGROUP_STAT_NSTATS];
+};
+
+static inline void mem_cgroup_stat_inc(struct mem_cgroup_stat * stat,
+ enum mem_cgroup_stat_index idx)
+{
+
+ atomic_long_inc(&stat->count[idx]);
+}
+
+static inline void mem_cgroup_stat_dec(struct mem_cgroup_stat * stat,
+ enum mem_cgroup_stat_index idx)
+{
+

```

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+ atomic_long_dec(&stat->count[idx]);
+}
+
+/*
+ * The memory controller data structure. The memory controller controls both
+ * page cache and RSS per cgroup. We would eventually like to provide
@@ -63,6 +110,11 @@ struct mem_cgroup {
+ */
+ spinlock_t lru_lock;
+ unsigned long control_type; /* control RSS or RSS+Pagecache */
+
+ /*
+ * statistics
+ */
+ struct mem_cgroup_stat stat;
+ };

+ /*
@@ -83,6 +135,9 @@ struct page_cgroup {
+ struct mem_cgroup *mem_cgroup;
+ atomic_t ref_cnt; /* Helpful when pages move b/w */
+ /* mapped and cached states */
+ int flags;
+ #define PCGF_PAGECACHE 1 /* charged as page cache */
+ #define PCGF_ACTIVE 2 /* on active_list */
+ };

+ enum {
@@ -164,10 +219,24 @@ static void __always_inline unlock_page_

+ static void __mem_cgroup_move_lists(struct page_cgroup *pc, bool active)
+ {
+ - if (active)
+ - list_move(&pc->lru, &pc->mem_cgroup->active_list);
+ - else
+ - list_move(&pc->lru, &pc->mem_cgroup->inactive_list);
+ + struct mem_cgroup *mem = pc->mem_cgroup;
+ + struct mem_cgroup_stat *stat = &mem->stat;
+ +
+ + if (active) {
+ + list_move(&pc->lru, &mem->active_list);
+ + if ((pc->flags & PCGF_ACTIVE) == 0) {
+ + mem_cgroup_stat_dec(stat, MEM_CGROUP_STAT_INACTIVE);
+ + mem_cgroup_stat_inc(stat, MEM_CGROUP_STAT_ACTIVE);
+ + pc->flags |= PCGF_ACTIVE;
+ + }
+ + } else {
+ + list_move(&pc->lru, &mem->inactive_list);

```

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+ if ((pc->flags & PCGF_ACTIVE) != 0) {
+ mem_cgroup_stat_dec(stat, MEM_CGROUP_STAT_ACTIVE);
+ mem_cgroup_stat_inc(stat, MEM_CGROUP_STAT_INACTIVE);
+ pc->flags &= ~PCGF_ACTIVE;
+ }
+ }
}

/*
@@ -256,10 +325,11 @@ unsigned long mem_cgroup_isolate_pages(u
 * 0 if the charge was successful
 * < 0 if the cgroup is over its limit
 */
-int mem_cgroup_charge(struct page *page, struct mm_struct *mm,
- gfp_t gfp_mask)
+int mem_cgroup_charge_common(struct page *page, struct mm_struct *mm,
+ gfp_t gfp_mask, int is_cache)
{
    struct mem_cgroup *mem;
+ struct mem_cgroup_stat *stat;
    struct page_cgroup *pc, *race_pc;
    unsigned long flags;
    unsigned long nr_retries = MEM_CGROUP_RECLAIM_RETRIES;
@@ -365,8 +435,17 @@ noreclaim:
    atomic_set(&pc->ref_cnt, 1);
    pc->mem_cgroup = mem;
    pc->page = page;
+ pc->flags = (is_cache ? PCGF_PAGECACHE : 0) | PCGF_ACTIVE;
    page_assign_page_cgroup(page, pc);

+ stat = &mem->stat;
+ if (is_cache)
+ mem_cgroup_stat_inc(stat, MEM_CGROUP_STAT_PAGECACHE);
+ else
+ mem_cgroup_stat_inc(stat, MEM_CGROUP_STAT_RSS);
+ mem_cgroup_stat_inc(stat, MEM_CGROUP_STAT_CHARGE);
+ mem_cgroup_stat_inc(stat, MEM_CGROUP_STAT_ACTIVE);
+
    spin_lock_irqsave(&mem->lru_lock, flags);
    list_add(&pc->lru, &mem->active_list);
    spin_unlock_irqrestore(&mem->lru_lock, flags);
@@ -382,6 +461,14 @@ err:
    return -ENOMEM;
}

+int mem_cgroup_charge(struct page *page, struct mm_struct *mm,
+ gfp_t gfp_mask)
+{

```

```

+
+ return mem_cgroup_charge_common(page, mm, gfp_mask, 0);
+}
+
+
+/*
+ * See if the cached pages should be charged at all?
+ */
@@ -394,7 +481,7 @@ int mem_cgroup_cache_charge(struct page

    mem = rcu_dereference(mm->mem_cgroup);
    if (mem->control_type == MEM_CGROUP_TYPE_ALL)
- return mem_cgroup_charge(page, mm, gfp_mask);
+ return mem_cgroup_charge_common(page, mm, gfp_mask, 1);
    else
        return 0;
}
@@ -417,7 +504,11 @@ void mem_cgroup_uncharge(struct page_cgr
    return;

    if (atomic_dec_and_test(&pc->ref_cnt)) {
+ struct mem_cgroup_stat *stat;
+ int is_cache;
+
    page = pc->page;
+ is_cache = (pc->flags & PCGF_PAGECACHE) != 0;
    lock_page_cgroup(page);
    mem = pc->mem_cgroup;
    css_put(&mem->css);
@@ -425,7 +516,19 @@ void mem_cgroup_uncharge(struct page_cgr
    unlock_page_cgroup(page);
    res_counter_uncharge(&mem->res, PAGE_SIZE);

+ stat = &mem->stat;
+ if (is_cache)
+ mem_cgroup_stat_dec(stat, MEM_CGROUP_STAT_PAGECACHE);
+ else
+ mem_cgroup_stat_dec(stat, MEM_CGROUP_STAT_RSS);
+ mem_cgroup_stat_inc(stat, MEM_CGROUP_STAT_UNCHARGE);
+ if ((pc->flags & PCGF_ACTIVE) != 0)
+ mem_cgroup_stat_dec(stat, MEM_CGROUP_STAT_ACTIVE);
+ else
+ mem_cgroup_stat_dec(stat, MEM_CGROUP_STAT_INACTIVE);
+
    spin_lock_irqsave(&mem->lru_lock, flags);
+ BUG_ON(list_empty(&pc->lru));
    list_del_init(&pc->lru);
    spin_unlock_irqrestore(&mem->lru_lock, flags);

```

```

    kfree(pc);
@@ -517,6 +620,43 @@ static ssize_t mem_control_type_read(str
    ppos, buf, s - buf);
}

+static void mem_cgroup_stat_init(struct mem_cgroup_stat *stat)
+{
+ int i;
+
+ for (i = 0; i < ARRAY_SIZE(stat->count); i++)
+ atomic_long_set(&stat->count[i], 0);
+}
+
+static int mem_control_stat_show(struct seq_file *m, void *arg)
+{
+ struct cgroup *cont = m->private;
+ struct mem_cgroup *mem_cont = mem_cgroup_from_cont(cont);
+ struct mem_cgroup_stat *stat = &mem_cont->stat;
+ int i;
+
+ for (i = 0; i < ARRAY_SIZE(stat->count); i++)
+ seq_printf(m, "%s %u\n", mem_cgroup_stat_desc[i],
+ (unsigned int)atomic_long_read(&stat->count[i]));
+
+ return 0;
+}
+
+static const struct file_operations mem_control_stat_file_operations = {
+ .read = seq_read,
+ .llseek = seq_lseek,
+ .release = single_release,
+};
+
+static int mem_control_stat_open(struct inode *unused, struct file *file)
+{
+ /* XXX __d_cont */
+ struct cgroup *cont = file->f_dentry->d_parent->d_fsdata;
+
+ file->f_op = &mem_control_stat_file_operations;
+ return single_open(file, mem_control_stat_show, cont);
+}
+
+static struct cftype mem_cgroup_files[] = {
+ {
+ .name = "usage_in_bytes",
@@ -539,6 +679,10 @@ static struct cftype mem_cgroup_files[]
+ .write = mem_control_type_write,
+ .read = mem_control_type_read,

```

```
    },
+ {
+   .name = "stat",
+   .open = mem_control_stat_open,
+ },
};

static struct mem_cgroup init_mem_cgroup;
@@ -562,6 +706,7 @@ mem_cgroup_create(struct cgroup_subsys *
    INIT_LIST_HEAD(&mem->inactive_list);
    spin_lock_init(&mem->lru_lock);
    mem->control_type = MEM_CGROUP_TYPE_ALL;
+ mem_cgroup_stat_init(&mem->stat);
    return &mem->css;
}
```

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Containers mailing list  
Containers@lists.linux-foundation.org  
<https://lists.linux-foundation.org/mailman/listinfo/containers>

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