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Subject: [PATCH][for -mm] Fix and Enhancements for memory cgroup [5/6] memory cgroup and migration fix

Posted by [KAMEZAWA Hiroyuki](#) on Tue, 09 Oct 2007 09:54:31 GMT

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While using memory control cgroup, page-migration under it works as following.

==

1. uncharge all refs at try to unmap.
2. charge regs again remove\_migration\_ptes()

==

This is simple but has following problems.

==

The page is uncharged and chaged back again if \*mapped\*.

- This means that cgroup before migraion can be different from one after migraion
- If page is not mapped but charged as page cache, charge is just ignored (because not mapped, it will not be uncharged before migration)  
This is memory leak.

==

This patch tries to keep memory cgroup at page migration by increasing one refcnt during it. 3 functions are added.

```
mem_cgroup_prepare_migration() --- increase refcnt of page->page_cgroup
mem_cgroup_end_migration()    --- decrease refcnt of page->page_cgroup
mem_cgroup_page_migration() --- copy page->page_cgroup from old page to
                             new page.
```

During migration

- old page is under PG\_locked.
- new page is under PG\_locked, too.
- both old page and new page are not on LRU.

These 3 facts guarantees page\_cgroup() migration has no race, I think.

Tested and worked well in x86\_64/fake-NUMA box.

Changelog v1 -> v2:

- reflected comments.
- divided a patche to !PageLRU patch and migration patch.

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```
include/linux/memcontrol.h | 19 ++++++
mm/memcontrol.c             | 43 ++++++
mm/migrate.c                | 14 ++++++
3 files changed, 73 insertions(+), 3 deletions(-)
```

Index: devel-2.6.23-rc8-mm2/mm/migrate.c

```
=====
--- devel-2.6.23-rc8-mm2.orig/mm/migrate.c
+++ devel-2.6.23-rc8-mm2/mm/migrate.c
@@ -598,9 +598,10 @@ static int move_to_new_page(struct page
     else
         rc = fallback_migrate_page(mapping, newpage, page);

- if (!rc)
+ if (!rc) {
+     mem_cgroup_page_migration(page, newpage);
+     remove_migration_ptes(page, newpage);
- else
+ } else
+     newpage->mapping = NULL;

    unlock_page(newpage);
@@ -619,6 +620,7 @@ static int unmap_and_move(new_page_t get
    int *result = NULL;
    struct page *newpage = get_new_page(page, private, &result);
    int rcu_locked = 0;
+ int charge = 0;

    if (!newpage)
        return -ENOMEM;
@@ -660,14 +662,20 @@ static int unmap_and_move(new_page_t get
    */
    if (!page->mapping)
        goto rcu_unlock;
+
+ charge = mem_cgroup_prepare_migration(page);
+ /* Establish migration ptes or remove ptes */
+ try_to_unmap(page, 1);

    if (!page_mapped(page))
        rc = move_to_new_page(newpage, page);

- if (rc)
+ if (rc) {
+     remove_migration_ptes(page, page);
+     if (charge)
+         mem_cgroup_end_migration(page);
+ } else if (charge)
+     mem_cgroup_end_migration(newpage);
    rcu_unlock;
    if (rcu_locked)
        rcu_read_unlock();
```

Index: devel-2.6.23-rc8-mm2/include/linux/memcontrol.h

```
=====
--- devel-2.6.23-rc8-mm2.orig/include/linux/memcontrol.h
+++ devel-2.6.23-rc8-mm2/include/linux/memcontrol.h
@@ -56,6 +56,10 @@ static inline void mem_cgroup_uncharge_p
    mem_cgroup_uncharge(page_get_page_cgroup(page));
}

+extern int mem_cgroup_prepare_migration(struct page *page);
+extern void mem_cgroup_end_migration(struct page *page);
+extern void mem_cgroup_page_migration(struct page *page, struct page *newpage);
+
#else /* CONFIG_CGROUP_MEM_CONT */
static inline void mm_init_cgroup(struct mm_struct *mm,
    struct task_struct *p)
@@ -107,6 +111,21 @@ static inline struct mem_cgroup *mm_cgro
    return NULL;
}

+static inline int mem_cgroup_prepare_migration(struct page *page)
+{
+ return 0;
+}
+
+static inline void mem_cgroup_end_migration(struct page *page)
+{
+}
+
+static inline void
+mem_cgroup_page_migration(struct page *page, struct page *newpage);
+{
+}
+
#endif /* CONFIG_CGROUP_MEM_CONT */

#endif /* _LINUX_MEMCONTROL_H */
```

Index: devel-2.6.23-rc8-mm2/mm/memcontrol.c

```
=====
--- devel-2.6.23-rc8-mm2.orig/mm/memcontrol.c
+++ devel-2.6.23-rc8-mm2/mm/memcontrol.c
@@ -463,6 +463,49 @@ void mem_cgroup_uncharge(struct page_cgr
    }
}

+/*
+ * Returns non-zero if a page (under migration) has valid page_cgroup member.
+ * Refcnt of page_cgroup is incremented.
+ */
```

```

+ */
+
+int mem_cgroup_prepare_migration(struct page *page)
+{
+ struct page_cgroup *pc;
+ int ret = 0;
+ lock_page_cgroup(page);
+ pc = page_get_page_cgroup(page);
+ if (pc && atomic_inc_not_zero(&pc->ref_cnt))
+ ret = 1;
+ unlock_page_cgroup(page);
+ return ret;
+}
+
+void mem_cgroup_end_migration(struct page *page)
+{
+ struct page_cgroup *pc = page_get_page_cgroup(page);
+ mem_cgroup_uncharge(pc);
+}
+/*
+ * We know both *page* and *newpage* are now not-on-LRU and Pg_locked.
+ * And no race with uncharge() routines because page_cgroup for *page*
+ * has extra one reference by mem_cgroup_prepare_migration.
+ */
+
+void mem_cgroup_page_migration(struct page *page, struct page *newpage)
+{
+ struct page_cgroup *pc;
+retry:
+ pc = page_get_page_cgroup(page);
+ if (!pc)
+ return;
+ if (clear_page_cgroup(page, pc) != pc)
+ goto retry;
+ pc->page = newpage;
+ lock_page_cgroup(newpage);
+ page_assign_page_cgroup(newpage, pc);
+ unlock_page_cgroup(newpage);
+ return;
+}

int mem_cgroup_write_strategy(char *buf, unsigned long long *tmp)
{

```