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Subject: [PATCH][for -mm] per-zone and reclaim enhancements for memory controller take 3 [3/10] per-zone acti

Posted by [KAMEZAWA Hiroyuki](#) on Tue, 27 Nov 2007 03:00:48 GMT

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Counting active/inactive per-zone in memory controller.

This patch adds per-zone status in memory cgroup.

These values are often read (as per-zone value) by page reclaiming.

In current design, per-zone stat is just a unsigned long value and not an atomic value because they are modified only under lru\_lock. (So, atomic\_ops is not necessary.)

This patch adds ACTIVE and INACTIVE per-zone status values.

For handling per-zone status, this patch adds

```
struct mem_cgroup_per_zone {  
    ...  
}
```

and some helper functions. This will be useful to add per-zone objects in mem\_cgroup.

This patch turns memory controller's early\_init to be 0 for calling kmalloc() in initialization.

Changelog V2 -> V3

- fixed comments.

Changelog V1 -> V2

- added mem\_cgroup\_per\_zone struct.  
This will help following patches to implement per-zone objects and pack them into a struct.
- added \_\_mem\_cgroup\_add\_list() and \_\_mem\_cgroup\_remove\_list()
- fixed page migration handling.
- renamed zstat to info (per-zone-info)  
This will be place for per-zone information(lru, lock, ..)
- use page\_cgroup\_nid()/zid() funcs.

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mm/memcontrol.c | 164 +++++  
1 file changed, 157 insertions(+), 7 deletions(-)

Index: linux-2.6.24-rc3-mm1/mm/memcontrol.c

```

--- linux-2.6.24-rc3-mm1.orig/mm/memcontrol.c 2007-11-26 16:39:00.000000000 +0900
+++ linux-2.6.24-rc3-mm1/mm/memcontrol.c 2007-11-26 16:39:02.000000000 +0900
@@ -78,6 +78,31 @@
}

/*
+ * per-zone information in memory controller.
+ */
+
+enum mem_cgroup_zstat_index {
+ MEM_CGROUP_ZSTAT_ACTIVE,
+ MEM_CGROUP_ZSTAT_INACTIVE,
+
+ NR_MEM_CGROUP_ZSTAT,
+};
+
+struct mem_cgroup_per_zone {
+ unsigned long count[NR_MEM_CGROUP_ZSTAT];
+};
+/* Macro for accessing counter */
+#define MEM_CGROUP_ZSTAT(mz, idx) ((mz)->count[(idx)])
+
+struct mem_cgroup_per_node {
+ struct mem_cgroup_per_zone zoneinfo[MAX_NR_ZONES];
+};
+
+struct mem_cgroup_lru_info {
+ struct mem_cgroup_per_node *nodeinfo[MAX_NUMNODES];
+};
+
+/*
+ * The memory controller data structure. The memory controller controls both
+ * page cache and RSS per cgroup. We would eventually like to provide
+ * statistics based on the statistics developed by Rik Van Riel for clock-pro,
@@ -101,6 +126,7 @@
*/
struct list_head active_list;
struct list_head inactive_list;
+ struct mem_cgroup_lru_info info;
/*
+ * spin_lock to protect the per cgroup LRU
+ */
@@ -158,6 +184,7 @@
MEM_CGROUP_CHARGE_TYPE_MAPPED,
};

+
+/*

```

```

* Always modified under lru lock. Then, not necessary to preempt_disable()
*/
@@ -173,7 +200,39 @@
    MEM_CGROUP_STAT_CACHE, val);
else
    __mem_cgroup_stat_add_safe(stat, MEM_CGROUP_STAT_RSS, val);
+}

+static inline struct mem_cgroup_per_zone *
+mem_cgroup_zoneinfo(struct mem_cgroup *mem, int nid, int zid)
+{
+ if (!mem->info.nodeinfo[nid])
+ return NULL;
+ return &mem->info.nodeinfo[nid]->zoneinfo[zid];
+}
+
+static inline struct mem_cgroup_per_zone *
+page_cgroup_zoneinfo(struct page_cgroup *pc)
+{
+ struct mem_cgroup *mem = pc->mem_cgroup;
+ int nid = page_cgroup_nid(pc);
+ int zid = page_cgroup_zid(pc);
+
+ return mem_cgroup_zoneinfo(mem, nid, zid);
+}
+
+static unsigned long mem_cgroup_get_all_zonestat(struct mem_cgroup *mem,
+ enum mem_cgroup_zstat_index idx)
+{
+ int nid, zid;
+ struct mem_cgroup_per_zone *mz;
+ u64 total = 0;
+
+ for_each_online_node(nid)
+ for (zid = 0; zid < MAX_NR_ZONES; zid++) {
+ mz = mem_cgroup_zoneinfo(mem, nid, zid);
+ total += MEM_CGROUP_ZSTAT(mz, idx);
+ }
+ return total;
+}

static struct mem_cgroup init_mem_cgroup;
@@ -286,12 +345,51 @@
    return ret;
}

+static void __mem_cgroup_remove_list(struct page_cgroup *pc)
+{

```

```

+ int from = pc->flags & PAGE_CGROUP_FLAG_ACTIVE;
+ struct mem_cgroup_per_zone *mz = page_cgroup_zoneinfo(pc);
+
+ if (from)
+ MEM_CGROUP_ZSTAT(mz, MEM_CGROUP_ZSTAT_ACTIVE) -= 1;
+ else
+ MEM_CGROUP_ZSTAT(mz, MEM_CGROUP_ZSTAT_INACTIVE) -= 1;
+
+ mem_cgroup_charge_statistics(pc->mem_cgroup, pc->flags, false);
+ list_del_init(&pc->lru);
+}
+
+static void __mem_cgroup_add_list(struct page_cgroup *pc)
+{
+ int to = pc->flags & PAGE_CGROUP_FLAG_ACTIVE;
+ struct mem_cgroup_per_zone *mz = page_cgroup_zoneinfo(pc);
+
+ if (!to) {
+ MEM_CGROUP_ZSTAT(mz, MEM_CGROUP_ZSTAT_INACTIVE) += 1;
+ list_add(&pc->lru, &pc->mem_cgroup->inactive_list);
+ } else {
+ MEM_CGROUP_ZSTAT(mz, MEM_CGROUP_ZSTAT_ACTIVE) += 1;
+ list_add(&pc->lru, &pc->mem_cgroup->active_list);
+ }
+ mem_cgroup_charge_statistics(pc->mem_cgroup, pc->flags, true);
+}
+
+static void __mem_cgroup_move_lists(struct page_cgroup *pc, bool active)
+{
+ int from = pc->flags & PAGE_CGROUP_FLAG_ACTIVE;
+ struct mem_cgroup_per_zone *mz = page_cgroup_zoneinfo(pc);
+
+ if (from)
+ MEM_CGROUP_ZSTAT(mz, MEM_CGROUP_ZSTAT_ACTIVE) -= 1;
+ else
+ MEM_CGROUP_ZSTAT(mz, MEM_CGROUP_ZSTAT_INACTIVE) -= 1;
+
+ if (active) {
+ MEM_CGROUP_ZSTAT(mz, MEM_CGROUP_ZSTAT_ACTIVE) += 1;
+ pc->flags |= PAGE_CGROUP_FLAG_ACTIVE;
+ list_move(&pc->lru, &pc->mem_cgroup->active_list);
+ } else {
+ MEM_CGROUP_ZSTAT(mz, MEM_CGROUP_ZSTAT_INACTIVE) += 1;
+ pc->flags &= ~PAGE_CGROUP_FLAG_ACTIVE;
+ list_move(&pc->lru, &pc->mem_cgroup->inactive_list);
+ }
+}
@@ -511,8 +609,7 @@

```

```

spin_lock_irqsave(&mem->lru_lock, flags);
/* Update statistics vector */
- mem_cgroup_charge_statistics(mem, pc->flags, true);
- list_add(&pc->lru, &mem->active_list);
+ __mem_cgroup_add_list(pc);
spin_unlock_irqrestore(&mem->lru_lock, flags);

done:
@@ -576,13 +673,13 @@
css_put(&mem->css);
res_counter_uncharge(&mem->res, PAGE_SIZE);
spin_lock_irqsave(&mem->lru_lock, flags);
- list_del_init(&pc->lru);
- mem_cgroup_charge_statistics(mem, pc->flags, false);
+ __mem_cgroup_remove_list(pc);
spin_unlock_irqrestore(&mem->lru_lock, flags);
kfree(pc);
}
}
}
+
/*
 * Returns non-zero if a page (under migration) has valid page_cgroup member.
 * Refcnt of page_cgroup is incremented.
@@ -614,16 +711,26 @@
void mem_cgroup_page_migration(struct page *page, struct page *newpage)
{
struct page_cgroup *pc;
+ struct mem_cgroup *mem;
+ unsigned long flags;
retry:
pc = page_get_page_cgroup(page);
if (!pc)
return;
+ mem = pc->mem_cgroup;
if (clear_page_cgroup(page, pc) != pc)
goto retry;
+
+ spin_lock_irqsave(&mem->lru_lock, flags);
+
+ __mem_cgroup_remove_list(pc);
pc->page = newpage;
lock_page_cgroup(newpage);
page_assign_page_cgroup(newpage, pc);
unlock_page_cgroup(newpage);
+ __mem_cgroup_add_list(pc);
+
+ spin_unlock_irqrestore(&mem->lru_lock, flags);

```

```

return;
}

@@ -651,10 +758,11 @@
/* Avoid race with charge */
atomic_set(&pc->ref_cnt, 0);
if (clear_page_cgrouper(page, pc) == pc) {
+ int active;
css_put(&mem->css);
+ active = pc->flags & PAGE_CGROUP_FLAG_ACTIVE;
res_counter_uncharge(&mem->res, PAGE_SIZE);
- list_del_init(&pc->lru);
- mem_cgroup_charge_statistics(mem, pc->flags, false);
+ __mem_cgroup_remove_list(pc);
kfree(pc);
} else /* being uncharged ? ...do relax */
break;
@@ -833,6 +941,17 @@
seq_printf(m, "%s %lld\n", mem_cgroup_stat_desc[i].msg,
(long long)val);
}
+ /* showing # of active pages */
+ {
+ unsigned long active, inactive;
+
+ inactive = mem_cgroup_get_all_zonestat(mem_cont,
+ MEM_CGROUP_ZSTAT_INACTIVE);
+ active = mem_cgroup_get_all_zonestat(mem_cont,
+ MEM_CGROUP_ZSTAT_ACTIVE);
+ seq_printf(m, "active %ld\n", (active) * PAGE_SIZE);
+ seq_printf(m, "inactive %ld\n", (inactive) * PAGE_SIZE);
+ }
return 0;
}

```

```

@@ -886,12 +1005,25 @@
},
};

```

```

+static int alloc_mem_cgroup_per_zone_info(struct mem_cgroup *mem, int node)
+{
+ struct mem_cgroup_per_node *pn;
+
+ pn = kmalloc_node(sizeof(*pn), GFP_KERNEL, node);
+ if (!pn)
+ return 1;
+ mem->info.nodeinfo[node] = pn;
+ memset(pn, 0, sizeof(*pn));

```

```

+ return 0;
+}
+
static struct mem_cgroup init_mem_cgroup;

static struct cgroup_subsys_state *
mem_cgroup_create(struct cgroup_subsys *ss, struct cgroup *cont)
{
    struct mem_cgroup *mem;
+ int node;

    if (unlikely((cont->parent) == NULL)) {
        mem = &init_mem_cgroup;
@@ -907,7 +1039,19 @@
        INIT_LIST_HEAD(&mem->inactive_list);
        spin_lock_init(&mem->lru_lock);
        mem->control_type = MEM_CGROUP_TYPE_ALL;
+ memset(&mem->info, 0, sizeof(mem->info));
+
+ for_each_node_state(node, N_POSSIBLE)
+ if (alloc_mem_cgroup_per_zone_info(mem, node))
+ goto free_out;
+
    return &mem->css;
+free_out:
+ for_each_node_state(node, N_POSSIBLE)
+ kfree(mem->info.nodeinfo[node]);
+ if (cont->parent != NULL)
+ kfree(mem);
+ return NULL;
    }

static void mem_cgroup_pre_destroy(struct cgroup_subsys *ss,
@@ -920,6 +1064,12 @@
static void mem_cgroup_destroy(struct cgroup_subsys *ss,
    struct cgroup *cont)
{
+ int node;
+ struct mem_cgroup *mem = mem_cgroup_from_cont(cont);
+
+ for_each_node_state(node, N_POSSIBLE)
+ kfree(mem->info.nodeinfo[node]);
+
    kfree(mem_cgroup_from_cont(cont));
}

@@ -972,5 +1122,5 @@
    .destroy = mem_cgroup_destroy,

```

```
.populate = mem_cgroup_populate,  
.attach = mem_cgroup_move_task,  
- .early_init = 1,  
+ .early_init = 0,  
};
```

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Containers mailing list

Containers@lists.linux-foundation.org

<https://lists.linux-foundation.org/mailman/listinfo/containers>

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