
Subject: Re: [RFC] [PATCH] memory controller background reclamation

Posted by [yamamoto](#) on Mon, 26 Nov 2007 23:46:19 GMT

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> Using numbers like 128 make the code unreadable. I prefer something
> like MEM_CGROUP_BATCH_COUNT since its more readable than 128. If we ever
> propagate batch_count to other dependent functions, I'd much rather do
> it with a well defined name.

here's a new version.

changes from the previous:

- define a constant. (MEM_CGROUP_BG_RECLAIM_BATCH_COUNT)
no functional changes.
- don't increment ALLOCSTALL vm event for mem cgroup because
it isn't appropriate esp. for background reclamation.
introduce MEM_CGROUP_STAT_ALLOCSTALL instead.
(its value is same as memory.failcnt unless GFP_ATOMIC.)

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```
--- linux-2.6.24-rc2-mm1-kame-pd/include/linux/res_counter.h.BACKUP 2007-11-14
16:05:48.000000000 +0900
+++ linux-2.6.24-rc2-mm1-kame-pd/include/linux/res_counter.h 2007-11-22 15:14:32.000000000
+0900
@@ -32,6 +32,13 @@ struct res_counter {
    * the number of unsuccessful attempts to consume the resource
    */
    unsigned long long failcnt;
+
+ /*
+  * watermarks
+  */
+ unsigned long long high_watermark;
+ unsigned long long low_watermark;
+
+ /*
+  * the lock to protect all of the above.
+  * the routines below consider this to be IRQ-safe
@@ -66,6 +73,8 @@ enum {
    RES_USAGE,
    RES_LIMIT,
    RES_FAILCNT,
+ RES_HIGH_WATERMARK,
```

```

+ RES_LOW_WATERMARK,
};

/*
@@ -124,4 +133,26 @@ static inline bool res_counter_check_and
    return ret;
}

+static inline bool res_counter_below_low_watermark(struct res_counter *cnt)
+{
+ bool ret;
+ unsigned long flags;
+
+ spin_lock_irqsave(&cnt->lock, flags);
+ ret = cnt->usage < cnt->low_watermark;
+ spin_unlock_irqrestore(&cnt->lock, flags);
+ return ret;
+}
+
+static inline bool res_counter_above_high_watermark(struct res_counter *cnt)
+{
+ bool ret;
+ unsigned long flags;
+
+ spin_lock_irqsave(&cnt->lock, flags);
+ ret = cnt->usage > cnt->high_watermark;
+ spin_unlock_irqrestore(&cnt->lock, flags);
+ return ret;
+}
+
#endif
--- linux-2.6.24-rc2-mm1-kame-pd/kernel/res_counter.c.BACKUP 2007-11-14
16:05:52.000000000 +0900
+++ linux-2.6.24-rc2-mm1-kame-pd/kernel/res_counter.c 2007-11-22 15:14:32.000000000 +0900
@@ -17,6 +17,8 @@ void res_counter_init(struct res_counter
{
    spin_lock_init(&counter->lock);
    counter->limit = (unsigned long long)LLONG_MAX;
+ counter->high_watermark = (unsigned long long)LLONG_MAX;
+ counter->low_watermark = (unsigned long long)LLONG_MAX;
}

int res_counter_charge_locked(struct res_counter *counter, unsigned long val)
@@ -69,6 +71,10 @@ res_counter_member(struct res_counter *c
    return &counter->limit;
    case RES_FAILCNT:
        return &counter->failcnt;
+ case RES_HIGH_WATERMARK:

```

```

+ return &counter->high_watermark;
+ case RES_LOW_WATERMARK:
+ return &counter->low_watermark;
+ };

BUG();
@@ -99,6 +105,7 @@ ssize_t res_counter_write(struct res_cou
    int ret;
    char *buf, *end;
    unsigned long long tmp, *val;
+ unsigned long flags;

    buf = kmalloc(nbytes + 1, GFP_KERNEL);
    ret = -ENOMEM;
@@ -122,9 +129,29 @@ ssize_t res_counter_write(struct res_cou
    goto out_free;
}

+ spin_lock_irqsave(&counter->lock, flags);
+ val = res_counter_member(counter, member);
+ /* ensure low_watermark <= high_watermark <= limit */
+ switch (member) {
+ case RES_LIMIT:
+ if (tmp < counter->high_watermark)
+ goto out_locked;
+ break;
+ case RES_HIGH_WATERMARK:
+ if (tmp > counter->limit || tmp < counter->low_watermark)
+ goto out_locked;
+ break;
+ case RES_LOW_WATERMARK:
+ if (tmp > counter->high_watermark)
+ goto out_locked;
+ break;
+ }
+ *val = tmp;
+ BUG_ON(counter->high_watermark > counter->limit);
+ BUG_ON(counter->low_watermark > counter->high_watermark);
+ ret = nbytes;
+out_locked:
+ spin_unlock_irqrestore(&counter->lock, flags);
+out_free:
+ kfree(buf);
+out:
--- linux-2.6.24-rc2-mm1-kame-pd/mm/vmscan.c.BACKUP 2007-11-20 13:11:09.000000000
+0900
+++ linux-2.6.24-rc2-mm1-kame-pd/mm/vmscan.c 2007-11-27 08:09:51.000000000 +0900
@@ -1333,7 +1333,6 @@ static unsigned long do_try_to_free_page

```

```

unsigned long lru_pages = 0;
int i;

- count_vm_event(ALLOCSTALL);
/*
 * mem_cgroup will not do shrink_slab.
 */
@@ -1432,6 +1431,7 @@ unsigned long try_to_free_pages(struct z
    .isolate_pages = isolate_pages_global,
};

+ count_vm_event(ALLOCSTALL);
return do_try_to_free_pages(zones, gfp_mask, &sc);
}

--- linux-2.6.24-rc2-mm1-kame-pd/mm/memcontrol.c.BACKUP 2007-11-20 13:11:09.000000000
+0900
+++ linux-2.6.24-rc2-mm1-kame-pd/mm/memcontrol.c 2007-11-27 08:27:10.000000000 +0900
@@ -28,6 +28,7 @@
#include <linux/rcupdate.h>
#include <linux/swap.h>
#include <linux/spinlock.h>
+#include <linux/workqueue.h>
#include <linux/fs.h>
#include <linux/seq_file.h>

@@ -35,6 +36,7 @@

struct cgroup_subsys mem_cgroup_subsys;
static const int MEM_CGROUP_RECLAIM_RETRIES = 5;
+static const int MEM_CGROUP_BG_RECLAIM_BATCH_COUNT = 128; /* XXX arbitrary */

/*
 * Statistics for memory cgroup.
@@ -45,6 +47,7 @@ enum mem_cgroup_stat_index {
/*
MEM_CGROUP_STAT_CACHE, /* # of pages charged as cache */
MEM_CGROUP_STAT_RSS, /* # of pages charged as rss */
+ MEM_CGROUP_STAT_ALLOCSTALL, /* allocation stalled due to memory.limit */

MEM_CGROUP_STAT_NSTATS,
};
@@ -138,6 +141,10 @@ struct mem_cgroup {
 * statistics.
 */
struct mem_cgroup_stat stat;
+ /*
+ * background reclamation.

```

```

+ */
+ struct work_struct reclaim_work;
+ };

/*
@@ -240,6 +247,21 @@ static unsigned long mem_cgroup_get_all_

static struct mem_cgroup init_mem_cgroup;

+static DEFINE_MUTEX(mem_cgroup_workqueue_init_lock);
+static struct workqueue_struct *mem_cgroup_workqueue;
+
+static void mem_cgroup_create_workqueue(void)
+{
+
+ if (mem_cgroup_workqueue != NULL)
+ return;
+
+ mutex_lock(&mem_cgroup_workqueue_init_lock);
+ if (mem_cgroup_workqueue == NULL)
+ mem_cgroup_workqueue = create_workqueue("mem_cgroup");
+ mutex_unlock(&mem_cgroup_workqueue_init_lock);
+}
+
static inline
struct mem_cgroup *mem_cgroup_from_cont(struct cgroup *cont)
{
@@ -566,6 +588,45 @@ unsigned long mem_cgroup_isolate_pages(u
return nr_taken;
}

+static void
+mem_cgroup_schedule_reclaim(struct mem_cgroup *mem)
+{
+
+ if (mem_cgroup_workqueue == NULL) {
+ BUG_ON(mem->css.cgroup->parent != NULL);
+ return;
+ }
+
+ if (work_pending(&mem->reclaim_work))
+ return;
+
+ css_get(&mem->css); /* XXX need some thoughts wrt cgroup removal. */
+ /*
+ * XXX workqueue is not an ideal mechanism for our purpose.
+ * revisit later.
+ */

```

```

+ if (!queue_work(mem_cgroup_workqueue, &mem->reclaim_work))
+ css_put(&mem->css);
+}
+
+static void
+mem_cgroup_reclaim(struct work_struct *work)
+{
+ struct mem_cgroup * const mem =
+ container_of(work, struct mem_cgroup, reclaim_work);
+ int batch_count = MEM_CGROUP_BG_RECLAIM_BATCH_COUNT;
+
+ for (; batch_count > 0; batch_count--) {
+ if (res_counter_below_low_watermark(&mem->res))
+ break;
+ if (!try_to_free_mem_cgroup_pages(mem, GFP_KERNEL))
+ break;
+ }
+ if (batch_count == 0)
+ mem_cgroup_schedule_reclaim(mem);
+ css_put(&mem->css);
+}
+
+/*
+ * Charge the memory controller for page usage.
+ * Return
@@ -631,6 +692,12 @@ retry:
    rcu_read_unlock();

+/*
+ * schedule background reclaim if we are above the high watermark.
+ */
+ if (res_counter_above_high_watermark(&mem->res))
+ mem_cgroup_schedule_reclaim(mem);
+
+/*
+ * If we created the page_cgroup, we should free it on exceeding
+ * the cgroup limit.
+ */
@@ -642,6 +709,10 @@ retry:
    if (is_atomic)
        goto noreclaim;

+ preempt_disable();
+ __mem_cgroup_stat_add_safe(&mem->stat,
+ MEM_CGROUP_STAT_ALLOCSTALL, 1);
+ preempt_enable();
+ if (try_to_free_mem_cgroup_pages(mem, gfp_mask))
+ continue;

```

```

@@ -939,9 +1010,16 @@ static ssize_t mem_cgroup_write(struct c
    struct file *file, const char __user *userbuf,
    size_t nbytes, loff_t *ppos)
{
- return res_counter_write(&mem_cgroup_from_cont(cont)->res,
+ ssize_t ret;
+
+ ret = res_counter_write(&mem_cgroup_from_cont(cont)->res,
    cft->private, userbuf, nbytes, ppos,
    mem_cgroup_write_strategy);
+
+ if (ret >= 0 && cft->private == RES_HIGH_WATERMARK)
+ mem_cgroup_create_workqueue();
+
+ return ret;
}

```

```

static ssize_t mem_control_type_write(struct cgroup *cont,
@@ -1031,6 +1109,7 @@ static const struct mem_cgroup_stat_desc
} mem_cgroup_stat_desc[] = {
    [MEM_CGROUP_STAT_CACHE] = { "cache", PAGE_SIZE, },
    [MEM_CGROUP_STAT_RSS] = { "rss", PAGE_SIZE, },
+ [MEM_CGROUP_STAT_ALLOCSTALL] = { "allocstall", 1, },
};

```

```

static int mem_control_stat_show(struct seq_file *m, void *arg)
@@ -1097,6 +1176,18 @@ static struct cftype mem_cgroup_files[]
    .read = mem_cgroup_read,
},
{
+ .name = "high_watermark_in_bytes",
+ .private = RES_HIGH_WATERMARK,
+ .write = mem_cgroup_write,
+ .read = mem_cgroup_read,
+ },
+ {
+ .name = "low_watermark_in_bytes",
+ .private = RES_LOW_WATERMARK,
+ .write = mem_cgroup_write,
+ .read = mem_cgroup_read,
+ },
+ {
    .name = "control_type",
    .write = mem_control_type_write,
    .read = mem_control_type_read,
@@ -1161,6 +1252,8 @@ mem_cgroup_create(struct cgroup_subsys *
    if (alloc_mem_cgroup_per_zone_info(mem, node))

```

```
goto free_out;

+ INIT_WORK(&mem->reclaim_work, mem_cgroup_reclaim);
+
return &mem->css;
free_out:
for_each_node_state(node, N_POSSIBLE)
```

Containers mailing list

Containers@lists.linux-foundation.org

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