
Subject: [PATCH v3 06/13] memcg: kmem controller infrastructure

Posted by [Glauber Costa](#) on Tue, 18 Sep 2012 14:04:03 GMT

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This patch introduces infrastructure for tracking kernel memory pages to a given memcg. This will happen whenever the caller includes the flag `__GFP_KMEMCG` flag, and the task belong to a memcg other than the root.

In `memcontrol.h` those functions are wrapped in inline accessors. The idea is to later on, patch those with static branches, so we don't incur any overhead when no mem cgroups with limited kmem are being used.

[v2: improved comments and standardized function names]

[v3: handle no longer opaque, functions not exported, even more comments]

[v4: reworked Used bit handling and surroundings for more clarity]

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```
include/linux/memcontrol.h | 97 ++++++
mm/memcontrol.c           | 177 ++++++
2 files changed, 274 insertions(+)
```

```
diff --git a/include/linux/memcontrol.h b/include/linux/memcontrol.h
```

```
index 8d9489f..82ede9a 100644
```

```
--- a/include/linux/memcontrol.h
```

```
+++ b/include/linux/memcontrol.h
```

```
@@ -21,6 +21,7 @@
```

```
#define _LINUX_MEMCONTROL_H
```

```
#include <linux/cgroup.h>
```

```
#include <linux/vm_event_item.h>
```

```
+#include <linux/hardirq.h>
```

```
struct mem_cgroup;
```

```
struct page_cgroup;
```

```
@@ -399,6 +400,17 @@ struct sock;
```

```
#ifdef CONFIG_MEMCG_KMEM
```

```
void sock_update_memcg(struct sock *sk);
```

```
void sock_release_memcg(struct sock *sk);
```

```
+
```

```
+static inline bool memcg_kmem_enabled(void)
```

```
#{
```

```
+ return true;
```

```

+}
+
+extern bool __memcg_kmem_newpage_charge(gfp_t gfp, struct mem_cgroup **memcg,
+ int order);
+extern void __memcg_kmem_commit_charge(struct page *page,
+ struct mem_cgroup *memcg, int order);
+extern void __memcg_kmem_uncharge_page(struct page *page, int order);
+else
+static inline void sock_update_memcg(struct sock *sk)
+{
@@ -406,6 +418,91 @@ static inline void sock_update_memcg(struct sock *sk)
+static inline void sock_release_memcg(struct sock *sk)
+{
+}
+
+static inline bool memcg_kmem_enabled(void)
+{
+return false;
+}
+
+static inline bool
+__memcg_kmem_newpage_charge(gfp_t gfp, struct mem_cgroup **memcg, int order)
+{
+return false;
+}
+
+static inline void __memcg_kmem_uncharge_page(struct page *page, int order)
+{
+}
+
+static inline void
+__memcg_kmem_commit_charge(struct page *page, struct mem_cgroup *memcg, int order)
+{
+}
+endif /* CONFIG_MEMCG_KMEM */
+
+/**
+ * memcg_kmem_newpage_charge: verify if a new kmem allocation is allowed.
+ * @gfp: the gfp allocation flags.
+ * @memcg: a pointer to the memcg this was charged against.
+ * @order: allocation order.
+ *
+ * returns true if the memcg where the current task belongs can hold this
+ * allocation.
+ *
+ * We return true automatically if this allocation is not to be accounted to
+ * any memcg.
+ */

```

```

+static __always_inline bool
+memcg_kmem_newpage_charge(gfp_t gfp, struct mem_cgroup **memcg, int order)
+{
+ if (!memcg_kmem_enabled())
+ return true;
+
+ /*
+ * __GFP_NOFAIL allocations will move on even if charging is not
+ * possible. Therefore we don't even try, and have this allocation
+ * unaccounted. We could in theory charge it with
+ * res_counter_charge_nofail, but we hope those allocations are rare,
+ * and won't be worth the trouble.
+ */
+ if (!(gfp & __GFP_KMEMCG) || (gfp & __GFP_NOFAIL))
+ return true;
+ if (in_interrupt() || (!current->mm) || (current->flags & PF_KTHREAD))
+ return true;
+ return __memcg_kmem_newpage_charge(gfp, memcg, order);
+}
+
+/**
+ * memcg_kmem_uncharge_page: uncharge pages from memcg
+ * @page: pointer to struct page being freed
+ * @order: allocation order.
+ *
+ * there is no need to specify memcg here, since it is embedded in page_cgroup
+ */
+static __always_inline void
+memcg_kmem_uncharge_page(struct page *page, int order)
+{
+ if (memcg_kmem_enabled())
+ __memcg_kmem_uncharge_page(page, order);
+}
+
+/**
+ * memcg_kmem_commit_charge: embeds correct memcg in a page
+ * @memcg: a pointer to the memcg this was charged against.
+ * @page: pointer to struct page recently allocated
+ * @memcg: the memcg structure we charged against
+ * @order: allocation order.
+ *
+ * Needs to be called after memcg_kmem_newpage_charge, regardless of success or
+ * failure of the allocation. if @page is NULL, this function will revert the
+ * charges. Otherwise, it will commit the memcg given by @memcg to the
+ * corresponding page_cgroup.
+ */
+static __always_inline void
+memcg_kmem_commit_charge(struct page *page, struct mem_cgroup *memcg, int order)

```

```

+{
+ if (memcg_kmem_enabled() && memcg)
+ __memcg_kmem_commit_charge(page, memcg, order);
+}
#endif /* _LINUX_MEMCONTROL_H */

diff --git a/mm/memcontrol.c b/mm/memcontrol.c
index f3fd354..0f36a01 100644
--- a/mm/memcontrol.c
+++ b/mm/memcontrol.c
@@ -10,6 +10,10 @@
 * Copyright (C) 2009 Nokia Corporation
 * Author: Kirill A. Shutemov
 *
+ * Kernel Memory Controller
+ * Copyright (C) 2012 Parallels Inc. and Google Inc.
+ * Authors: Glauber Costa and Suleiman Souhlal
+ *
 * This program is free software; you can redistribute it and/or modify
 * it under the terms of the GNU General Public License as published by
 * the Free Software Foundation; either version 2 of the License, or
@@ -426,6 +430,9 @@ struct mem_cgroup *mem_cgroup_from_css(struct cgroup_subsys_state
*s)
#include <net/ip.h>

static bool mem_cgroup_is_root(struct mem_cgroup *memcg);
+static int memcg_charge_kmem(struct mem_cgroup *memcg, gfp_t gfp, u64 size);
+static void memcg_uncharge_kmem(struct mem_cgroup *memcg, u64 size);
+
void sock_update_memcg(struct sock *sk)
{
if (mem_cgroup_sockets_enabled) {
@@ -480,6 +487,110 @@ struct cg_proto *tcp_proto_cgroup(struct mem_cgroup *memcg)
}
EXPORT_SYMBOL(tcp_proto_cgroup);
#endif /* CONFIG_INET */
+
+static inline bool memcg_can_account_kmem(struct mem_cgroup *memcg)
+{
+ return !mem_cgroup_disabled() && !mem_cgroup_is_root(memcg) &&
+ memcg->kmem_accounted;
+}
+
+/*
+ * We need to verify if the allocation against current->mm->owner's memcg is
+ * possible for the given order. But the page is not allocated yet, so we'll
+ * need a further commit step to do the final arrangements.
+ */

```

```

+ * It is possible for the task to switch cgroups in this mean time, so at
+ * commit time, we can't rely on task conversion any longer. We'll then use
+ * the handle argument to return to the caller which cgroup we should commit
+ * against. We could also return the memcg directly and avoid the pointer
+ * passing, but a boolean return value gives better semantics considering
+ * the compiled-out case as well.
+ *
+ * Returning true means the allocation is possible.
+ */
+bool
+__memcg_kmem_newpage_charge(gfp_t gfp, struct mem_cgroup **_memcg, int order)
+{
+ struct mem_cgroup *memcg;
+ bool ret;
+ struct task_struct *p;
+
+ *_memcg = NULL;
+ rcu_read_lock();
+ p = rcu_dereference(current->mm->owner);
+ memcg = mem_cgroup_from_task(p);
+ rcu_read_unlock();
+
+ if (!memcg_can_account_kmem(memcg))
+ return true;
+
+ mem_cgroup_get(memcg);
+
+ ret = memcg_charge_kmem(memcg, gfp, PAGE_SIZE << order) == 0;
+ if (ret)
+ *_memcg = memcg;
+ else
+ mem_cgroup_put(memcg);
+
+ return ret;
+}
+
+void __memcg_kmem_commit_charge(struct page *page, struct mem_cgroup *memcg,
+ int order)
+{
+ struct page_cgroup *pc;
+
+ WARN_ON(mem_cgroup_is_root(memcg));
+
+ /* The page allocation failed. Revert */
+ if (!page) {
+ memcg_uncharge_kmem(memcg, PAGE_SIZE << order);
+ return;
+ }

```

```

+
+ pc = lookup_page_cgroup(page);
+ lock_page_cgroup(pc);
+ pc->mem_cgroup = memcg;
+ SetPageCgroupUsed(pc);
+ unlock_page_cgroup(pc);
+}
+
+void __memcg_kmem_uncharge_page(struct page *page, int order)
+{
+ struct mem_cgroup *memcg = NULL;
+ struct page_cgroup *pc;
+
+
+ pc = lookup_page_cgroup(page);
+ /*
+  * Fast unlocked return. Theoretically might have changed, have to
+  * check again after locking.
+  */
+ if (!PageCgroupUsed(pc))
+ return;
+
+ lock_page_cgroup(pc);
+ if (PageCgroupUsed(pc)) {
+ memcg = pc->mem_cgroup;
+ ClearPageCgroupUsed(pc);
+ }
+ unlock_page_cgroup(pc);
+
+ /*
+  * Checking if kmem accounted is enabled won't work for uncharge, since
+  * it is possible that the user enabled kmem tracking, allocated, and
+  * then disabled it again.
+  *
+  * We trust if there is a memcg associated with the page, it is a valid
+  * allocation
+  */
+ if (!memcg)
+ return;
+
+ WARN_ON(mem_cgroup_is_root(memcg));
+ memcg_uncharge_kmem(memcg, PAGE_SIZE << order);
+ mem_cgroup_put(memcg);
+}
+
+ #endif /* CONFIG_MEMCG_KMEM */

+
+ #if defined(CONFIG_INET) && defined(CONFIG_MEMCG_KMEM)
+ @@ -5700,3 +5811,69 @@ static int __init enable_swap_account(char *s)

```

```

__setup("swapaccount=", enable_swap_account);

#endif
+
+ #ifdef CONFIG_MEMCG_KMEM
+ int memcg_charge_kmem(struct mem_cgroup *memcg, gfp_t gfp, u64 size)
+ {
+ struct res_counter *fail_res;
+ struct mem_cgroup *_memcg;
+ int ret;
+ bool may_oom;
+ bool nofail = false;
+
+ may_oom = (gfp & __GFP_WAIT) && (gfp & __GFP_FS) &&
+ !(gfp & __GFP_NORETRY);
+
+ ret = 0;
+
+ if (!memcg)
+ return ret;
+
+ _memcg = memcg;
+ ret = __mem_cgroup_try_charge(NULL, gfp, size / PAGE_SIZE,
+ &_memcg, may_oom);
+
+ if (ret == -EINTR) {
+ nofail = true;
+ /*
+ * __mem_cgroup_try_charge() chosed to bypass to root due to
+ * OOM kill or fatal signal. Since our only options are to
+ * either fail the allocation or charge it to this cgroup, do
+ * it as a temporary condition. But we can't fail. From a
+ * kmem/slab perspective, the cache has already been selected,
+ * by mem_cgroup_get_kmem_cache(), so it is too late to change
+ * our minds
+ */
+ res_counter_charge_nofail(&memcg->res, size, &fail_res);
+ if (do_swap_account)
+ res_counter_charge_nofail(&memcg->memsw, size,
+ &fail_res);
+ ret = 0;
+ } else if (ret == -ENOMEM)
+ return ret;
+
+ if (nofail)
+ res_counter_charge_nofail(&memcg->kmem, size, &fail_res);
+ else
+ ret = res_counter_charge(&memcg->kmem, size, &fail_res);

```

```
+
+ if (ret) {
+ res_counter_uncharge(&memcg->res, size);
+ if (do_swap_account)
+ res_counter_uncharge(&memcg->memsw, size);
+ }
+
+ return ret;
+}
+
+void memcg_uncharge_kmem(struct mem_cgroup *memcg, u64 size)
+{
+ if (!memcg)
+ return;
+
+ res_counter_uncharge(&memcg->kmem, size);
+ res_counter_uncharge(&memcg->res, size);
+ if (do_swap_account)
+ res_counter_uncharge(&memcg->memsw, size);
+}
+#endif /* CONFIG_MEMCG_KMEM */
--
1.7.11.4
```
