
Subject: [PATCH v2 06/11] memcg: kmem controller infrastructure

Posted by [Glauber Costa](#) on Thu, 09 Aug 2012 13:01:14 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]

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```
include/linux/memcontrol.h | 79 ++++++
mm/memcontrol.c             | 185 ++++++
2 files changed, 264 insertions(+)
```

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

index 8d9489f..75b247e 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 +400,11 @@ struct sock;

#ifdef CONFIG_MEMCG_KMEM

void sock_update_memcg(struct sock *sk);

void sock_release_memcg(struct sock *sk);

+

+#define memcg_kmem_on 1

+bool __memcg_kmem_new_page(gfp_t gfp, void *handle, int order);

+void __memcg_kmem_commit_page(struct page *page, void *handle, int order);

+void __memcg_kmem_free_page(struct page *page, int order);

#else

static inline void sock_update_memcg(struct sock *sk)


```

+ * memcg_kmem_free_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_free_page(struct page *page, int order)
+{
+ if (memcg_kmem_on)
+  __memcg_kmem_free_page(page, order);
+}
+
+/**
+ * memcg_kmem_commit_page: embeds correct memcg in a page
+ * @handle: a pointer to the memcg this was charged against.
+ * @page: pointer to struct page recently allocated
+ * @handle: the memcg structure we charged against
+ * @order: allocation order.
+ *
+ * Needs to be called after memcg_kmem_new_page, 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 @handle to the
+ * corresponding page_cgroup.
+ */
+static __always_inline void
+memcg_kmem_commit_page(struct page *page, struct mem_cgroup *handle, int order)
+{
+ if (memcg_kmem_on)
+  __memcg_kmem_commit_page(page, handle, order);
+}
+
+#endif /* _LINUX_MEMCONTROL_H */

```

```
diff --git a/mm/memcontrol.c b/mm/memcontrol.c
```

```
index 54e93de..e9824c1 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
```

```
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```

```
 * the Free Software Foundation; either version 2 of the License, or
```

```

@@ -434,6 +438,9 @@ 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, s64 delta);
+static void memcg_uncharge_kmem(struct mem_cgroup *memcg, s64 delta);
+
void sock_update_memcg(struct sock *sk)
{
if (mem_cgroup_sockets_enabled) {
@@ -488,6 +495,118 @@ struct cg_proto *tcp_proto_cgroup(struct mem_cgroup *memcg)
}
EXPORT_SYMBOL(tcp_proto_cgroup);
#endif /* CONFIG_INET */
+
+static inline bool memcg_kmem_enabled(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
+ *
+ * Returning true means the allocation is possible.
+ */
+bool __memcg_kmem_new_page(gfp_t gfp, void *_handle, int order)
+{
+ struct mem_cgroup *memcg;
+ struct mem_cgroup **handle = (struct mem_cgroup **) _handle;
+ bool ret = true;
+ size_t size;
+ struct task_struct *p;
+
+ *handle = NULL;
+ rcu_read_lock();
+ p = rcu_dereference(current->mm->owner);
+ memcg = mem_cgroup_from_task(p);
+ if (!memcg_kmem_enabled(memcg))
+ goto out;

```

```

+
+ mem_cgroup_get(memcg);
+
+ size = PAGE_SIZE << order;
+ ret = memcg_charge_kmem(memcg, gfp, size) == 0;
+ if (!ret) {
+   mem_cgroup_put(memcg);
+   goto out;
+ }
+
+ *handle = memcg;
+out:
+ rcu_read_unlock();
+ return ret;
+}
+EXPORT_SYMBOL(__memcg_kmem_new_page);
+
+void __memcg_kmem_commit_page(struct page *page, void *handle, int order)
+{
+   struct page_cgroup *pc;
+   struct mem_cgroup *memcg = handle;
+
+   if (!memcg)
+       return;
+
+   WARN_ON(mem_cgroup_is_root(memcg));
+   /* The page allocation must have failed. Revert */
+   if (!page) {
+       size_t size = PAGE_SIZE << order;
+
+       memcg_uncharge_kmem(memcg, size);
+       mem_cgroup_put(memcg);
+       return;
+   }
+
+   pc = lookup_page_cgroup(page);
+   lock_page_cgroup(pc);
+   pc->mem_cgroup = memcg;
+   SetPageCgroupUsed(pc);
+   unlock_page_cgroup(pc);
+}
+
+void __memcg_kmem_free_page(struct page *page, int order)
+{
+   struct mem_cgroup *memcg;
+   size_t size;
+   struct page_cgroup *pc;
+
+

```

```

+ if (mem_cgroup_disabled())
+ return;
+
+ pc = lookup_page_cgroup(page);
+ lock_page_cgroup(pc);
+ memcg = pc->mem_cgroup;
+ pc->mem_cgroup = NULL;
+ if (!PageCgroupUsed(pc)) {
+ unlock_page_cgroup(pc);
+ return;
+ }
+ 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));
+ size = (1 << order) << PAGE_SHIFT;
+ memcg_uncharge_kmem(memcg, size);
+ mem_cgroup_put(memcg);
+}
+EXPORT_SYMBOL(__memcg_kmem_free_page);
+#endif /* CONFIG_MEMCG_KMEM */

#if defined(CONFIG_INET) && defined(CONFIG_MEMCG_KMEM)
@@ -5759,3 +5878,69 @@ static int __init enable_swap_account(char *s)
__setup("swapaccount=", enable_swap_account);

#endif
+
+
+#ifndef CONFIG_MEMCG_KMEM
+int memcg_charge_kmem(struct mem_cgroup *memcg, gfp_t gfp, s64 delta)
+{
+ 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, delta / PAGE_SIZE,
+   &_amp;_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, delta, &fail_res);
+   if (do_swap_account)
+     res_counter_charge_nofail(&memcg->memsw, delta,
+       &fail_res);
+   ret = 0;
+ } else if (ret == -ENOMEM)
+   return ret;
+
+ if (nofail)
+   res_counter_charge_nofail(&memcg->kmem, delta, &fail_res);
+ else
+   ret = res_counter_charge(&memcg->kmem, delta, &fail_res);
+
+ if (ret) {
+   res_counter_uncharge(&memcg->res, delta);
+   if (do_swap_account)
+     res_counter_uncharge(&memcg->memsw, delta);
+ }
+
+ return ret;
+}
+
+void memcg_uncharge_kmem(struct mem_cgroup *memcg, s64 delta)
+{
+ if (!memcg)

```

```
+ return;
+
+ res_counter_uncharge(&memcg->kmem, delta);
+ res_counter_uncharge(&memcg->res, delta);
+ if (do_swap_account)
+ res_counter_uncharge(&memcg->memsw, delta);
+}
+#endif /* CONFIG_MEMCG_KMEM */
--
1.7.11.2
```
