
Subject: [PATCH v4 24/25] memcg/slub: shrink dead caches
Posted by [Glauber Costa](#) on Mon, 18 Jun 2012 10:28:17 GMT
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In the slub allocator, when the last object of a page goes away, we don't necessarily free it - there is not necessarily a test for empty page in any slab_free path.

This means that when we destroy a memcg cache that happened to be empty, those caches may take a lot of time to go away: removing the memcg reference won't destroy them - because there are pending references, and the empty pages will stay there, until a shrinker is called upon for any reason.

This patch marks all memcg caches as dead. kmem_cache_shrink is called for the ones who are not yet dead - this will force internal cache reorganization, and then all references to empty pages will be removed.

An unlikely branch is used to make sure this case does not affect performance in the usual slab_free path.

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```
include/linux/slab.h      | 3 +++
include/linux/slub_def.h | 8 ++++++++
mm/memcontrol.c          | 44 ++++++++++++++++++++++++++++++++++++++
mm/slub.c                 | 1 +
4 files changed, 55 insertions(+), 1 deletion(-)
```

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

```
index 155d19f..7e13055 100644
```

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

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

```
@@ -182,6 +182,8 @@ unsigned int kmem_cache_size(struct kmem_cache *);
#endif
```

```
#ifdef CONFIG_CGROUP_MEM_RES_CTLR_KMEM
```

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

```
+
```

```
struct mem_cgroup_cache_params {
    struct mem_cgroup *memcg;
    struct kmem_cache *parent;
```

```
@@ -190,6 +192,7 @@ struct mem_cgroup_cache_params {
    atomic_t nr_pages;
    struct list_head destroyed_list; /* Used when deleting memcg cache */
    struct list_head sibling_list;
+ struct work_struct cache_shrinker;
};
#endif
```

```
diff --git a/include/linux/slub_def.h b/include/linux/slub_def.h
index 7183596..871f82b 100644
```

```
--- a/include/linux/slub_def.h
+++ b/include/linux/slub_def.h
@@ -116,6 +116,14 @@ struct kmem_cache {
    struct kmem_cache_node *node[MAX_NUMNODES];
};
```

```
+static inline void kmem_cache_verify_dead(struct kmem_cache *cachep)
+{
+ #ifdef CONFIG_CGROUP_MEM_RES_CTLR_KMEM
+ if (unlikely(cachep->memcg_params.dead))
+ schedule_work(&cachep->memcg_params.cache_shrinker);
+ #endif
+}
+
+/*
+ * Kmalloc subsystem.
+ */
```

```
diff --git a/mm/memcontrol.c b/mm/memcontrol.c
index 972e83f..c368480 100644
```

```
--- a/mm/memcontrol.c
+++ b/mm/memcontrol.c
@@ -531,7 +531,7 @@ static char *mem_cgroup_cache_name(struct mem_cgroup *memcg,
struct kmem_cache *
```

```
    BUG_ON(dentry == NULL);
```

```
- name = kasprintf(GFP_KERNEL, "%s(%d:%s)",
+ name = kasprintf(GFP_KERNEL, "%s(%d:%s)dead",
    cachep->name, css_id(&memcg->css), dentry->d_name.name);
```

```
    return name;
```

```
@@ -592,11 +592,24 @@ void mem_cgroup_release_cache(struct kmem_cache *cachep)

}
```

```
+static void cache_shrinker_work_func(struct work_struct *work)
+{
+ struct mem_cgroup_cache_params *params;
```

```

+ struct kmem_cache *cachep;
+
+ params = container_of(work, struct mem_cgroup_cache_params,
+     cache_shrinker);
+ cachep = container_of(params, struct kmem_cache, memcg_params);
+
+ kmem_cache_shrink(cachep);
+}
+
static struct kmem_cache *memcg_create_kmem_cache(struct mem_cgroup *memcg,
    struct kmem_cache *cachep)
{
    struct kmem_cache *new_cachep;
    int idx;
+ char *name;

    BUG_ON(!mem_cgroup_kmem_enabled(memcg));

@@ -616,10 +629,21 @@ static struct kmem_cache *memcg_create_kmem_cache(struct
mem_cgroup *memcg,
    goto out;
}

+ /*
+  * Because the cache is expected to duplicate the string,
+  * we must make sure it has opportunity to copy its full
+  * name. Only now we can remove the dead part from it
+  */
+ name = (char *)new_cachep->name;
+ if (name)
+     name[strlen(name) - 4] = '\0';
+
    mem_cgroup_get(memcg);
    memcg->slabs[idx] = new_cachep;
    new_cachep->memcg_params.memcg = memcg;
    atomic_set(&new_cachep->memcg_params.nr_pages, 0);
+ INIT_WORK(&new_cachep->memcg_params.cache_shrinker,
+     cache_shrinker_work_func);
out:
    mutex_unlock(&memcg_cache_mutex);
    return new_cachep;
@@ -642,6 +666,21 @@ static void kmem_cache_destroy_work_func(struct work_struct *w)
    struct mem_cgroup_cache_params *p, *tmp;
    unsigned long flags;
    LIST_HEAD(del_unlocked);
+ LIST_HEAD(shrinkers);
+
+ spin_lock_irqsave(&cache_queue_lock, flags);

```

```

+ list_for_each_entry_safe(p, tmp, &destroyed_caches, destroyed_list) {
+   cachep = container_of(p, struct kmem_cache, memcg_params);
+   if (atomic_read(&cachep->memcg_params.nr_pages) != 0)
+   list_move(&cachep->memcg_params.destroyed_list, &shrinkers);
+ }
+ spin_unlock_irqrestore(&cache_queue_lock, flags);
+
+ list_for_each_entry_safe(p, tmp, &shrinkers, destroyed_list) {
+   cachep = container_of(p, struct kmem_cache, memcg_params);
+   list_del(&cachep->memcg_params.destroyed_list);
+   kmem_cache_shrink(cachep);
+ }

spin_lock_irqsave(&cache_queue_lock, flags);
list_for_each_entry_safe(p, tmp, &destroyed_caches, destroyed_list) {
@@ -719,11 +758,14 @@ static void mem_cgroup_destroy_all_caches(struct mem_cgroup
*memcg)

spin_lock_irqsave(&cache_queue_lock, flags);
for (i = 0; i < MAX_KMEM_CACHE_TYPES; i++) {
+ char *name;
cachep = memcg->slabs[i];
if (!cachep)
continue;

cachep->memcg_params.dead = true;
+ name = (char *)cachep->name;
+ name[strlen(name)] = 'd';
__mem_cgroup_destroy_cache(cachep);
}
spin_unlock_irqrestore(&cache_queue_lock, flags);
diff --git a/mm/slub.c b/mm/slub.c
index d5b91f4..37ac548 100644
--- a/mm/slub.c
+++ b/mm/slub.c
@@ -2593,6 +2593,7 @@ redo:
} else
__slab_free(s, page, x, addr);

+ kmem_cache_verify_dead(s);
}

void kmem_cache_free(struct kmem_cache *s, void *x)
--
1.7.10.2

```
