

---

Subject: [PATCH] cgroup: Remove call to synchronize\_rcu in cgroup\_attach\_task  
Posted by [Colin Cross](#) on Wed, 24 Nov 2010 01:43:38 GMT  
[View Forum Message](#) <> [Reply to Message](#)

---

synchronize\_rcu can be very expensive, averaging 100 ms in some cases. In cgroup\_attach\_task, it is used to prevent a task->cgroups pointer dereferenced in an RCU read side critical section from being invalidated by delaying the call to put\_css\_set until after an RCU grace period.

To avoid the call to synchronize\_rcu, make the put\_css\_set call rcu-safe by moving the deletion of the css\_set links into rcu-protected free\_css\_set\_rcu.

The calls to check\_for\_release in free\_css\_set\_rcu now occur in softirq context, so convert all uses of the release\_list\_lock spinlock to irq safe versions.

The decrement of the cgroup refcount is no longer synchronous with the call to put\_css\_set, which can result in the cgroup refcount staying positive after the last call to cgroup\_attach\_task returns. To allow the cgroup to be deleted with cgroup\_rmdir synchronously after cgroup\_attach\_task, introduce a second refcount, rmdir\_count, that is decremented synchronously in put\_css\_set. If cgroup\_rmdir is called on a cgroup for which rmdir\_count is zero but count is nonzero, reuse the rmdir waitqueue to block the rmdir until the rcu callback is called.

Signed-off-by: Colin Cross <ccross@android.com>

---

This patch is similar to what you described. The main differences are that I used a new atomic to handle the rmdir case, and I converted check\_for\_release to be callable in softirq context rather than schedule work in free\_css\_set\_rcu. Your css\_set scanning in rmdir sounds better, I'll take another look at that. Is there any problem with disabling irqs with spin\_lock\_irqsave in check\_for\_release?

```
include/linux/cgroup.h | 6 ++
kernel/cgroup.c        | 124 ++++++-----
2 files changed, 78 insertions(+), 52 deletions(-)
```

```
diff --git a/include/linux/cgroup.h b/include/linux/cgroup.h
index ed4ba11..3b6e73d 100644
--- a/include/linux/cgroup.h
+++ b/include/linux/cgroup.h
```

```

@@ -202,6 +202,12 @@ struct cgroup {
    atomic_t count;

    /*
+ * separate refcount for rmdir on a cgroup. When rmdir_count is 0,
+ * rmdir should block until count is 0.
+ */
+ atomic_t rmdir_count;
+
+ /*
+ * We link our 'sibling' struct into our parent's 'children'.
+ * Our children link their 'sibling' into our 'children'.
+ */
diff --git a/kernel/cgroup.c b/kernel/cgroup.c
index 66a416b..fa3c0ac 100644
--- a/kernel/cgroup.c
+++ b/kernel/cgroup.c
@@ -267,6 +267,33 @@ static void cgroup_release_agent(struct work_struct *work);
static DECLARE_WORK(release_agent_work, cgroup_release_agent);
static void check_for_release(struct cgroup *cgrp);

+/*
+ * A queue for waiters to do rmdir() cgroup. A tasks will sleep when
+ * cgroup->count == 0 && list_empty(&cgroup->children) && subsys has some
+ * reference to css->refcnt. In general, this refcnt is expected to goes down
+ * to zero, soon.
+ *
+ * CGRP_WAIT_ON_RMDIR flag is set under cgroup's inode->i_mutex;
+ */
+DECLARE_WAIT_QUEUE_HEAD(cgroup_rmdir_waitq);
+
+static void cgroup_wakeup_rmdir_waiter(struct cgroup *cgrp)
+{
+ if (unlikely(test_and_clear_bit(CGRP_WAIT_ON_RMDIR, &cgrp->flags)))
+  wake_up_all(&cgroup_rmdir_waitq);
+}
+
+void cgroup_exclude_rmdir(struct cgroup_subsys_state *css)
+{
+ css_get(css);
+}
+
+void cgroup_release_and_wakeup_rmdir(struct cgroup_subsys_state *css)
+{
+ cgroup_wakeup_rmdir_waiter(css->cgroup);
+ css_put(css);
+}

```

```

/* Link structure for associating css_set objects with cgroups */
struct cg_cgroup_link {
/*
@@ -329,6 +356,22 @@ static struct hlist_head *css_set_hash(struct cgroup_subsys_state
*css[])
static void free_css_set_rcu(struct rcu_head *obj)
{
    struct css_set *cg = container_of(obj, struct css_set, rcu_head);
+ struct cg_cgroup_link *link;
+ struct cg_cgroup_link *saved_link;
+
+ /* Nothing else can have a reference to cg, no need for css_set_lock */
+ list_for_each_entry_safe(link, saved_link, &cg->cg_links,
+    cg_link_list) {
+ struct cgroup *cgrp = link->cgrp;
+ list_del(&link->cg_link_list);
+ list_del(&link->cgrp_link_list);
+ if (atomic_dec_and_test(&cgrp->count)) {
+     check_for_release(cgrp);
+     cgroup_wakeup_rmdir_waiter(cgrp);
+ }
+ kfree(link);
+ }
+
    kfree(cg);
}

@@ -355,23 +398,20 @@ static void __put_css_set(struct css_set *cg, int taskexit)
    return;
}

- /* This css_set is dead. unlink it and release cgroup refcounts */
    hlist_del(&cg->hlist);
    css_set_count--;

+ /* This css_set is now unreachable from the css_set_table, but RCU
+  * read-side critical sections may still have a reference to it.
+  * Decrement the cgroup rmdir_count so that rmdir's on an empty
+  * cgroup can block until the free_css_set_rcu callback */
    list_for_each_entry_safe(link, saved_link, &cg->cg_links,
        cg_link_list) {
        struct cgroup *cgrp = link->cgrp;
- list_del(&link->cg_link_list);
- list_del(&link->cgrp_link_list);
- if (atomic_dec_and_test(&cgrp->count) &&
-     notify_on_release(cgrp)) {
-     if (taskexit)
-         set_bit(CGRP_RELEASABLE, &cgrp->flags);

```

```

- check_for_release(cgrp);
- }
-
- kfree(link);
+ if (taskexit)
+ set_bit(CGRP_RELEASABLE, &cgrp->flags);
+ atomic_dec(&cgrp->rmdir_count);
+ smp_mb();
}

write_unlock(&css_set_lock);
@@ -571,6 +611,8 @@ static void link_css_set(struct list_head *tmp_cg_links,
    cgrp_link_list);
link->cg = cg;
link->cgrp = cgrp;
+ atomic_inc(&cgrp->rmdir_count);
+ smp_mb(); /* make sure rmdir_count increments first */
atomic_inc(&cgrp->count);
list_move(&link->cgrp_link_list, &cgrp->css_sets);
/*
@@ -725,9 +767,9 @@ static struct cgroup *task_cgroup_from_root(struct task_struct *task,
 * cgroup_attach_task(), which overwrites one task's cgroup pointer with
 * another. It does so using cgroup_mutex, however there are
 * several performance critical places that need to reference
- * task->cgroup without the expense of grabbing a system global
+ * task->cgroups without the expense of grabbing a system global
 * mutex. Therefore except as noted below, when dereferencing or, as
- * in cgroup_attach_task(), modifying a task's cgroup pointer we use
+ * in cgroup_attach_task(), modifying a task's cgroups pointer we use
 * task_lock(), which acts on a spinlock (task->alloc_lock) already in
 * the task_struct routinely used for such matters.
 *
@@ -909,33 +951,6 @@ static void cgroup_d_remove_dir(struct dentry *dentry)
}

/*
- * A queue for waiters to do rmdir() cgroup. A task will sleep when
- * cgroup->count == 0 && list_empty(&cgroup->children) && subsys has some
- * reference to css->refcnt. In general, this refcnt is expected to go down
- * to zero, soon.
- *
- * CGRP_WAIT_ON_RMDIR flag is set under cgroup's inode->i_mutex;
- */
-DECLARE_WAIT_QUEUE_HEAD(cgroup_rmdir_waitq);
-
-static void cgroup_wakeup_rmdir_waiter(struct cgroup *cgrp)
-{
- if (unlikely(test_and_clear_bit(CGRP_WAIT_ON_RMDIR, &cgrp->flags)))

```

```

- wake_up_all(&cgroup_rmdir_waitq);
-}
-
-void cgroup_exclude_rmdir(struct cgroup_subsys_state *css)
-{
- css_get(css);
-}
-
-void cgroup_release_and_wakeup_rmdir(struct cgroup_subsys_state *css)
-{
- cgroup_wakeup_rmdir_waiter(css->cgroup);
- css_put(css);
-}
-
-/*
 * Call with cgroup_mutex held. Drops reference counts on modules, including
 * any duplicate ones that parse_cgroupfs_options took. If this function
 * returns an error, no reference counts are touched.
@@ -1802,7 +1817,7 @@ int cgroup_attach_task(struct cgroup *cgrp, struct task_struct *tsk)
    ss->attach(ss, cgrp, oldcgrp, tsk, false);
}
set_bit(CGRP_RELEASABLE, &oldcgrp->flags);
- synchronize_rcu();
+ /* put_css_set will not destroy cg until after an RCU grace period */
put_css_set(cg);

/*
@@ -3566,11 +3581,12 @@ static int cgroup_rmdir(struct inode *unused_dir, struct dentry
*dentry)
    DEFINE_WAIT(wait);
    struct cgroup_event *event, *tmp;
    int ret;
+ unsigned long flags;

    /* the vfs holds both inode->i_mutex already */
    again:
    mutex_lock(&cgroup_mutex);
- if (atomic_read(&cgrp->count) != 0) {
+ if (atomic_read(&cgrp->rmdir_count) != 0) {
    mutex_unlock(&cgroup_mutex);
    return -EBUSY;
}
@@ -3603,13 +3619,13 @@ again:

    mutex_lock(&cgroup_mutex);
    parent = cgrp->parent;
- if (atomic_read(&cgrp->count) || !list_empty(&cgrp->children)) {
+ if (atomic_read(&cgrp->rmdir_count) || !list_empty(&cgrp->children)) {

```

```

clear_bit(CGRP_WAIT_ON_RMDIR, &cgrp->flags);
mutex_unlock(&cgroup_mutex);
return -EBUSY;
}
prepare_to_wait(&cgroup_rmdir_waitq, &wait, TASK_INTERRUPTIBLE);
- if (!cgroup_clear_css_refs(cgrp)) {
+ if (atomic_read(&cgrp->count) != 0 || !cgroup_clear_css_refs(cgrp)) {
    mutex_unlock(&cgroup_mutex);
    /*
     * Because someone may call cgroup_wakeup_rmdir_waiter() before
@@ -3627,11 +3643,11 @@ again:
    finish_wait(&cgroup_rmdir_waitq, &wait);
    clear_bit(CGRP_WAIT_ON_RMDIR, &cgrp->flags);

- spin_lock(&release_list_lock);
+ spin_lock_irqsave(&release_list_lock, flags);
    set_bit(CGRP_REMOVED, &cgrp->flags);
    if (!list_empty(&cgrp->release_list))
        list_del(&cgrp->release_list);
- spin_unlock(&release_list_lock);
+ spin_unlock_irqrestore(&release_list_lock, flags);

cgroup_lock_hierarchy(cgrp->root);
/* delete this cgroup from parent->children */
@@ -4389,6 +4405,8 @@ int cgroup_is_descendant(const struct cgroup *cgrp, struct task_struct
*task)

static void check_for_release(struct cgroup *cgrp)
{
+ unsigned long flags;
+
    /* All of these checks rely on RCU to keep the cgroup
     * structure alive */
    if (cgroup_is_releasable(cgrp) && !atomic_read(&cgrp->count)
@@ -4397,13 +4415,13 @@ static void check_for_release(struct cgroup *cgrp)
    /* already queued for a userspace notification, queue
     * it now */
    int need_schedule_work = 0;
- spin_lock(&release_list_lock);
+ spin_lock_irqsave(&release_list_lock, flags);
    if (!cgroup_is_removed(cgrp) &&
        list_empty(&cgrp->release_list)) {
        list_add(&cgrp->release_list, &release_list);
        need_schedule_work = 1;
    }
- spin_unlock(&release_list_lock);
+ spin_unlock_irqrestore(&release_list_lock, flags);
    if (need_schedule_work)

```

```

    schedule_work(&release_agent_work);
}
@@ -4453,9 +4471,11 @@ EXPORT_SYMBOL_GPL(__css_put);
*/
static void cgroup_release_agent(struct work_struct *work)
{
+ unsigned long flags;
+
    BUG_ON(work != &release_agent_work);
    mutex_lock(&cgroup_mutex);
- spin_lock(&release_list_lock);
+ spin_lock_irqsave(&release_list_lock, flags);
    while (!list_empty(&release_list)) {
        char *argv[3], *envp[3];
        int i;
@@ -4464,7 +4484,7 @@ static void cgroup_release_agent(struct work_struct *work)
        struct cgroup,
        release_list);
    list_del_init(&cgrp->release_list);
- spin_unlock(&release_list_lock);
+ spin_unlock_irqrestore(&release_list_lock, flags);
    pathbuf = kmalloc(PAGE_SIZE, GFP_KERNEL);
    if (!pathbuf)
        goto continue_free;
@@ -4494,9 +4514,9 @@ static void cgroup_release_agent(struct work_struct *work)
    continue_free:
    kfree(pathbuf);
    kfree(agentbuf);
- spin_lock(&release_list_lock);
+ spin_lock_irqsave(&release_list_lock, flags);
    }
- spin_unlock(&release_list_lock);
+ spin_unlock_irqrestore(&release_list_lock, flags);
    mutex_unlock(&cgroup_mutex);
}

--
1.7.3.1

```

---

Containers mailing list  
Containers@lists.linux-foundation.org  
<https://lists.linux-foundation.org/mailman/listinfo/containers>

---



---

Subject: Re: [PATCH] cgroup: Remove call to synchronize\_rcu in  
cgroup\_attach\_task

---

Posted by [Colin Cross](#) on Wed, 24 Nov 2010 02:29:32 GMT

[View Forum Message](#) <> [Reply to Message](#)

---

On Tue, Nov 23, 2010 at 5:43 PM, Colin Cross <[ccross@android.com](mailto:ccross@android.com)> wrote:

> This patch is similar to what you described. The main differences are  
> that I used a new atomic to handle the rmdir case, and I converted  
> check\_for\_release to be callable in softirq context rather than schedule  
> work in free\_css\_set\_rcu. Your css\_set scanning in rmdir sounds better,  
> I'll take another look at that. Is there any problem with disabling irqs  
> with spin\_lock\_irqsave in check\_for\_release?

free\_css\_set\_rcu needs to take a write lock on css\_set\_lock to protect the  
list\_del(&link->cgrp\_link\_list). I'll convert it to schedule work, and change  
the spin\_lock\_irqsave back to spin\_lock.

---

Containers mailing list

[Containers@lists.linux-foundation.org](mailto:Containers@lists.linux-foundation.org)

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

---

---

Subject: Re: [PATCH] cgroup: Remove call to synchronize\_rcu in  
cgroup\_attach\_task

Posted by [Bryan Huntsman](#) on Sat, 22 Jan 2011 01:17:24 GMT

[View Forum Message](#) <> [Reply to Message](#)

---

On 11/23/2010 05:43 PM, Colin Cross wrote:

> synchronize\_rcu can be very expensive, averaging 100 ms in  
> some cases. In cgroup\_attach\_task, it is used to prevent  
> a task->cgroups pointer dereferenced in an RCU read side  
> critical section from being invalidated by delaying the call  
> to put\_css\_set until after an RCU grace period.

>  
> To avoid the call to synchronize\_rcu, make the put\_css\_set  
> call rcu-safe by moving the deletion of the css\_set links  
> into rcu-protected free\_css\_set\_rcu.

>  
> The calls to check\_for\_release in free\_css\_set\_rcu now occur  
> in softirq context, so convert all uses of the  
> release\_list\_lock spinlock to irq safe versions.

>  
> The decrement of the cgroup refcount is no longer  
> synchronous with the call to put\_css\_set, which can result  
> in the cgroup refcount staying positive after the last call  
> to cgroup\_attach\_task returns. To allow the cgroup to be  
> deleted with cgroup\_rmdir synchronously after  
> cgroup\_attach\_task, introduce a second refcount,  
> rmdir\_count, that is decremented synchronously in  
> put\_css\_set. If cgroup\_rmdir is called on a cgroup for



```

> hich rmdir_count is zero but count is nonzero, reuse the
> rmdir waitqueue to block the rmdir until the rcu callback
> is called.
>
> Signed-off-by: Colin Cross <ccross@android.com>
> ---
>
> This patch is similar to what you described. The main differences are
> that I used a new atomic to handle the rmdir case, and I converted
> check_for_release to be callable in softirq context rather than schedule
> work in free_css_set_rcu. Your css_set scanning in rmdir sounds better,
> I'll take another look at that. Is there any problem with disabling irqs
> with spin_lock_irqsave in check_for_release?
>
> include/linux/cgroup.h | 6 ++
> kernel/cgroup.c        | 124 ++++++-----
> 2 files changed, 78 insertions(+), 52 deletions(-)
>

```

Colin, what became of this patch? I see this in your Tegra tree for Android.

<http://android.git.kernel.org/?p=kernel/tegra.git;a=commit;h=05946a1e0fdb011ac0e6638ee60b181c584f127b>

I looked in linux-next but didn't see it there. This resolves a performance issue on MSM SMP so I'm curious if this is going upstream.  
Thanks.

- Bryan

--

Sent by an employee of the Qualcomm Innovation Center, Inc.  
The Qualcomm Innovation Center, Inc. is a member of the Code Aurora Forum.

---

Containers mailing list  
Containers@lists.linux-foundation.org  
<https://lists.linux-foundation.org/mailman/listinfo/containers>

---



---

Subject: Re: [PATCH] cgroup: Remove call to synchronize\_rcu in  
cgroup\_attach\_task  
Posted by [Colin Cross](#) on Sat, 22 Jan 2011 02:04:06 GMT  
[View Forum Message](#) <> [Reply to Message](#)

---

On Fri, Jan 21, 2011 at 5:17 PM, Bryan Huntsman <bryanh@codeaurora.org> wrote:  
> On 11/23/2010 05:43 PM, Colin Cross wrote:

```

>> synchronize_rcu can be very expensive, averaging 100 ms in
>> some cases. In cgroup_attach_task, it is used to prevent
>> a task->cgroups pointer dereferenced in an RCU read side
>> critical section from being invalidated by delaying the call
>> to put_css_set until after an RCU grace period.
>>
>> To avoid the call to synchronize_rcu, make the put_css_set
>> call rcu-safe by moving the deletion of the css_set links
>> into rcu-protected free_css_set_rcu.
>>
>> The calls to check_for_release in free_css_set_rcu now occur
>> in softirq context, so convert all uses of the
>> release_list_lock spinlock to irq safe versions.
>>
>> The decrement of the cgroup refcount is no longer
>> synchronous with the call to put_css_set, which can result
>> in the cgroup refcount staying positive after the last call
>> to cgroup_attach_task returns. To allow the cgroup to be
>> deleted with cgroup_rmdir synchronously after
>> cgroup_attach_task, introduce a second refcount,
>> rmdir_count, that is decremented synchronously in
>> put_css_set. If cgroup_rmdir is called on a cgroup for
>> which rmdir_count is zero but count is nonzero, reuse the
>> rmdir waitqueue to block the rmdir until the rcu callback
>> is called.
>>
>> Signed-off-by: Colin Cross <ccross@android.com>
>> ---
>>
>> This patch is similar to what you described. The main differences are
>> that I used a new atomic to handle the rmdir case, and I converted
>> check_for_release to be callable in softirq context rather than schedule
>> work in free_css_set_rcu. Your css_set scanning in rmdir sounds better,
>> I'll take another look at that. Is there any problem with disabling irqs
>> with spin_lock_irqsave in check_for_release?
>>
>> include/linux/cgroup.h | 6 ++
>> kernel/cgroup.c | 124 ++++++-----
>> 2 files changed, 78 insertions(+), 52 deletions(-)
>>
>
> Colin, what became of this patch? I see this in your Tegra tree for
> Android.
>
>
> http://android.kernel.org/?p=kernel/tegra.git;a=commit;h=05946a1e0fdb011ac0e6638ee60b18
> 1c584f127b
>

```

> I looked in linux-next but didn't see it there. This resolves a  
> performance issue on MSM SMP so I'm curious if this is going upstream.  
> Thanks.  
>

It's been posted, there are no outstanding comments I am working on,  
but they haven't been picked up.

---

Containers mailing list

Containers@lists.linux-foundation.org

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

---

---

Subject: Re: [PATCH] cgroup: Remove call to synchronize\_rcu in  
cgroup\_attach\_task

Posted by [Bryan Huntsman](#) on Fri, 28 Jan 2011 01:17:18 GMT

[View Forum Message](#) <> [Reply to Message](#)

---

On 11/23/2010 05:43 PM, Colin Cross wrote:

> synchronize\_rcu can be very expensive, averaging 100 ms in  
> some cases. In cgroup\_attach\_task, it is used to prevent  
> a task->cgroups pointer dereferenced in an RCU read side  
> critical section from being invalidated by delaying the call  
> to put\_css\_set until after an RCU grace period.

>

> To avoid the call to synchronize\_rcu, make the put\_css\_set  
> call rcu-safe by moving the deletion of the css\_set links  
> into rcu-protected free\_css\_set\_rcu.

>

> The calls to check\_for\_release in free\_css\_set\_rcu now occur  
> in softirq context, so convert all uses of the  
> release\_list\_lock spinlock to irq safe versions.

>

> The decrement of the cgroup refcount is no longer  
> synchronous with the call to put\_css\_set, which can result  
> in the cgroup refcount staying positive after the last call  
> to cgroup\_attach\_task returns. To allow the cgroup to be  
> deleted with cgroup\_rmdir synchronously after  
> cgroup\_attach\_task, introduce a second refcount,  
> rmdir\_count, that is decremented synchronously in  
> put\_css\_set. If cgroup\_rmdir is called on a cgroup for  
> which rmdir\_count is zero but count is nonzero, reuse the  
> rmdir waitqueue to block the rmdir until the rcu callback  
> is called.

>

> Signed-off-by: Colin Cross <[ccross@android.com](mailto:ccross@android.com)>

> ---

>

```

> This patch is similar to what you described. The main differences are
> that I used a new atomic to handle the rmdir case, and I converted
> check_for_release to be callable in softirq context rather than schedule
> work in free_css_set_rcu. Your css_set scanning in rmdir sounds better,
> I'll take another look at that. Is there any problem with disabling irqs
> with spin_lock_irqsave in check_for_release?
>
> include/linux/cgroup.h | 6 ++
> kernel/cgroup.c | 124 ++++++-----
> 2 files changed, 78 insertions(+), 52 deletions(-)
>
> diff --git a/include/linux/cgroup.h b/include/linux/cgroup.h
> index ed4ba11..3b6e73d 100644
> --- a/include/linux/cgroup.h
> +++ b/include/linux/cgroup.h
> @@ -202,6 +202,12 @@ struct cgroup {
>  atomic_t count;
>
>  /*
>  * separate refcount for rmdir on a cgroup. When rmdir_count is 0,
>  * rmdir should block until count is 0.
>  */
>  atomic_t rmdir_count;
>
>  /*
>  * We link our 'sibling' struct into our parent's 'children'.
>  * Our children link their 'sibling' into our 'children'.
>  */
> diff --git a/kernel/cgroup.c b/kernel/cgroup.c
> index 66a416b..fa3c0ac 100644
> --- a/kernel/cgroup.c
> +++ b/kernel/cgroup.c
> @@ -267,6 +267,33 @@ static void cgroup_release_agent(struct work_struct *work);
> static DECLARE_WORK(release_agent_work, cgroup_release_agent);
> static void check_for_release(struct cgroup *cgrp);
>
>  /*
>  * A queue for waiters to do rmdir() cgroup. A tasks will sleep when
>  * cgroup->count == 0 && list_empty(&cgroup->children) && subsys has some
>  * reference to css->refcnt. In general, this refcnt is expected to goes down
>  * to zero, soon.
>  *
>  * CGRP_WAIT_ON_RMDIR flag is set under cgroup's inode->i_mutex;
>  */
> +DECLARE_WAIT_QUEUE_HEAD(cgroup_rmdir_waitq);
> +
> +static void cgroup_wakeup_rmdir_waiter(struct cgroup *cgrp)
> +{

```

```

> + if (unlikely(test_and_clear_bit(CGRP_WAIT_ON_RMDIR, &cgrp->flags)))
> + wake_up_all(&cgroup_rmdir_waitq);
> +}
> +
> +void cgroup_exclude_rmdir(struct cgroup_subsys_state *css)
> +{
> + css_get(css);
> +}
> +
> +void cgroup_release_and_wakeup_rmdir(struct cgroup_subsys_state *css)
> +{
> + cgroup_wakeup_rmdir_waiter(css->cgroup);
> + css_put(css);
> +}
> +
> /* Link structure for associating css_set objects with cgroups */
> struct cg_cgroup_link {
> /*
> @@ -329,6 +356,22 @@ static struct hlist_head *css_set_hash(struct cgroup_subsys_state
> *css[])
> static void free_css_set_rcu(struct rcu_head *obj)
> {
> struct css_set *cg = container_of(obj, struct css_set, rcu_head);
> + struct cg_cgroup_link *link;
> + struct cg_cgroup_link *saved_link;
> +
> + /* Nothing else can have a reference to cg, no need for css_set_lock */
> + list_for_each_entry_safe(link, saved_link, &cg->cg_links,
> + cg_link_list) {
> + struct cgroup *cgrp = link->cgrp;
> + list_del(&link->cg_link_list);
> + list_del(&link->cgrp_link_list);
> + if (atomic_dec_and_test(&cgrp->count)) {
> + check_for_release(cgrp);
> + cgroup_wakeup_rmdir_waiter(cgrp);
> + }
> + kfree(link);
> + }
> +
> kfree(cg);
> }
>
> @@ -355,23 +398,20 @@ static void __put_css_set(struct css_set *cg, int taskexit)
> return;
> }
>
> - /* This css_set is dead. unlink it and release cgroup refcounts */
> hlist_del(&cg->hlist);

```

```

> css_set_count--;
>
> + /* This css_set is now unreachable from the css_set_table, but RCU
> + * read-side critical sections may still have a reference to it.
> + * Decrement the cgroup rmdir_count so that rmdir's on an empty
> + * cgroup can block until the free_css_set_rcu callback */
> list_for_each_entry_safe(link, saved_link, &cg->cg_links,
>   cg_link_list) {
>   struct cgroup *cgrp = link->cgrp;
>   list_del(&link->cg_link_list);
>   list_del(&link->cgrp_link_list);
>   if (atomic_dec_and_test(&cgrp->count) &&
>       notify_on_release(cgrp)) {
>       if (taskexit)
>       set_bit(CGRP_RELEASABLE, &cgrp->flags);
>       check_for_release(cgrp);
>   }
>
>   kfree(link);
>   if (taskexit)
>   set_bit(CGRP_RELEASABLE, &cgrp->flags);
>   atomic_dec(&cgrp->rmdir_count);
>   smp_mb();
> }
>
> write_unlock(&css_set_lock);
> @@ -571,6 +611,8 @@ static void link_css_set(struct list_head *tmp_cg_links,
>   cgrp_link_list);
> link->cg = cg;
> link->cgrp = cgrp;
> + atomic_inc(&cgrp->rmdir_count);
> + smp_mb(); /* make sure rmdir_count increments first */
>   atomic_inc(&cgrp->count);
>   list_move(&link->cgrp_link_list, &cgrp->css_sets);
>   /*
> @@ -725,9 +767,9 @@ static struct cgroup *task_cgroup_from_root(struct task_struct *task,
>   * cgroup_attach_task(), which overwrites one task's cgroup pointer with
>   * another. It does so using cgroup_mutex, however there are
>   * several performance critical places that need to reference
>   * task->cgroup without the expense of grabbing a system global
>   * task->cgroups without the expense of grabbing a system global
>   * mutex. Therefore except as noted below, when dereferencing or, as
>   * in cgroup_attach_task(), modifying a task's cgroup pointer we use
>   * in cgroup_attach_task(), modifying a task's cgroups pointer we use
>   * task_lock(), which acts on a spinlock (task->alloc_lock) already in
>   * the task_struct routinely used for such matters.
>   *
> @@ -909,33 +951,6 @@ static void cgroup_d_remove_dir(struct dentry *dentry)

```

```

> }
>
> /*
> - * A queue for waiters to do rmdir() cgroup. A tasks will sleep when
> - * cgroup->count == 0 && list_empty(&cgroup->children) && subsys has some
> - * reference to css->refcnt. In general, this refcnt is expected to goes down
> - * to zero, soon.
> - *
> - * CGRP_WAIT_ON_RMDIR flag is set under cgroup's inode->i_mutex;
> - */
> -DECLARE_WAIT_QUEUE_HEAD(cgroup_rmdir_waitq);
> -
> -static void cgroup_wakeup_rmdir_waiter(struct cgroup *cgrp)
> -{
> - if (unlikely(test_and_clear_bit(CGRP_WAIT_ON_RMDIR, &cgrp->flags)))
> - wake_up_all(&cgroup_rmdir_waitq);
> -}
> -
> -void cgroup_exclude_rmdir(struct cgroup_subsys_state *css)
> -{
> - css_get(css);
> -}
> -
> -void cgroup_release_and_wakeup_rmdir(struct cgroup_subsys_state *css)
> -{
> - cgroup_wakeup_rmdir_waiter(css->cgroup);
> - css_put(css);
> -}
> -
> -/*
> * Call with cgroup_mutex held. Drops reference counts on modules, including
> * any duplicate ones that parse_cgroupfs_options took. If this function
> * returns an error, no reference counts are touched.
> @@ -1802,7 +1817,7 @@ int cgroup_attach_task(struct cgroup *cgrp, struct task_struct *tsk)
> ss->attach(ss, cgrp, oldcgrp, tsk, false);
> }
> set_bit(CGRP_RELEASABLE, &oldcgrp->flags);
> - synchronize_rcu();
> + /* put_css_set will not destroy cg until after an RCU grace period */
> put_css_set(cg);
>
> /*
> @@ -3566,11 +3581,12 @@ static int cgroup_rmdir(struct inode *unused_dir, struct dentry
> *dentry)
> DEFINE_WAIT(wait);
> struct cgroup_event *event, *tmp;
> int ret;
> + unsigned long flags;

```

```

>
> /* the vfs holds both inode->i_mutex already */
> again:
> mutex_lock(&cgroup_mutex);
> - if (atomic_read(&cgrp->count) != 0) {
> + if (atomic_read(&cgrp->rmdir_count) != 0) {
> mutex_unlock(&cgroup_mutex);
> return -EBUSY;
> }
> @@ -3603,13 +3619,13 @@ again:
>
> mutex_lock(&cgroup_mutex);
> parent = cgrp->parent;
> - if (atomic_read(&cgrp->count) || !list_empty(&cgrp->children)) {
> + if (atomic_read(&cgrp->rmdir_count) || !list_empty(&cgrp->children)) {
> clear_bit(CGRP_WAIT_ON_RMDIR, &cgrp->flags);
> mutex_unlock(&cgroup_mutex);
> return -EBUSY;
> }
> prepare_to_wait(&cgroup_rmdir_waitq, &wait, TASK_INTERRUPTIBLE);
> - if (!cgroup_clear_css_refs(cgrp)) {
> + if (atomic_read(&cgrp->count) != 0 || !cgroup_clear_css_refs(cgrp)) {
> mutex_unlock(&cgroup_mutex);
> /*
> * Because someone may call cgroup_wakeup_rmdir_waiter() before
> @@ -3627,11 +3643,11 @@ again:
> finish_wait(&cgroup_rmdir_waitq, &wait);
> clear_bit(CGRP_WAIT_ON_RMDIR, &cgrp->flags);
>
> - spin_lock(&release_list_lock);
> + spin_lock_irqsave(&release_list_lock, flags);
> set_bit(CGRP_REMOVED, &cgrp->flags);
> if (!list_empty(&cgrp->release_list))
> list_del(&cgrp->release_list);
> - spin_unlock(&release_list_lock);
> + spin_unlock_irqrestore(&release_list_lock, flags);
>
> cgroup_lock_hierarchy(cgrp->root);
> /* delete this cgroup from parent->children */
> @@ -4389,6 +4405,8 @@ int cgroup_is_descendant(const struct cgroup *cgrp, struct
task_struct *task)
>
> static void check_for_release(struct cgroup *cgrp)
> {
> + unsigned long flags;
> +
> /* All of these checks rely on RCU to keep the cgroup
> * structure alive */

```



```

> if (cgroup_is_releasable(cgrp) && !atomic_read(&cgrp->count)
> @@ -4397,13 +4415,13 @@ static void check_for_release(struct cgroup *cgrp)
> * already queued for a userspace notification, queue
> * it now */
> int need_schedule_work = 0;
> - spin_lock(&release_list_lock);
> + spin_lock_irqsave(&release_list_lock, flags);
> if (!cgroup_is_removed(cgrp) &&
>     list_empty(&cgrp->release_list)) {
>     list_add(&cgrp->release_list, &release_list);
>     need_schedule_work = 1;
> }
> - spin_unlock(&release_list_lock);
> + spin_unlock_irqrestore(&release_list_lock, flags);
> if (need_schedule_work)
>     schedule_work(&release_agent_work);
> }
> @@ -4453,9 +4471,11 @@ EXPORT_SYMBOL_GPL(__css_put);
> */
> static void cgroup_release_agent(struct work_struct *work)
> {
> + unsigned long flags;
> +
>     BUG_ON(work != &release_agent_work);
>     mutex_lock(&cgroup_mutex);
> - spin_lock(&release_list_lock);
> + spin_lock_irqsave(&release_list_lock, flags);
>     while (!list_empty(&release_list)) {
>         char *argv[3], *envp[3];
>         int i;
> @@ -4464,7 +4484,7 @@ static void cgroup_release_agent(struct work_struct *work)
>         struct cgroup,
>         release_list);
>     list_del_init(&cgrp->release_list);
> - spin_unlock(&release_list_lock);
> + spin_unlock_irqrestore(&release_list_lock, flags);
>     pathbuf = kmalloc(PAGE_SIZE, GFP_KERNEL);
>     if (!pathbuf)
>         goto continue_free;
> @@ -4494,9 +4514,9 @@ static void cgroup_release_agent(struct work_struct *work)
>     continue_free:
>     kfree(pathbuf);
>     kfree(agentbuf);
> - spin_lock(&release_list_lock);
> + spin_lock_irqsave(&release_list_lock, flags);
> }
> - spin_unlock(&release_list_lock);
> + spin_unlock_irqrestore(&release_list_lock, flags);

```

```
> mutex_unlock(&cgroup_mutex);  
> }  
>
```

Tested-by: Mike Bohan <mbohan@codeaurora.org>

I'm responding on Mike's behalf and adding him to this thread. This patch improves launch time of a test app from ~700ms to ~250ms on MSM, with much lower variance across tests. We also see UI latency improvements, but have not quantified the gains.

- Bryan

--

Sent by an employee of the Qualcomm Innovation Center, Inc.  
The Qualcomm Innovation Center, Inc. is a member of the Code Aurora Forum.

---

Containers mailing list  
Containers@lists.linux-foundation.org  
<https://lists.linux-foundation.org/mailman/listinfo/containers>

---