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Subject: Re: [PATCH] Hookup group-scheduler with task container infrastructure  
Posted by [Srivatsa Vaddagiri](#) on Thu, 13 Sep 2007 12:27:21 GMT  
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On Wed, Sep 12, 2007 at 06:25:37PM +0200, Dmitry Adamushko wrote:

```
> > +    kfree(tg);  
> > +}  
>  
> kfree(tg->cfs_rq) && kfree(tg->se) ?
```

oops, yes!

```
> > +    if (tsk->sched_class != &fair_sched_class)  
> > +        goto done;  
>  
> this check should be redundant now with sched_can_attach() in place.
```

well, there is remote possibility that task could have changed policies between sched\_can\_attach() and sched\_move\_task()! In the updated patch below, I have put some hooks to deal with that scenario elsewhere also (in rt\_mutex\_setprio and \_\_setscheduler). Pls let me know if you see any issues with that.

```
> > +static void set_se_shares(struct sched_entity *se, unsigned long shares)  
> > +{  
> > +    struct cfs_rq *cfs_rq = se->cfs_rq;  
> > +    struct rq *rq = cfs_rq->rq;  
> > +    int on_rq;  
> > +  
> > +    spin_lock_irq(&rq->lock);  
> > +  
> > +    on_rq = se->on_rq;  
> > +    if (on_rq)  
> > +        __dequeue_entity(cfs_rq, se);  
> > +  
> > +    se->load.weight = shares;  
> > +    se->load.inv_weight = div64_64((1ULL<<32), shares);  
>  
> A bit of nit-picking... are you sure, there is no need in non '___'  
> versions of dequeue/enqueue() here (at least, for the sake of
```

You are right, we need the dequeue/enqueue\_entity here, as the sched entity load is changing in between the two function calls.

How does the updated patch look? (Thanks again for all your review so far!)

--

Add interface to control cpu bandwidth allocation to task-groups.

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Signed-off-by : Dhaval Giani <dhaval@linux.vnet.ibm.com>

```
---
include/linux/container_subsys.h | 6
init/Kconfig                      | 9 +
kernel/sched.c                   | 344 ++++++
kernel/sched_fair.c              | 3
kernel/sched_idletask.c          | 5
kernel/sched_rt.c                | 5
6 files changed, 355 insertions(+), 17 deletions(-)
```

Index: current/include/linux/container\_subsys.h

```
=====
--- current.orig/include/linux/container_subsys.h
+++ current/include/linux/container_subsys.h
@@ -36,3 +36,9 @@ SUBSYS(mem_container)
#endif
```

```
/* */
+
+#ifdef CONFIG_FAIR_GROUP_SCHED
+SUBSYS(cpu)
+#endif
```

```
+
+/* */
Index: current/init/Kconfig
```

```
=====
--- current.orig/init/Kconfig
+++ current/init/Kconfig
@@ -326,6 +326,15 @@ config RESOURCE_COUNTERS
    infrastructure that works with containers
    depends on CONTAINERS
```

```
+config FAIR_GROUP_SCHED
+ bool "Fair group scheduler"
+ depends on EXPERIMENTAL && CONTAINERS
+ help
+   This option enables you to group tasks and control CPU resource
+   allocation to such groups.
+
+ Say N if unsure.
+
```

```
config SYSFS_DEPRECATED
bool "Create deprecated sysfs files"
default y
```

Index: current/kernel/sched.c

```
=====
--- current.orig/kernel/sched.c
+++ current/kernel/sched.c
@@ -179,6 +179,58 @@ struct load_stat {
    unsigned long delta_fair, delta_exec, delta_stat;
};

#ifdef CONFIG_FAIR_GROUP_SCHED
+
+#include <linux/container.h>
+
+struct cfs_rq;
+
+/* task group related information */
+struct task_grp {
+ struct container_subsys_state css;
+ /* schedulable entities of this group on each cpu */
+ struct sched_entity **se;
+ /* runqueue "owned" by this group on each cpu */
+ struct cfs_rq **cfs_rq;
+ unsigned long shares;
+};
+
+/* Default task group's sched entity on each cpu */
+static DEFINE_PER_CPU(struct sched_entity, init_sched_entity);
+/* Default task group's cfs_rq on each cpu */
+static DEFINE_PER_CPU(struct cfs_rq, init_cfs_rq) ____cacheline_aligned_in_smp;
+
+static struct sched_entity *init_sched_entity_p[CONFIG_NR_CPUS];
+static struct cfs_rq *init_cfs_rq_p[CONFIG_NR_CPUS];
+
+/* Default task group.
+ * Every task in system belong to this group at bootup.
+ */
+static struct task_grp init_task_grp = {
+ .se = init_sched_entity_p,
+ .cfs_rq = init_cfs_rq_p,
+ };
+
+/* return group to which a task belongs */
+static inline struct task_grp *task_grp(struct task_struct *p)
+{
+ return container_of(task_subsys_state(p, cpu_subsys_id),
+ struct task_grp, css);

```



```

    on_rq = p->se.on_rq;
- if (on_rq)
+ if (on_rq) {
    dequeue_task(rq, p, 0);
+ if (task_running(rq, p))
+ p->sched_class->put_prev_task(rq, p);
+ }

    if (rt_prio(prio))
        p->sched_class = &rt_sched_class;
@@ -4007,6 +4051,7 @@ void rt_mutex_setprio(struct task_struct
    if (task_running(rq, p)) {
        if (p->prio > oldprio)
            resched_task(rq->curr);
+ p->sched_class->set_curr_task(rq);
    } else {
        check_preempt_curr(rq, p);
    }
@@ -4293,8 +4338,11 @@ recheck:
    }
    update_rq_clock(rq);
    on_rq = p->se.on_rq;
- if (on_rq)
+ if (on_rq) {
    deactivate_task(rq, p, 0);
+ if (task_running(rq, p))
+ p->sched_class->put_prev_task(rq, p);
+ }
    oldprio = p->prio;
    __setscheduler(rq, p, policy, param->sched_priority);
    if (on_rq) {
@@ -4307,6 +4355,7 @@ recheck:
    if (task_running(rq, p)) {
        if (p->prio > oldprio)
            resched_task(rq->curr);
+ p->sched_class->set_curr_task(rq);
    } else {
        check_preempt_curr(rq, p);
    }
@@ -6567,7 +6616,25 @@ void __init sched_init(void)
    init_cfs_rq(&rq->cfs, rq);
#ifdef CONFIG_FAIR_GROUP_SCHED
    INIT_LIST_HEAD(&rq->leaf_cfs_rq_list);
- list_add(&rq->cfs.leaf_cfs_rq_list, &rq->leaf_cfs_rq_list);
+ {
+ struct cfs_rq *cfs_rq = &per_cpu(init_cfs_rq, i);
+ struct sched_entity *se =
+ &per_cpu(init_sched_entity, i);

```



```

+ if (cont->parent->parent)
+ return ERR_PTR(-EINVAL);
+
+ tg = kzalloc(sizeof(*tg), GFP_KERNEL);
+ if (!tg)
+ return ERR_PTR(-ENOMEM);
+
+ tg->cfs_rq = kzalloc(sizeof(cfs_rq) * num_possible_cpus(), GFP_KERNEL);
+ if (!tg->cfs_rq)
+ goto err;
+ tg->se = kzalloc(sizeof(se) * num_possible_cpus(), GFP_KERNEL);
+ if (!tg->se)
+ goto err;
+
+ for_each_possible_cpu(i) {
+ struct rq *rq = cpu_rq(i);
+
+ cfs_rq = kcalloc_node(sizeof(struct cfs_rq), GFP_KERNEL,
+     cpu_to_node(i));
+ if (!cfs_rq)
+ goto err;
+
+ se = kcalloc_node(sizeof(struct sched_entity), GFP_KERNEL,
+     cpu_to_node(i));
+ if (!se)
+ goto err;
+
+ memset(cfs_rq, 0, sizeof(struct cfs_rq));
+ memset(se, 0, sizeof(struct sched_entity));
+
+ tg->cfs_rq[i] = cfs_rq;
+ init_cfs_rq(cfs_rq, rq);
+ cfs_rq->tg = tg;
+ list_add_rcu(&cfs_rq->leaf_cfs_rq_list, &rq->leaf_cfs_rq_list);
+
+ tg->se[i] = se;
+ se->cfs_rq = &rq->cfs;
+ se->my_q = cfs_rq;
+ se->load.weight = NICE_0_LOAD;
+ se->load.inv_weight = div64_64(1ULL<<32, NICE_0_LOAD);
+ se->parent = NULL;
+ }
+
+ tg->shares = NICE_0_LOAD;
+
+ /* Bind the container to task_grp object we just created */
+ tg->css.container = cont;
+
+

```

```

+ return &tg->css;
+
+err:
+ for_each_possible_cpu(i) {
+   if (tg->cfs_rq && tg->cfs_rq[i])
+     kfree(tg->cfs_rq[i]);
+   if (tg->se && tg->se[i])
+     kfree(tg->se[i]);
+ }
+ if (tg->cfs_rq)
+   kfree(tg->cfs_rq);
+ if (tg->se)
+   kfree(tg->se);
+ if (tg)
+   kfree(tg);
+
+ return ERR_PTR(-ENOMEM);
+}
+
+
+/* destroy runqueue etc associated with a task group */
+static void sched_destroy_group(struct container_subsys *ss,
+    struct container *cont)
+{
+   struct task_grp *tg = container_tg(cont);
+   struct cfs_rq *cfs_rq;
+   struct sched_entity *se;
+   int i;
+
+   for_each_possible_cpu(i) {
+     cfs_rq = tg->cfs_rq[i];
+     list_del_rcu(&cfs_rq->leaf_cfs_rq_list);
+   }
+
+   /* wait for possible concurrent references to cfs_rqs complete */
+   synchronize_sched();
+
+   /* now it should be safe to free those cfs_rqs */
+   for_each_possible_cpu(i) {
+     cfs_rq = tg->cfs_rq[i];
+     kfree(cfs_rq);
+
+     se = tg->se[i];
+     kfree(se);
+   }
+
+   kfree(tg->cfs_rq);
+   kfree(tg->se);

```



```

+ kfree(tg);
+}
+
+static int sched_can_attach(struct container_subsys *ss,
+    struct container *cont, struct task_struct *tsk)
+{
+ /* We don't support RT-tasks being in separate groups */
+ if (tsk->sched_class != &fair_sched_class)
+ return -EINVAL;
+
+ return 0;
+}
+
+/* change task's runqueue when it moves between groups */
+static void sched_move_task(struct container_subsys *ss, struct container *cont,
+    struct container *old_cont, struct task_struct *tsk)
+{
+ int on_rq, running;
+ unsigned long flags;
+ struct rq *rq;
+
+ rq = task_rq_lock(tsk, &flags);
+
+ if (tsk->sched_class != &fair_sched_class)
+ goto done;
+
+ update_rq_clock(rq);
+
+ running = task_running(rq, tsk);
+ on_rq = tsk->se.on_rq;
+
+ if (on_rq) {
+ dequeue_task(rq, tsk, 0);
+ if (unlikely(running))
+ tsk->sched_class->put_prev_task(rq, tsk);
+ }
+
+ set_task_cfs_rq(tsk);
+
+ if (on_rq) {
+ enqueue_task(rq, tsk, 0);
+ if (unlikely(running))
+ tsk->sched_class->set_curr_task(rq);
+ }
+
+done:
+ task_rq_unlock(rq, &flags);
+}

```

```

+
+static void set_se_shares(struct sched_entity *se, unsigned long shares)
+{
+ struct cfs_rq *cfs_rq = se->cfs_rq;
+ struct rq *rq = cfs_rq->rq;
+ int on_rq;
+
+ spin_lock_irq(&rq->lock);
+
+ on_rq = se->on_rq;
+ if (on_rq)
+ dequeue_entity(cfs_rq, se, 0);
+
+ se->load.weight = shares;
+ se->load.inv_weight = div64_64((1ULL<<32), shares);
+
+ if (on_rq)
+ enqueue_entity(cfs_rq, se, 0);
+
+ spin_unlock_irq(&rq->lock);
+}
+
+static ssize_t cpu_shares_write(struct container *cont, struct cftype *cftype,
+ struct file *file, const char __user *userbuf,
+ size_t nbytes, loff_t *ppos)
+{
+ int i;
+ unsigned long shareval;
+ struct task_grp *tg = container_tg(cont);
+ char buffer[2*sizeof(unsigned long) + 1];
+
+ if (nbytes > 2*sizeof(unsigned long)) /* safety check */
+ return -E2BIG;
+
+ if (copy_from_user(buffer, userbuf, nbytes))
+ return -EFAULT;
+
+ buffer[nbytes] = 0; /* nul-terminate */
+ shareval = simple_strtoul(buffer, NULL, 10);
+
+ tg->shares = shareval;
+ for_each_possible_cpu(i)
+ set_se_shares(tg->se[i], shareval);
+
+ return nbytes;
+}
+
+static u64 cpu_shares_read_uint(struct container *cont, struct cftype *cft)

```

```

+{
+ struct task_grp *tg = container_tg(cont);
+
+ return (u64) tg->shares;
+}
+
+struct cftype cpuctl_share = {
+ .name = "shares",
+ .read_uint = cpu_shares_read_uint,
+ .write = cpu_shares_write,
+};
+
+static int sched_populate(struct container_subsys *ss, struct container *cont)
+{
+ return container_add_file(cont, ss, &cpuctl_share);
+}
+
+struct container_subsys cpu_subsys = {
+ .name = "cpu",
+ .create = sched_create_group,
+ .destroy = sched_destroy_group,
+ .can_attach = sched_can_attach,
+ .attach = sched_move_task,
+ .populate = sched_populate,
+ .subsys_id = cpu_subsys_id,
+ .early_init = 1,
+};
+
+#endif /* CONFIG_FAIR_GROUP_SCHED */

```

Index: current/kernel/sched\_fair.c

=====

--- current.orig/kernel/sched\_fair.c

+++ current/kernel/sched\_fair.c

```

@@ -798,8 +798,7 @@ static inline struct cfs_rq *group_cfs_r
 */

```

```

static inline struct cfs_rq *cpu_cfs_rq(struct cfs_rq *cfs_rq, int this_cpu)
{
- /* A later patch will take group into account */
- return &cpu_rq(this_cpu)->cfs;
+ return cfs_rq->tg->cfs_rq[this_cpu];
}

```

/\* Iterate thr' all leaf cfs\_rq's on a runqueue \*/

Index: current/kernel/sched\_idletask.c

=====

--- current.orig/kernel/sched\_idletask.c

+++ current/kernel/sched\_idletask.c

```

@@ -50,6 +50,10 @@ static void task_tick_idle(struct rq *rq

```

```
{  
}
```

```
+static void set_curr_task_idle(struct rq *rq)
```

```
+{  
+}
```

```
+
```

```
/*
```

```
 * Simple, special scheduling class for the per-CPU idle tasks:
```

```
 */
```

```
@@ -66,6 +70,7 @@ static struct sched_class idle_sched_cla
```

```
.load_balance = load_balance_idle,
```

```
+ .set_curr_task      = set_curr_task_idle,
```

```
.task_tick = task_tick_idle,
```

```
/* no .task_new for idle tasks */
```

```
};
```

```
Index: current/kernel/sched_rt.c
```

```
=====
```

```
--- current.orig/kernel/sched_rt.c
```

```
+++ current/kernel/sched_rt.c
```

```
@@ -218,6 +218,10 @@ static void task_tick_rt(struct rq *rq,
```

```
{
```

```
}
```

```
+static void set_curr_task_rt(struct rq *rq)
```

```
+{
```

```
+}
```

```
+
```

```
static struct sched_class rt_sched_class __read_mostly = {
```

```
.enqueue_task = enqueue_task_rt,
```

```
.dequeue_task = dequeue_task_rt,
```

```
@@ -230,5 +234,6 @@ static struct sched_class rt_sched_class
```

```
.load_balance = load_balance_rt,
```

```
+ .set_curr_task      = set_curr_task_rt,
```

```
.task_tick = task_tick_rt,
```

```
};
```

```
--
```

```
Regards,
```

```
vatsa
```

---

```
Containers mailing list
```

```
Containers@lists.linux-foundation.org
```

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

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