
Subject: Re: [RFC] Control Groups Roadmap ideas
Posted by [Balbir Singh](#) on Sat, 12 Apr 2008 05:10:26 GMT
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On Fri, Apr 11, 2008 at 8:18 PM, Serge E. Hallyn <serue@us.ibm.com> wrote:

>
> Quoting Paul Menage (menage@google.com):
> > This is a list of some of the sub-projects that I'm planning for
> > Control Groups, or that I know others are planning on or working on.
> > Any comments or suggestions are welcome.
> >
> >
> > 1) Stateless subsystems
> > -----
> >
> > This was motivated by the recent "freezer" subsystem proposal, which
> > included a facility for sending signals to all members of a cgroup.
> > This wasn't specifically freezer-related, and wasn't even something
> > that needed particular per-cgroup state - its only state is that set
> > of processes, which is already tracked by cgroups. So it could
> > theoretically be mounted on multiple hierarchies at once, and wouldn't
> > need an entry in the css_set array.
> >
> > This would require a few internal plumbing changes in cgroups, in particular:
> >
> > - hashing css_set objects based on their cgroups rather than their css pointers
> > - allowing stateless subsystems to be in multiple hierarchies
> > - changing the way hierarchy ids are calculated - simply ORing
> > together the subsystem would no longer work since that could result in
> > duplicates
> >
> > 2) More flexible binding/unbinding/rebinding
> > -----
> >
> > Currently you can only add/remove subsystems to a hierarchy when it
> > has just a single (root) cgroup. This is a bit inflexible, so I'm
> > planning to support:
> >
> > - adding a subsystem to an existing hierarchy by automatically
> > creating a subsys state object for the new subsystem for each existing
> > cgroup in the hierarchy and doing the appropriate
> > can_attach()/attach_tasks() callbacks for all tasks in the system
> >
> > - removing a subsystem from an existing hierarchy by moving all tasks
> > to that subsystem's root cgroup and destroying the child subsystem
> > state objects
> >
> > - merging two existing hierarchies that have identical cgroup trees

> >

> > - (maybe) splitting one hierarchy into two separate hierarchies

> >

> > Whether all these operations should be forced through the mount()

> > system call, or whether they should be done via operations on cgroup

> > control files, is something I've not figured out yet.

>

> I'm tempted to ask what the use case is for this (I assume you have one,

> you don't generally introduce features for no good reason), but it

> doesn't sound like this would have any performance effect on the general

> case, so it sounds good.

>

> I'd stick with mount semantics. Just

> mount -t cgroup -o remount,devices,cpu none /devwh"

> should handle all cases, no?

>

>

>

> > 3) Subsystem dependencies

> > -----

> >

> > This would be a fairly simple change, essentially allowing one

> > subsystem to require that it only be mounted on a hierarchy when some

> > other subsystem was also present. The implementation would probably be

> > a callback that allows a subsystem to confirm whether it's prepared to

> > be included in a proposed hierarchy containing a specified subsystem

> > bitmask; it would be able to prevent the hierarchy from being created

> > by giving an error return. An example of a use for this would be a

> > swap subsystem that is mostly independent of the memory controller,

> > but uses the page-ownership tracking of the memory controller to

> > determine which cgroup to charge swap pages to. Hence it would require

> > that it only be mounted on a hierarchy that also included a memory

> > controller. The memory controller would make no such requirement by

> > itself, so could be used on its own without the swap controller.

> >

> >

> > 4) Subsystem Inheritance

> > -----

> >

> > This is an idea that I've been kicking around for a while trying to

> > figure out whether its usefulness is worth the in-kernel complexity,

> > versus doing it in userspace. It comes from the idea that although

> > cgroups supports multiple hierarchies so that different subsystems can

> > see different task groupings, one of the more common uses of this is

> > (I believe) to support a setup where say we have separate groups A, B

> > and C for one resource X, but for resource Y we want a group

> > consisting of A+B+C. E.g. we want individual CPU limits for A, B and

> > C, but for disk I/O we want them all to share a common limit. This can

> > be done from userspace by mounting two hierarchies, one for CPU and
> > one for disk I/O, and creating appropriate groupings, but it could
> > also be done in the kernel as follows:

> >

> > - each subsystem "foo" would have a "foo.inherit" file provided by
> > (and handled by) cgroups in each group directory

> >

> > - setting the foo.inherit flag (i.e. writing 1 to it) would cause
> > tasks in that cgroup to share the "foo" subsystem state with the
> > parent cgroup

> >

> > - from the subsystem's point of view, it would only need to worry
> > about its own foo_cgroup objects and which task was associated with
> > each object; the subsystem wouldn't need to care about which tasks
> > were part of each cgroup, and which cgroups were sharing state; that
> > would all be taken care of by the cgroup framework

> >

> > I've mentioned this a couple of times on the containers list as part
> > of other random discussions; at one point Serge Hallyn expressed some
> > interest but there's not been much noise about it either way. I
> > figured I'd include it on this list anyway to see what people think of
> > it.

>

> I guess I'm hoping that if libcg goes well then a userspace daemon can
> do all we need. Of course the use case I envision is having a container
> which is locked to some amount of ram, wherein the container admin wants
> to lock some daemon to a subset of that ram. If the host admin lets the
> container admin edit a config file (or talk to a daemon through some
> sock designated for the container) that will only create a child of the
> container's cgroup, that's probably great.

>

I thought of doing something like this in libcg (having a daemon and a
client socket interface), but dropped the idea later. When all
controllers support multi-levels well, the plan is to create a
sub-directory in the cgroup hierarchy and give subtree ownership to
the application administrator.

> So I'm basically being quiet until I see whether libcg will suffice.

>

If you do have any specific requirements, we can cater to them right
now. Please do let us know. The biggest challenge right now is getting
a stable API.

>

>

> > 5) "procs" control file

> > -----
> >
> > This would be the equivalent of the "tasks" file, but acting/reporting
> > on entire thread groups. Not sure exactly what the read semantics
> > should be if a sub-thread of a process is in the cgroup, but not its
> > thread group leader.
> >
> >
> > 6) Statistics / binary API
> > ----
> >
> > Balaji Rao is working on a generic way to gather per-subsystem
> > statistics; it would also be interesting to construct an extensible
> > binary API via taskstats. One possible way to do this (taken from my
> > email earlier today) would be:
> >
> > With the taskstats interface, we could have operations to:
> >
> > - describe the API exported by a given subsystem (automatically
> > generated, based on its registered control files and their access
> > methods)
> >
> > - retrieve a specified set of stats in a binary format
> >
> > So as a concrete example, with the memory, cpuacct and cpu subsystems
> > configured, the reported API might look something like (in pseudo-code
> > form)
> >
> > 0 : memory.usage_in_bytes : u64
> > 1 : memory.limit_in_bytes : u64
> > 2 : memory.failcnt : u64
> > 3 : memory.stat : map
> > 4 : cpuacct.usage : u64
> > 5 : cpu.shares : u64
> > 6 : cpu.rt_runtime_ms : s64
> > 7 : cpu.stat : map
> >
> > This list would be auto-generated by cgroups based on inspection of
> > the control files.
> >
> > The user could then request stats 0, 3 and 7 for a cgroup to get the
> > memory.usage_in_bytes, memory.stat and cpu.stat statistics.
> >
> > The stats could be returned in a binary format; the format for each
> > individual stat would depend on the type of that stat, and these could
> > be simply concatenated together.
> >
> > A u64 or s64 stat would simply be a 64-bit value in the data stream

> >
> > A map stat would be represented as a sequence of 64-bit values,
> > representing the values in the map. There would be no need to include
> > the size of the map or the key ordering in the binary format, since
> > userspace could determine that by reading the ASCII version of the map
> > control file once at startup.
> >
> > So in the case of the request above for stats 0, 3 & 7, the binary
> > stats stream would be a sequence of 64-bit values consisting of:
> >
> > <memory.usage>
> > <memory.stat.cache>
> > <memory.stat.rss>
> > <memory.stat.active>
> > <memory.stat.inactive>
> > <cpu.stat.utime>
> > <cpu.stat.stime>
> >
> > If more stats were added to memory.stat or cpu.stat by a future
> > version of the code, then they would automatically appear; any that
> > userspace didn't understand it could ignore.
> >
> > The userspace side of this could be handled by libcg.
> >

Yes, it can be easily handled by libcg. I think this is an important piece of the cgroup infrastructure.

> > 8) Subsystems from modules
> > -----
> >
> > Having completely unknown subsystems registered at run time would
> > involve adding a bunch of complexity and additional locking to cgroups
> > - but allowing a subsystem to be known at compile time but just
> > stubbed until first mounted (at which time its module would be loaded)
> > should increase the flexibility of cgroups without hurting its
> > complexity or performance.
> >
> >
> > 7) New subsystems
> > -----
> >
> > - Swap, disk I/O - already being worked on by others
> >
> > - OOM handler. Exactly what semantics this should provide aren't 100%
> > clear. At Google we have a useful OOM handler that allows root to
> > intercept OOMs as they're about to happen, and take appropriate action
> > such as killing some other lower-priority job to free up memory, etc.

> > Another useful feature of this subsystem might be to allow a process
> > in that cgroup to get an early notification that its cgroup is getting
> > close to OOM. This needs to be a separate subsystem since it could be
> > used to provide OOM notification/handling for localized OOMs caused
> > either by cpusets or the memory controller.
> >
> > - network tx/rx isolation. The cleanest way that we've found to do
> > this is to provide a per-cgroup id which can be exposed as a traffic
> > filter for regular Linux traffic control - then you can construct
> > arbitrary network queueing structures without requiring any new APIs,
> > and tie flows from particular cgroups into the appropriate queues.
> >
> >
> > 8) per-mm owner field
> > ----
> >
> > To remove the need for per-subsystem counted references from the mm.
> > Being developed by Balbir Singh
>

I have version 9 out. It has all the review comments incorporated. If the patch seems reasonable, I'll ask Andrew to include it.

> I'm slooowly trying to whip together a swapfile namespace - not a
> cgroup - which ties a swapfns to a list of swapfiles (where each
> swapfile belongs to only one swapfns). So I also need an mm->task
> pointer of some kind. I've got my own in my patches right now but
> sure do hope to make use of Balbir's mm owner field.

Serge, do you have any specific requirements for the mm owner field.
Will the current patch meet your requirements (including
mm_owner_changed field callbacks)?

Balbir

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