Subject: Re: [RFC] kernel/pid.c pid allocation wierdness
Posted by William Lee Irwin III on Thu, 15 Mar 2007 20:26:54 GMT
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William Lee Irwin III <wli@holomorphy.com> writes:
>> Radix trees' space behavior is extremely poor in sparsely-populated
>> index spaces. There is no way they would save space or even come close
>> to the current space footprint.

On Wed, Mar 14, 2007 at 10:54:07AM -0600, Eric W. Biederman wrote:
> Possibly.  We aren't that sparsely populated when it comes to pids.
> Hash tables aren't good at saving space either, and when they are space
> efficient they are on the edge of long hash chains so they are on
> the edge of performance problems.  There is at least one variant of the
> fib tree that is as space efficient as any binary tree but works by
> looking at bits.  Not that I think that one makes much sense.

I'd not mind something better than a hashtable. The fib tree may make
more sense than anticipated. It's truly better to switch data structures
completely than fiddle with e.g. hashtable sizes. However, bear in mind
the degenerate space behavior of radix trees in sparse contexts.

William Lee Irwin III <wli@holomorphy.com> writes:
>> Lock contention here would be a severe functional regression (note
>> "functional," not "performance;" the lock contention surrounding these
>> affairs takes down systems vs. mere slowdown nonsense), so it would
>> necessarily depend on lockless radix tree code for correctness.

On Wed, Mar 14, 2007 at 10:54:07AM -0600, Eric W. Biederman wrote:
> I don't know about the existing in kernel implementations but there is no
> reason we could not have an rcu protected radix tree.  At which point the
> challenges are about the same but we have indexes that would help us find
> the next free bit, which could reduce cpu time.

RCU'ing radix trees is trendy but the current implementation needs a
spinlock where typically radix trees do not need them for RCU. I'm
talking this over with others interested in lockless radix tree
algorithms for reasons other than concurrency and/or parallelism.

On Wed, Mar 14, 2007 at 10:54:07AM -0600, Eric W. Biederman wrote:
> The current pid implementation does not scale to larger process counts
> particularly well.  The hash table size is fixed so we get a lot of hash
> collisions etc.  Several other things go wonky as well.  The one time
> I actually had 64K pids on a system (most of them zombies) it was not
> a very pleasant situation.

If you've got a microbenchmark that would be convenient for me to use
while addressing it, unless you'd prefer to take it on yourself.
Otherwise I can always write one myself.

On Wed, Mar 14, 2007 at 10:54:07AM -0600, Eric W. Biederman wrote:
> It isn't common that we push the pid count up, and with the normal pid
> counts the current data structures seem very well suited to the
> problem.  I have been looking at the data structures though in case it
> ever changes because the current good behavior seems quite fragile.
> Not that I am advocating changing anything yet, but I'm thinking about
> it so when we do come to the point where it matters we can make a
> reasonable change.

I'd say you already have enough evidence to motivate a change of data
structure. Tree hashing (e.g. using balanced search trees in collision
chains) is generally good for eliminating straight-line issues of this
form but the available in-kernel tree structures don't do so well in
concurrent/parallel contexts and the utility of hashing becomes somewhat
questionable afterward given the stringent limits kernel environments
impose on pid spaces. I favor Peter Zijlstra's B+ trees once a few
relatively minor issues are addressed on account of good behavior in
sparse keyspaces, though cleanups (not stylistic) of radix trees' space
behavior may yet render them suitable, and may also be more popular to
pursue.

Basically all that's needed for radix trees' space behavior to get
fixed up is proper path compression as opposed to the ->depth hack.
Done properly it also eliminates the need for a spinlock around the
whole radix tree for RCU.

William Lee Irwin III <wli@holomorphy.com> writes:
>> The comment block describing the hashtable locking is stale and should
>> have been updated in tandem with the RCU changes.

On Wed, Mar 14, 2007 at 10:54:07AM -0600, Eric W. Biederman wrote:
> Feel free to submit the patch.  I didn't make the RCU changes just took
> advantage of them.

I needed to note that because it and my description were in direct
conflict. I'd rather leave it for a kernel janitor or someone who needs
to get patches under their belt to sweep up as I've got enough laurels
to rest on and other areas where I can get large amounts of code in
easily enough, provided I get my act together on various fronts.

-- wli

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