Subject: Re: [PATCH] Memory controller Add Documentation Posted by Randy Dunlap on Wed, 22 Aug 2007 16:46:33 GMT

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On Wed, 22 Aug 2007 18:36:12 +0530 Balbir Singh wrote:

Is there some sub-dir that is appropriate for this, such as vm/ or accounting/ or containers/ (new)?

- > 1 file changed, 193 insertions(+)
- >
- > diff -puN /dev/null Documentation/memcontrol.txt
- > --- /dev/null 2007-06-01 20:42:04.000000000 +0530
- > +++ linux-2.6.23-rc2-mm2-balbir/Documentation/memcontrol.txt 2007-08-22 18:29:29.00000000 +0530
- > @ @ -0,0 +1,193 @ @
- > +Memory Controller
- > +
- > +0. Salient features
- > 4
- > +a. Enable control of both RSS and Page Cache pages
- > +b. The infrastructures allows easy addition of other types of memory to control

infrastructure

- > +c. Provides *zero overhead* for non memory controller users
- > +d. Provides a double LRU, global memory pressure causes reclaim from the
- > + global LRU, a container on hitting a limit, reclaims from the per
- > + container LRU

Punctuation:

Provides a double LRU: global memory pressure causes reclaim from the global LRU; a container, on hitting a limit, reclaims from the percontainer LRU

- > +
- > +1. History
- > +
- > +The memory controller has a long history. A request for comments for the memory
- > +controller was posted by Balbir Singh [1]. At the time the RFC was posted
- > +there were several implementations for memory control, the goal of the
- s/, the/. The/

- > +RFC was to build consensus and agreement for the minimal features required
- > +for memory control. The first RSS controller was posted by Balbir Singh[2]
- > +in Feb 2007. Pavel Emelianov [3][4][5] has since posted three versions of the
- > +RSS controller. At OLS, at the resource management BoF, everyone suggested
- > +that we handle both page cache and RSS together. Another request was raised
- > +to allow user space handling of OOM. The current memory controller is
- > +at version 6, it combines both RSS and Page Cache Control [11].

s/,/;/

- > +2. Memory Control
- > +Memory is a unique resource in the sense that it is present in a limited
- > +amount. If a task requires a lot of CPU processing, the task can spread
- > +its processing over a period of hours, days, months or years, but with
- > +memory, the same physical memory needs to be reused to accomplish the task.
- > +The memory controller implementation has been divided into phases, these
- > +are

Punctuation:

The memory controller implementation has been divided into phases. These are:

```
> +1. Memory controller
> +2. mlock(2) controller
> +3. Kernel user memory accounting and slab control
> +4. user mappings length controller
> +
> +The memory controller is the first controller developed.
> +2.1. Design
> +The core of the design is a counter called the res_counter. The res_counter
> +tracks the current memory usage and limit of the group of processes associated
> +with the controller. Each container has a memory controller specific data
> +structure (mem_container) associated with it.
> +
> +2.2. Accounting
> + +-----+
> + | mem_container
> + | (res_counter)
> + +-----+
```

^ \

> + /

```
> + /
          | \
        +----- |
        mm_struct | .... | mm_struct
        +----+
                  +----> page container
        page
         (Figure 1: Hierarchy of Accounting)
> +Figure 1 shows the important aspects of the controller
> +1. Accounting happens per container
> +2. Each mm_struct knows about which container they belong to
```

it belongs to

- > +3. Each page has a pointer to the page_container, which in turn knows the
- > + container it belongs to

> +

> +The accounting is done as follows, mem_container_charge() is invoked to setup

as follows:

- > +the necessary data structures and check if the container that is being charged
- > +is over its limit. If it is then reclaim is invoked on the container.
- > +More details can be found in the reclaim section of this document.
- > +If everything goes well, a page meta-data-structure called page_container is
- > +allocated and associated with the page. This routine also adds the page to
- > +the per container LRU.

> +2.3 Shared Page Accounting

- > +Shared pages are accounted on the basis of the first touch approach. The
- > +container that first touches a page is accounted for the page. The principle
- > +behind this approach is that a container that aggressively uses a shared
- > +page, will eventually get charged for it (once it is uncharged from

drop comma

> +the container that brought it in -- this will happen on memory pressure).

> +

```
> +2.4 Reclaim
> +Each container maintains a per container LRU that consists of an active
> +and inactive list. When a container goes over its limit, we first try
> +and reclaim memory from the container so as to make space for the new
 to reclaim memory
> +pages that the container has touched. If the reclaim is unsuccessful,
> +an OOM routine is invoked to select and kill the bulkiest task in the
> +container.
> +
> +The reclaim algorithm has not been modified for containers, except that
> +pages that are selected for reclaiming come from the per container LRU
> +list.
> +
> +2.5
> +3. User Interface
> +0. Configuration
> +a. Enable CONFIG_CONTAINERS
> +b. Enable CONFIG RESOURCE COUNTERS
> +c. Enable CONFIG_CONTAINER_MEM_CONT
> +
> +1. Prepare the containers
> +# mkdir -p /containers
> +# mount -t container none /containers -o memory
> +2. Make the new group and move bash into it
> +# mkdir /containers/0
> +# echo $$ > /containers/0/tasks
> +Since now we're in the 0 container.
                      s/./,/
> +We can alter the memory limit
 we can alter the memory limit:
> +# echo -n 6000 > /containers/0/memory.limit
> +
```

> +We can check the usage

```
> +# cat /containers/0/memory.usage
> +25
> +
> +The memory.failcnt gives the number of times that the container limit was
    memory.failcnt field (?)
> +exceeded.
> +
> +4. Testing
> +Balbir posted Imbench, AIM9, LTP and vmmstress results [10] and [11].
> +Apart from that v6 has been tested with several applications and regular
> +daily use. The controller has also been tested on the PPC64, x86 64 and
> +UML platforms.
> +4.1 Troubleshooting
> +Sometimes a user might find that the application under a container is
> +terminated, there are several causes for this
Punctuation + wording:
 Sometimes a user might find that the application under a container is
 terminated. There are several possible causes of this:
> +1. The container limit is too low (just too low to do anything useful)
> +2. The user is using anonymous memory and swap is turned off or too low
> +echo 1 > /proc/sys/vm/drop pages will help get rid of some of the pages
> +cached in the container (page cache pages).
> +5. TODO
> +
> +1. Add support for accounting huge pages (as a separate controller)
> +2. Improve the user interface to accept/display memory limits in KB or MB
> + rather than pages (since page sizes can differ across platforms/machines).
> +3. Make container lists per-zone
> +4. Make per-container scanner reclaim not-shared pages first
> +5. Teach controller to account for shared-pages
> +6. Start reclamation when the limit is lowered
> +7. Start reclamation in the background when the limit is
> + not yet hit but the usage is getting closer
> +8. Create per zone LRU lists per container
> +Summary
> +
```

- > +Overall, the memory controller has been a stable controller and has been
- > +commented and discussed on quite extensively in the community.

drop "on"

> +References

- > +1. Singh, Balbir. RFC: Memory Controller, http://lwn.net/Articles/206697/
- > +2. Singh, Balbir. Memory Controller (RSS Control),
- > + http://lwn.net/Articles/222762/
- > +3. Emelianov, Pavel. Resource controllers based on process containers
- > + http://lkml.org/lkml/2007/3/6/198
- > +4. Emelianov, Pavel. RSS controller based on process containers (v2)
- > + http://lkml.org/lkml/2007/4/9/74
- > +5. Emelianov, Pavel. RSS controller based on process containers (v3)
- > + http://lkml.org/lkml/2007/5/30/244
- > +6. Menage, Paul. Containers v10, http://lwn.net/Articles/236032/
- > +7. Vaidyanathan, Srinivasan, Containers: Pagecache accounting and control
- > + subsystem (v3), http://lwn.net/Articles/235534/
- > +8. Singh, Balbir. RSS controller V2 test results (Imbench),
- > + http://lkml.org/lkml/2007/5/17/232
- > +9. Singh, Balbir. RSS controller V2 AIM9 results
- > + http://lkml.org/lkml/2007/5/18/1
- > +10. Singh, Balbir. Memory controller v6 results,
- > + http://lkml.org/lkml/2007/8/19/36
- > +11. Singh, Balbir. Memory controller v6, http://lkml.org/lkml/2007/8/17/69

~Randv

*** Remember to use Documentation/SubmitChecklist when testing your code ***

Containers mailing list

Containers@lists.linux-foundation.org

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

Subject: Re: [PATCH] Memory controller Add Documentation Posted by Balbir Singh on Wed, 22 Aug 2007 17:28:42 GMT

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Randy Dunlap wrote:

> On Wed, 22 Aug 2007 18:36:12 +0530 Balbir Singh wrote:

>

> Is there some sub-dir that is appropriate for this, such as

> vm/ or accounting/ or containers/ (new) ? > > <snip> Hi, Randy, Thanks for the detailed review. Most of the comments seem valid, I will fix them in the next release. Warm Regards, Balbir Singh Linux Technology Center IBM, ISTL Containers mailing list Containers@lists.linux-foundation.org

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