

Status of VmBatch – A virtualization tool for grid jobs

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What is VmBatch

- ▶ System for running batch jobs inside virtual machines.
- ▶ A new virtual machine will be created for each job.
 - Each job will run inside its own virtual machine.
- ▶ The virtual machine is removed when job finishes.
- ▶ Has been tested in our private AliEn testbed to run AliEn jobs.
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Why VmBatch

- ▶ Homogenize the execution environment.
- ▶ Sandbox the execution environment.
 - Improved security.
 - Less interference between jobs.
- ▶ Use CernVM for running AliEn jobs.
 - Make it easier to include new resources.
- ▶ Less complex than a full private cloud infrastructure.

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Cbatch – A project using containers

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- ▶ A system, *Cbatch* has been made that can run batch jobs inside Docker containers.
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How VmBatch works

- ▶ When the worker node Torque service (*pbs_mom*) receives a job, VmBatch will:
 - Start a virtual machine.
 - Run the job inside the virtual machine.
 - Stop and remove the virtual machine when the job has finished.
- ▶ VmBatch can use guest images located on the worker node, but can also download images from the net.
 - VmBatch can work with a stock CentOS/SLC and CernVM image.
 - No prior adaption of images is required.
- ▶ VmBatch can also create the empty disk image used by CernVM for the CernVM-FS cache.

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- ▶ Uses Libvirt for managing Xen guests.
- ▶ A VmBatch script **remoteshell** gives Torque access to guest.
 - Uses a SSH connection into the running guest.
 - Experimental support also for using the console of guest.
- ▶ Guest parameters (e.g.: notification that the guest is alive and ready, and IP of guest) are transferred to VmBatch using a NFS share.
- ▶ Uses Torque **prologue** script to setup and start guest.
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VmBatch will prepare the guest before running the job:

- ▶ The submitting user must be created.
- ▶ The job must be copied to the guest.
- ▶ The NFS share must be set up inside the guest.
- ▶ The guest network must be set up.
- ▶ Can unpack tar archives.
- ▶ Can enable and disable guest init services.

VmBatch contextualization approaches

DISK: Disk images are contextualized prior to starting guest.

- ▶ Currently no support for LVM disks.

CDROM: A CDROM ISO image is set up with contextualization parameters and scripts.

- ▶ Will work with a stock CernVM guest.

ROOTSSH: A SSH connection into guest is used for contextualization.

- ▶ Guest parameters through the kernel boot line.
- ▶ Guest must be set up in advance with VmBatch init scripts.

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Setup for testing of stability

- ▶ Torque server and one worker node with Xen.
- ▶ Run 20 000 jobs through VmBatch.
 - Have had failures after 8 000 jobs. Therefore 20 000.
 - Test will create, start and remove 20 000 virtual machines, one for each job.
- ▶ 5 jobs are kept in the job queue at any time.
- ▶ 2 jobs are run concurrently.

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Observed problems

- ▶ Libvirt suddenly dies.
- ▶ Libvirt can stop responding.
- ▶ Libvirt can exhaust host memory.
 - Does Libvirt/Xen on CentOS6 have a memory leak problem?
 - If killed by kernel (OOM killer), restarting the services does not always work. Host must be restarted.
- ▶ If Libvirt crashes when starting guest, the result can be a Xen Zombie.
 - Invisible to Libvirt, but
 - take up all assigned resources
 - A normal reboot of host is not possible. Require "reboot --force".
- ▶ SSH into the virtual machine might require more than one attempt.
 - Rarely. Has happened twice during all tests.
- ▶ Mounting the NFS share might require several attempts.
 - Rare, but does happen.

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- ▶ Monitor the memory consumption of Libvirt, and restart if necessary.
- ▶ Abort hanging Libvirt calls and restart the hypervisor services.
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Running the stability test

- ▶ Have successfully run the test with CentOS6 as host and guest.
 - All three contextualization methods have been tested with 20 000 jobs.
- ▶ Have also successfully run a test with CernVM.
- ▶ VmBatch has also been tested on SLC5, but not as extensively.
 - Had one case on SLC5 where the Xen daemon took all memory.

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- ▶ The stability tests test the normal behaviour of VmBatch.
- ▶ Necessary to test also the robustness:
 - How does VmBatch handle failed jobs?
 - How does VmBatch recover if aborted?
 - How does it handle problems with network connections, timeouts, missing resources?
 - What if bad configuration choices? Are the error messages useful?

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Setup for testing robustness

- ▶ Running and arbitrarily killing jobs.
 - Non-aborted jobs should run without problems.
- ▶ Running jobs and aborting VmBatch at critical points in the code.
 - Non-aborted jobs should run without problems.
- ▶ Rerunnable job and time out in the VmBatch code.
 - Timeout can happen when e.g. downloading large images.
 - The resubmitted job should run without problems.
- ▶ Rerunnable job and time out each time for the same job.
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Towards a robust solution of VmBatch

- ▶ Solved a synchronization problem related to NFS cache delays.
- ▶ The default Torque scheduler (*pbs_sched*) continues to resubmit a rerunnable job if VmBatch time out each time.
 - Stopped the test before job TTL expired.

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Running the robustness tests

- ▶ Have successfully run the tests using the Maui scheduler, and with CentOS6 as host and guest.
- ▶ Does the default Torque scheduler (*pbs_sched*) have a memory leak problem?
 - Had to monitor *pbs_sched* memory usage on the Torque server, and restart if to high.

More testing needed

- ▶ Need to rerun the robustness tests.
 - Updates due to the stability tests can have introduced new problems.
- ▶ Not all VmBatch working modes have been tested for stability and robustness.
 - All modes have been tested to run, both with Xen 3 and Xen 4.
- ▶ Need also to test longer running jobs.
- ▶ Have not tested error behaviour with bad configuration choices.
- ▶ February – Xen 4.6 for CentOS6 is available from CentOS.
 - Have just started tests with Xen 4.6.
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- ▶ If anyone would like to use or test VmBatch, I would be glad to help.
- ▶ Available through SVN – [Latest VmBatch version](#).
- ▶ Examples of HOWTOs:
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What next?

- ▶ KVM on CentOS7?
- ▶ Xen on CentOS7?
- ▶ KVM on SLC6?
- ▶ Slurm in addition to Torque?
- ▶ Support for LVM disk if DISK contextualization.
- ▶ Or, something else?