Putting your users in a Box

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Outline

- Why put job in a box?
- Old boxes that work everywhere*
  - *Everywhere that isn't Windows
- New shiny boxes

3 Protections

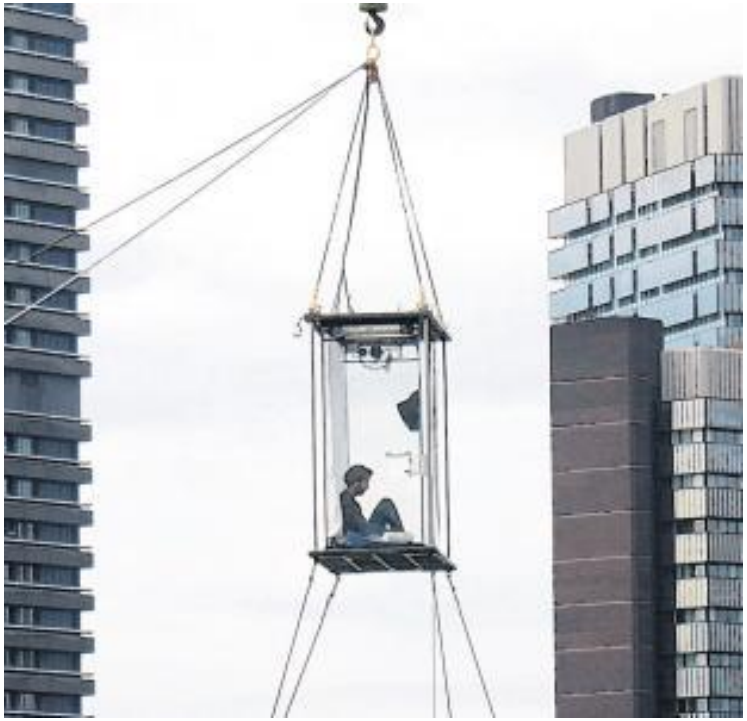
1) Protect the machine from the job.

2) Protect the job from the machine.

3) Protect one job from another.

The perfect box

- Allows nesting
- Need not require root
- Can't be broken out of
- Portable to all OSes
- Allows full management:
  - Creation // Destruction
  - Monitoring
  - Limiting



A Job ain't nothing but work

- Resources a job can (ab)use
  - CPU
  - Memory
  - Disk
  - Signals
  - Network.

Previous Solutions

- HTCondor Preempt expression
  - PREEMPT =

    TARGET.MemoryUsage > threshold
    - ProportionalSetSizeKb > threshold

- setrlimit call
  - USER_JOB_WRAPPER
  - STARTER_RLIMIT_AS

From here on out…

- Newish stuff

The Big Hammer

- Some people see this problem, and say
- "I know, we'll use a Virtual Machine"

Problems with VMs

- Might need hypervisor installed
  - The right hypervisor (the right Version…)
- Need to keep full OS image maintained
- Difficult to debug
- Hard to federate

- Just too heavyweight

Containers, not VMs

- Want opaque box
- Much LXC work applicable here
- Work with Best feature of HTCondor ever?

CPU AFFINITY

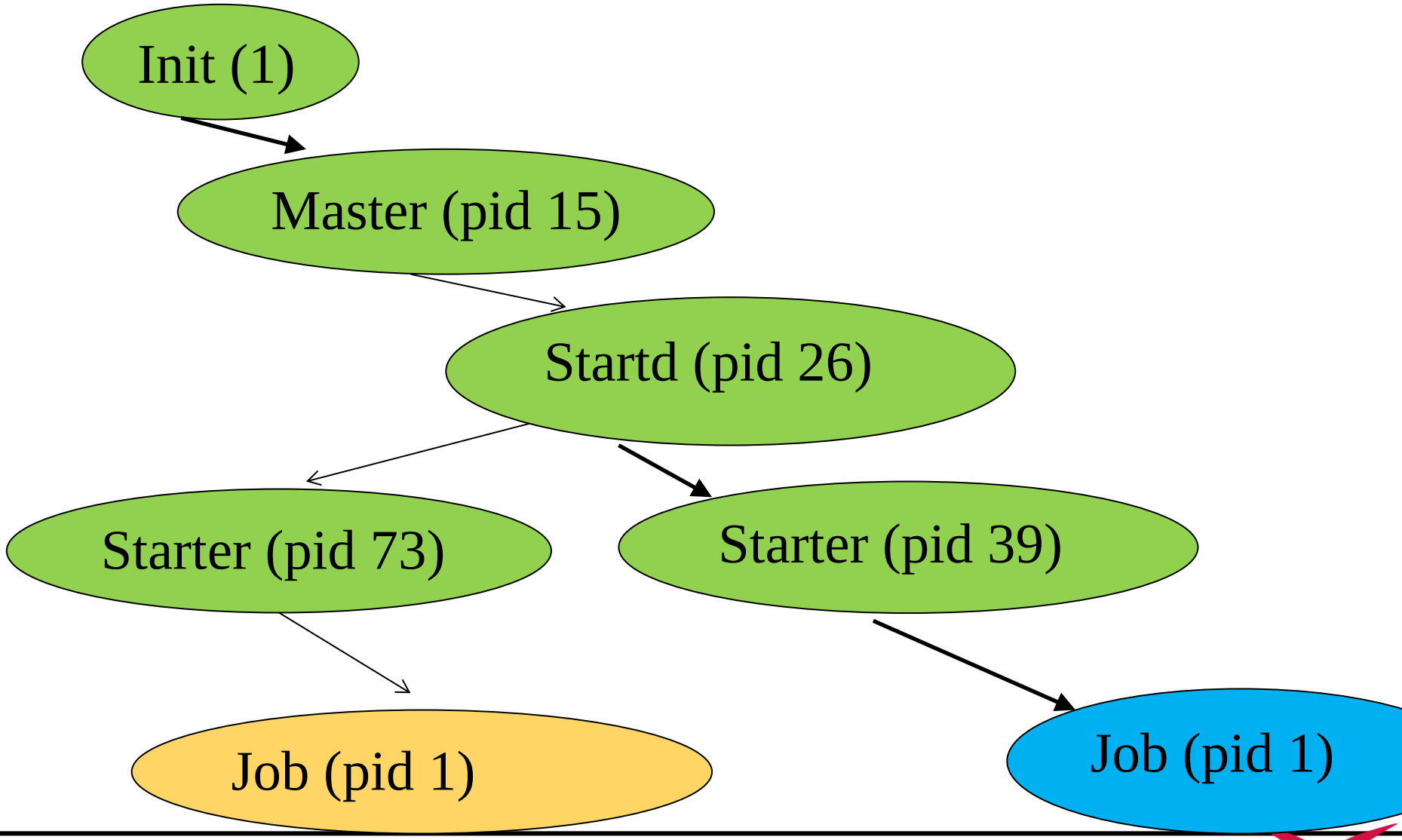
- ASSIGN_CPU_AFFINITY=true

- Now works with dynamic slots
- Need not be root
- Any Linux version
  - Only limits the job

PID namespaces

- You can't kill what you can't see
- Requirements:
  - HTCondor 7.9.4+
  - RHEL 6
  - `USE_PID_NAMESPACES = true`
    - (off by default)
  - Doesn't work with privsep
  - Must be root

PID Namespaces



Named Chroots

- “Lock the kids in their room”

- Startd advertises set
  - `NAMED_CHROOT = /foo/R1,/foo/R2`
- Job picks one:
  - `+RequestedChroot = “/foo/R1”`
- Make sure path is secure!

Control Groups aka “cgroups”

- Two basic kernel abstractions:
- 1) nested groups of processes
- 2) “controllers” which limit resources

Control Cgroup setup

- Implemented as filesystem
  - Mounted on /sys/fs/cgroup, or /cgroup or …
- User-space tools in flux
  - Systemd
  - Cgservice
- /proc/self/cgroup

Cgroup controllers

- Cpu
- Memory
- freezer

Enabling cgroups

- Requires:
  - RHEL6, RHEL7 even better
  - HTCondor 7.9.5+
  - Rootly condor

  - BASE_CGROUP=htcondor

  - And… cgroup fs mounted…

Cgroups with HTCondor

- Starter puts each job into own cgroup
  - Named exec_dir + job id
- Procd monitors
  - Procd freezes and kills atomically
- MEMORY attr into memory controller
- CGROUP_MEMORY_LIMIT_POLICY
  - Hard or soft
  - Job goes on hold with specific message

Cgroup artifacts

StarterLog:

```
04/22/13 11:39:08 Requesting cgroup
      htcondor/condor_exec_slot1@localhost for job
…
```

ProcLog

```
  cgroup to htcondor/condor_exec_slot1@localhost for ProcFamily
… 2727.
  04/22/13 11:39:13 : PROC_FAMILY_GET_USAGE
  04/22/13 11:39:13 : gathering usage data for family with root
  pid 2724
  04/22/13 11:39:17 : PROC_FAMILY_GET_USAGE
  04/22/13 11:39:17 : gathering usage
```

```
$ condor_q
-- Submitter: localhost : <127.0.0.1:58873> : localhost
 ID      OWNER            SUBMITTED RUN_TIME ST PRI SIZE
CMD
   2.0   gthain          4/22 11:36 0+00:00:02 R 0 0.0 sleep 3600
```

```
$ ps ax | grep 3600
gthain  2727  4268 4880 condor_exec.exe 3600
```

A process with Cgroups

```
$ cat /proc/2727/cgroup

3:freezer:/htcondor/condor_exec_slot1@localhost
2:memory:/htcondor/condor_exec_slot1@localhost
1:cpuacct,cpu:/htcondor/condor_exec_slot1@localhost
```

```
$ cd
/sys/fs/cgroup/memory/htcondor/condor_exec_sl
ot1@localhost/
$ cat memory.usage_in_bytes
258048
$ cat tasks
2727
```

MOUNT_UNDER_SCRATCH

- Or, “Shared subtrees”
- Goal: protect /tmp from shared jobs
- Requires
  - Condor 7.9.4+
  - RHEL 5
  - Doesn’t work with privsep
  - HTCondor must be running as root
  - MOUNT_UNDER_SCRATCH = /tmp,/var/tmp

MOUNT_UNDER_SCRATCH

```
MOUNT_UNDER_SCRATCH=/tmp,/var/tmp
```

Each job sees private /tmp, /var/tmp

Downsides:

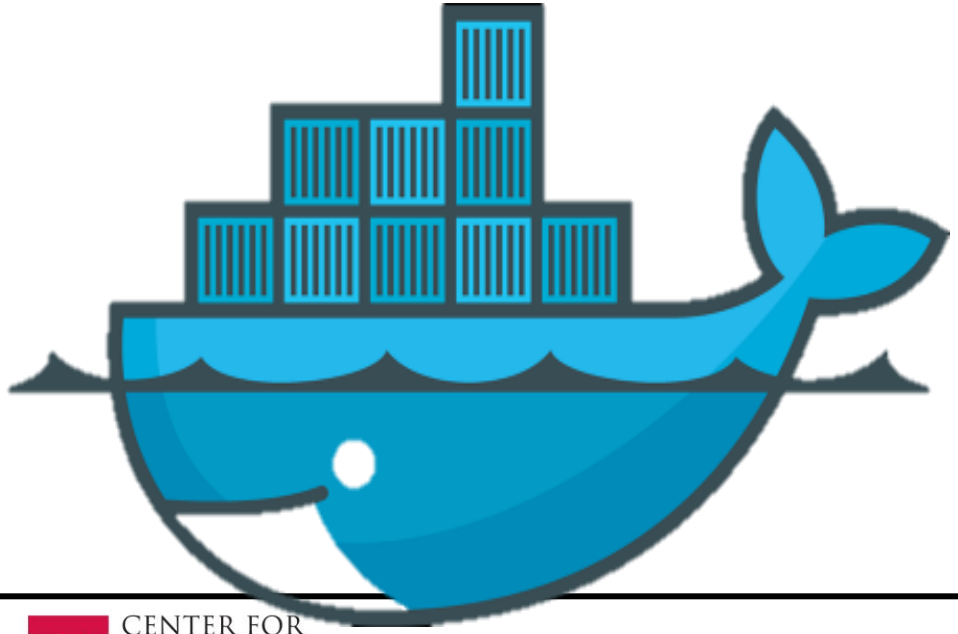
No sharing of files in /tmp

Future work

Future Work

Docker Universe

Containers give Linux processes a private:



- Cgroups +
- Repo for images
- Bind mounts

Conclusion

- Questions?

- See cgroup reference material in kernel doc
  - https://www.kernel.org/doc/Documentation/cgroups/cgroups.txt
- LKN article about shared subtree mounts:
  - http://lwn.net/Articles/159077/