Simunix, a large scale platform simulator

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Bull
atos technologies

Yet an another Slurm simulator

- We want to:
  - Test new developments
  - Test new clusters
  - Test new configurations
  - Develop machine learning algorithms

Yet an another slurm simulator

- Previous works to test slurm:
  - Production cluster
  - Small dev cluster
  - Virtual machines
  - Multiple-slurmd (multiple slurm nodes per real node)
  - Slurm simulator

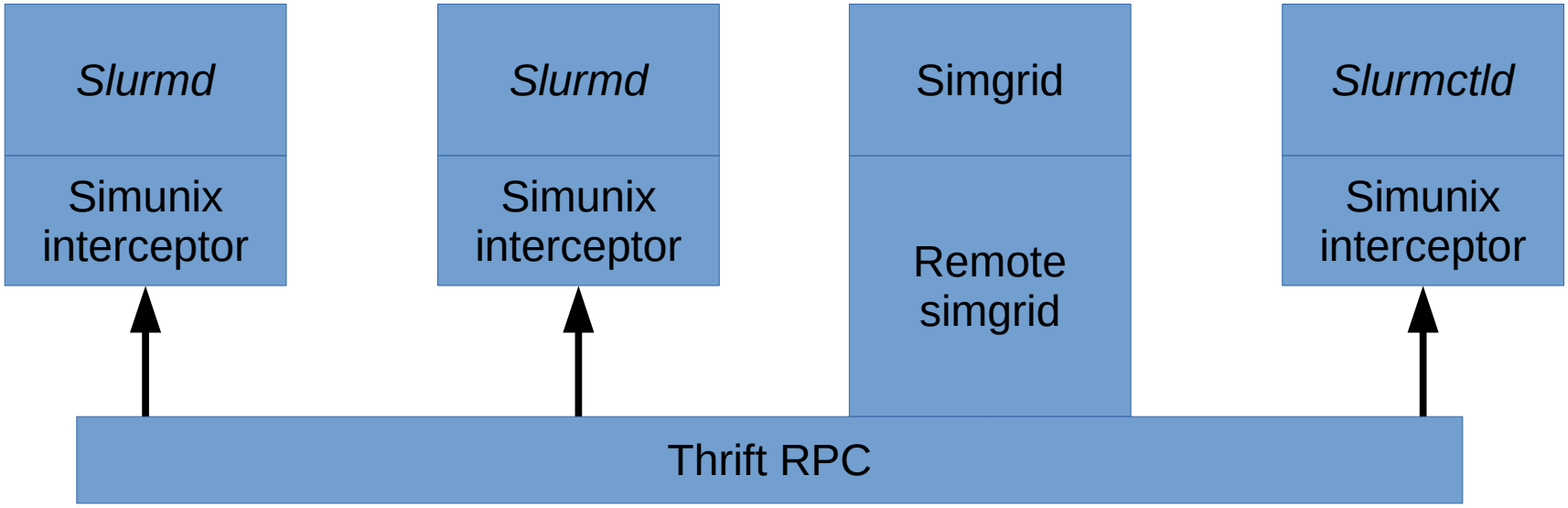
Yet an another slurm simulator

- Previous works to test slurm:
  - Production cluster impossible!
  - Small dev cluster too small!
  - Virtual machines too heavy!
  - Multiple-slurmd limited! (eg. network contention)
  - Slurm simulator limited! (eg. the code of slurm is modified)

Our solution

- We simulate the underlying platform, not slurm!

The architecture



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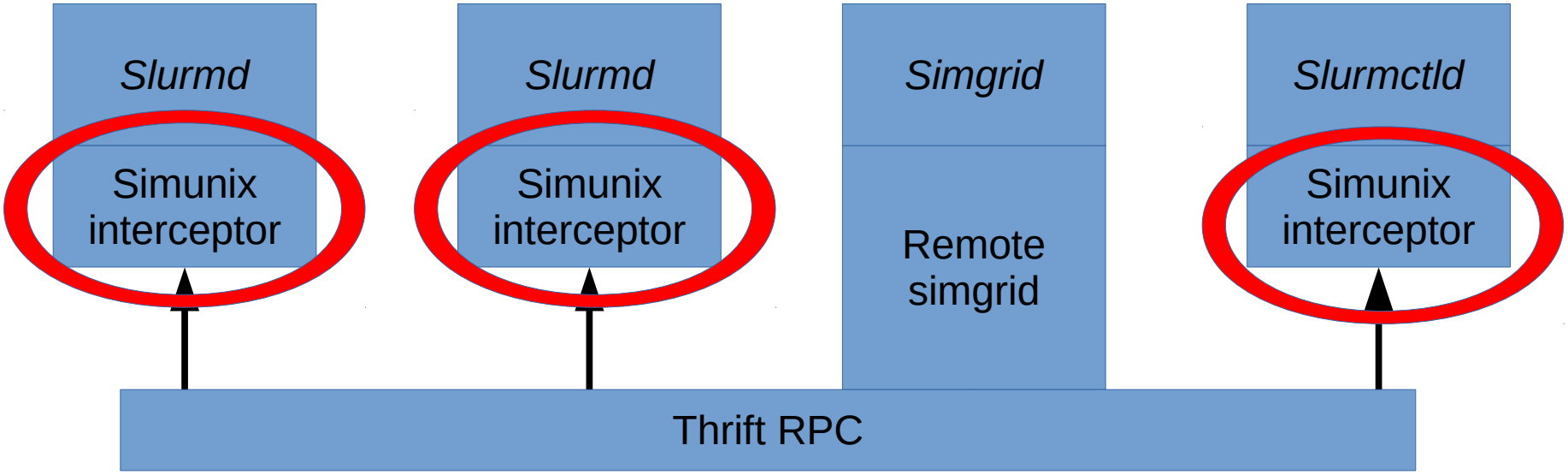


The architecture – interceptors

- They implement the "UNIX" API: pthreads, pthread_mutex, gettimeofday, sleep, send, recv…
- Then, they traduce UNIX calls to calls to the simulaltor

The architecture – interceptors

How to intercept function calls?

- Change how linking is done!

- The Linux linker load from the system and LD_PRELOAD the needed shared libraries
- It fills the GOT (Global Object Table) with the address of each functions of each libraries
- The compiler compile

```
sleep(10);
```

to

```
GOT[“sleep@libc“](10);
```

(Of course, it's not exactly like this, if you have more question RTFM of the ELF format)

The architecture – interceptors

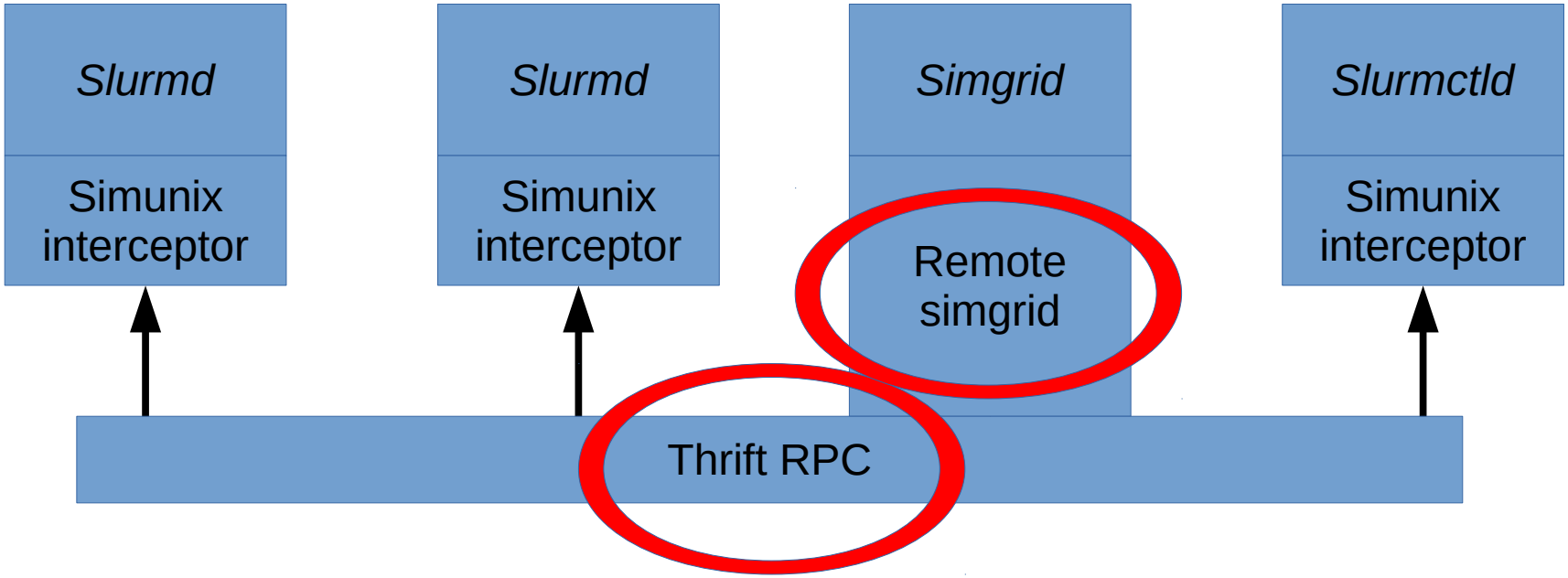
How to intercept function calls?

- Change how linking is done!

- At runtime, simunix rewrite the GOT
  - Of the selected binary/libraries
  - Not on the simunix library nor the Simgrid library!
  - Addresses in the GOT are replace by our own functions:

```
GOT[“sleep@libc“] = &simunix_sleep;
GOT[“time@libc“] = &simunix_time;
...
```

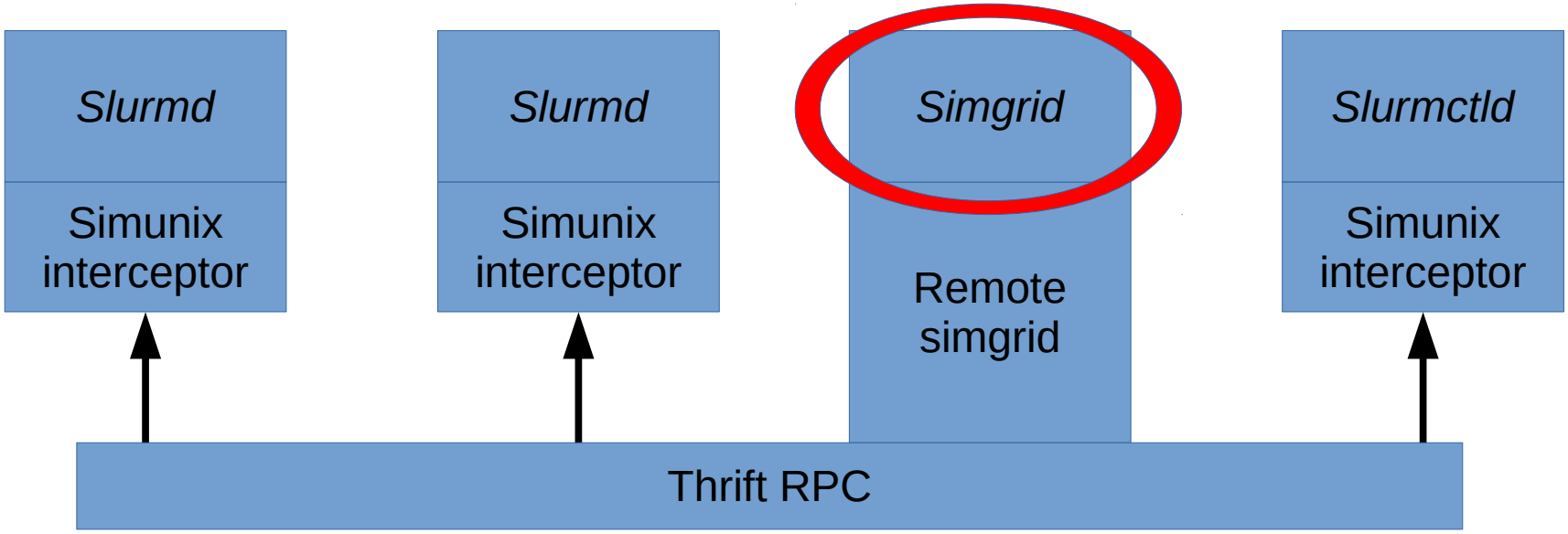
The architecture



The architecture – Thrift RPC

- *Apache Thrift* is an open-source library to build RPC client and server
- From a custom language, it generates files to build the client and the server
- We use it to transfer calls from the interceptors to the simulator
- *Remmote-simgrid* is our code to use thrift with simgrid

The architecture



The architecture – Simgrid

Simgrid

- a framework to design simulators of distributed applications

- Supports:
  - advanced network models
  - energy consumption models
  - I/O models
- Actively developed
- Good practice : they (in)validate their simulator (they explicitly give the strengths and weaknesses of their models by testing them and compared them to real runs)

How to start a simulation?

How to start a simulation?

Specific to slurm:

- A slurm installation
- A slurm configuration

Specific to Simgrid:

- A platform XML file (that describe the platform)
- A deployement XML file (that describe who will run where)

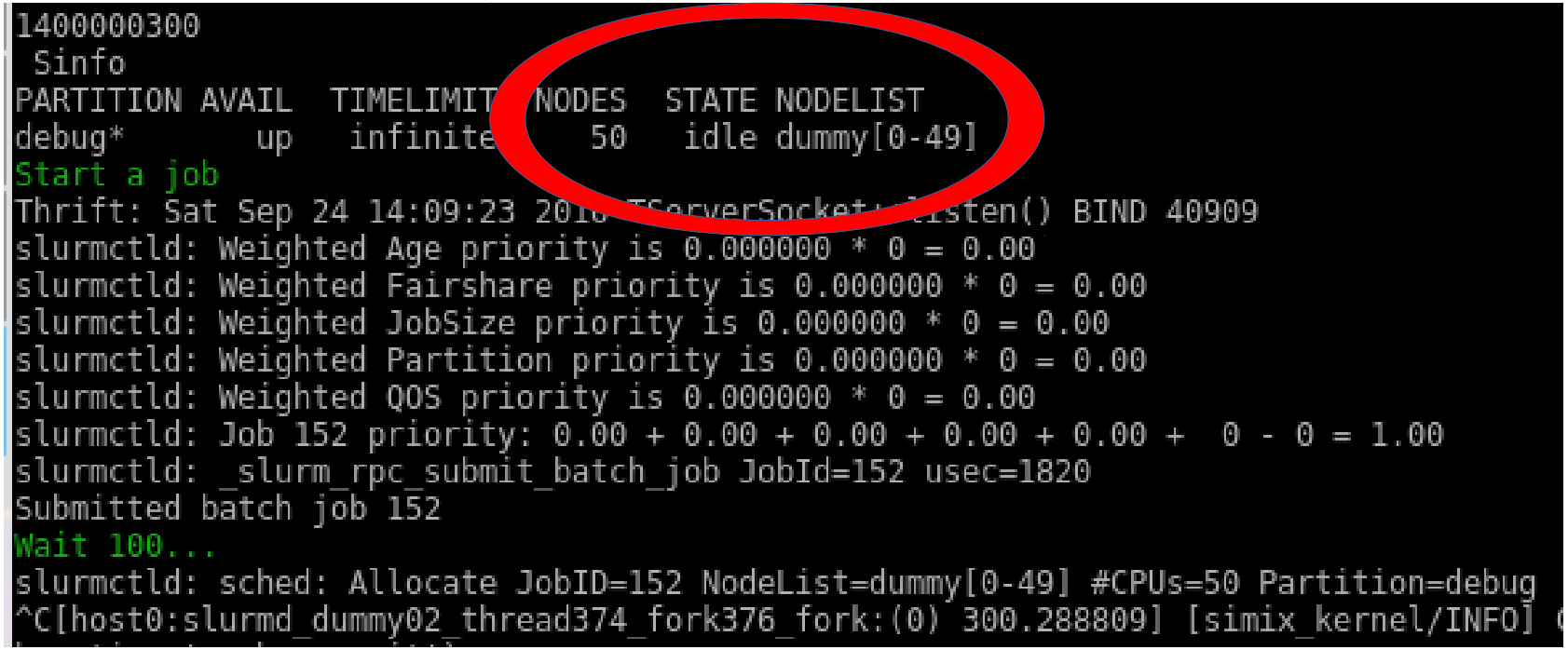
Specific to the experiment:

- A script to launch commands (sinfo, srun…)

Demo!

Some experiments already done

- Scalabilty: we are limited to ~50 nodes



(Bug spotted, fixed *soon*)

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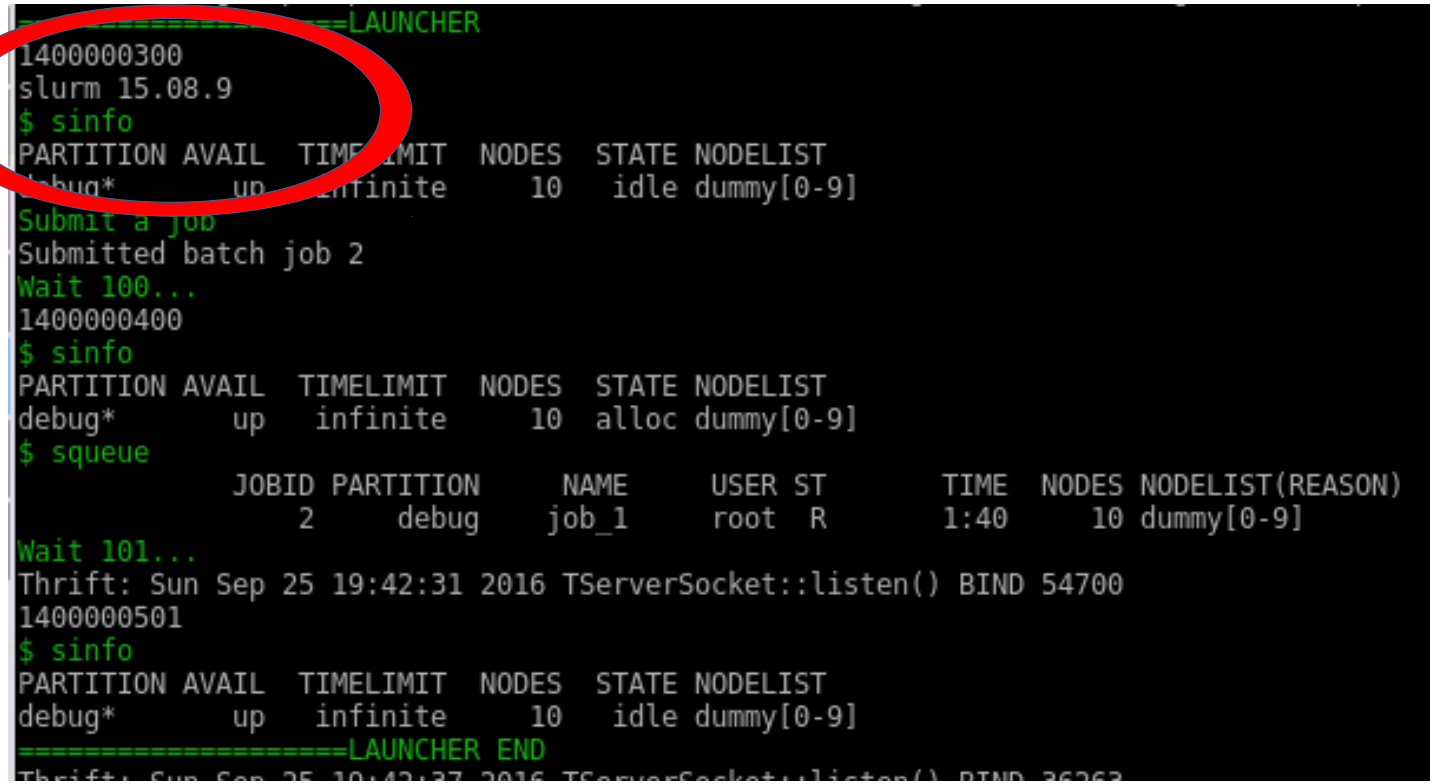

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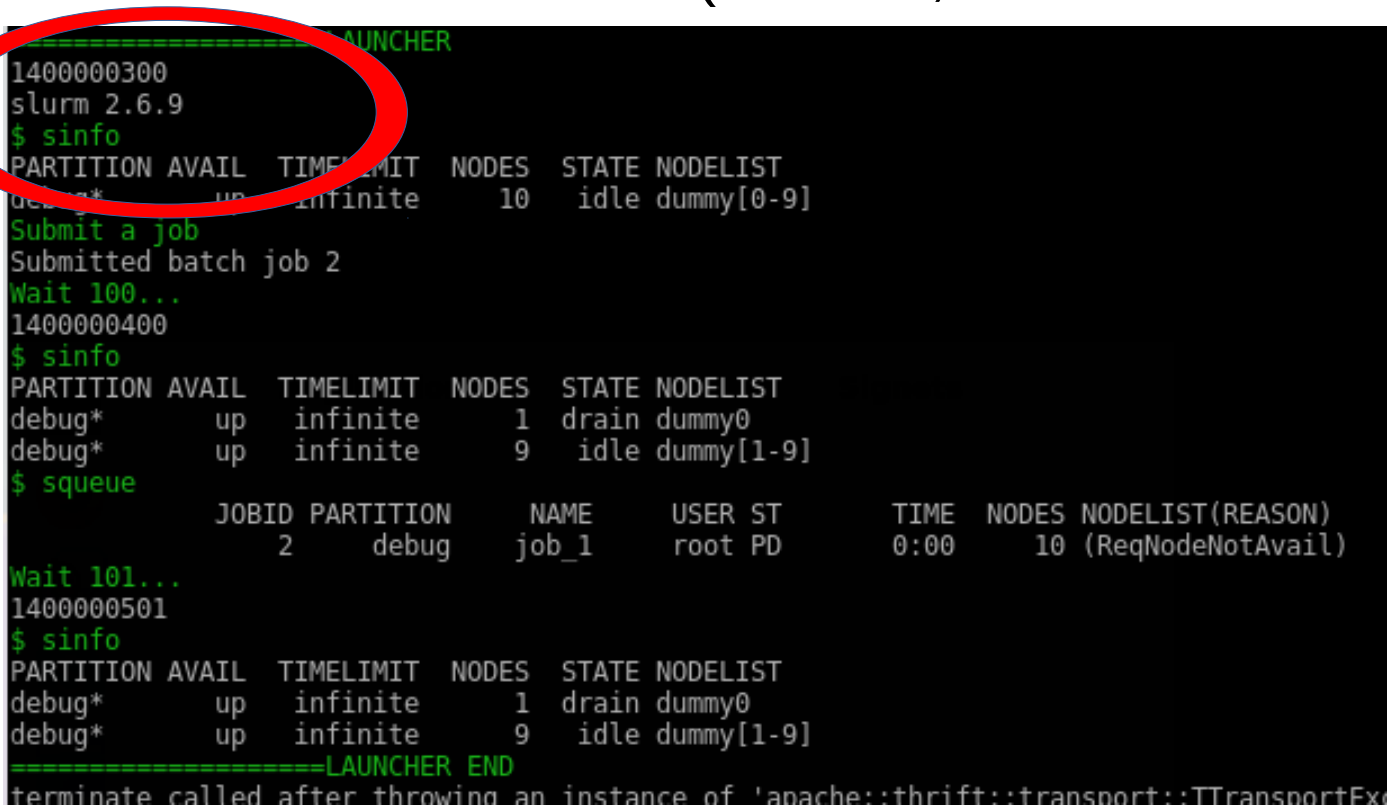

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- Speed: 10 nodes doing nothing for 4 days run in 1m30
- Interceptor size: about 20Mo added to each binary

Future work

Short term future works

- Remove bugs (scalability, srun)
- Ease of installation (provide a docker)
- Ease of use (4 files to start an experiment?!)
- Support databases
- Publish it (GPL)

Long term future works

- How close are we to the reality?
- Optimize
- Intercept /proc and related calls
- Intercept IPMI or RAPL calls (to support energy)
- Use it on other batch schedulers

Thanks

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