Perlmuter HPC integration and operation

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Out with the old and in with the new

Why HPC?

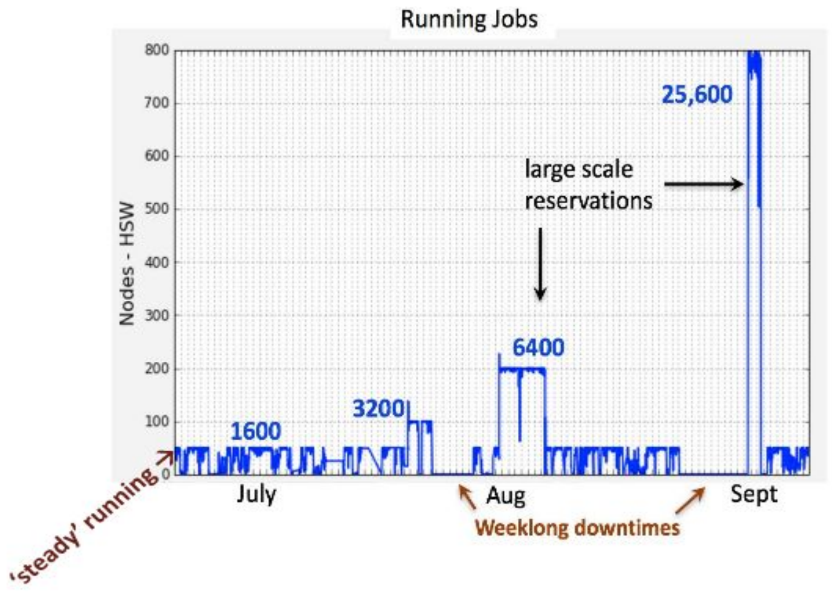
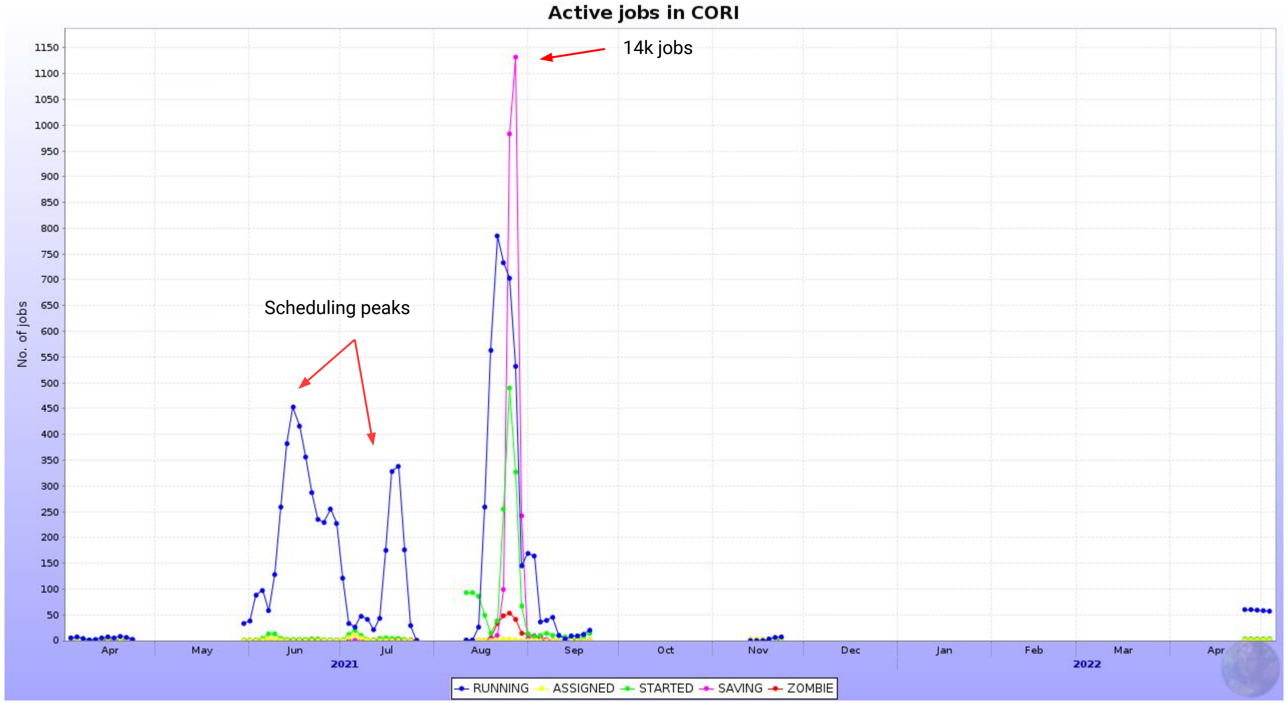


Chart extracted from Cori supercomputer at Lawrence Berkeley National Lab

Running Jobs On Cori



- Most of the time running 100-200 jobs
- Peaks in scheduling, as expected
- Long shutdown while testing networking and job behaviour

Cori Supercomputer

- Can communicate to the outside
- Limited per-job bandwidth (not even 2MB/s per job on two nodes)
  - Could not ramp up train jobs
- Used shifter for containers
- The VObox deployed on “service node” with low uptime
- Used custom JAliEn setup
  - First JAliEn deployment outside of CERN

HPC Particularities

- Closed networks
- Heterogeneous architecture meant for data center-wide jobs
- Peculiar software distributions
    - Some can’t run CVMFS

Meet Perlmutter

- Runs HPE Cray OS
- Only whole-node scheduling
- 3072 nodes running AMD EPYC 7763, 64 core, 512 GB memory
- Jobs run in Shifter containers
- Outside connection from nodes
- Full CVMFS support

Objectives

- Turn the HPC site into a production system
- Low maintenance
- Steady scheduling
- Burn as many resources as possible

Perlmutter Points of Contention

- Sending jobs to the supercomputer
- Storage bandwidth for I/O bound jobs
- CPU hours allocation

How do we send jobs to Perlmutter?

- Internally runs SLURM for job scheduling

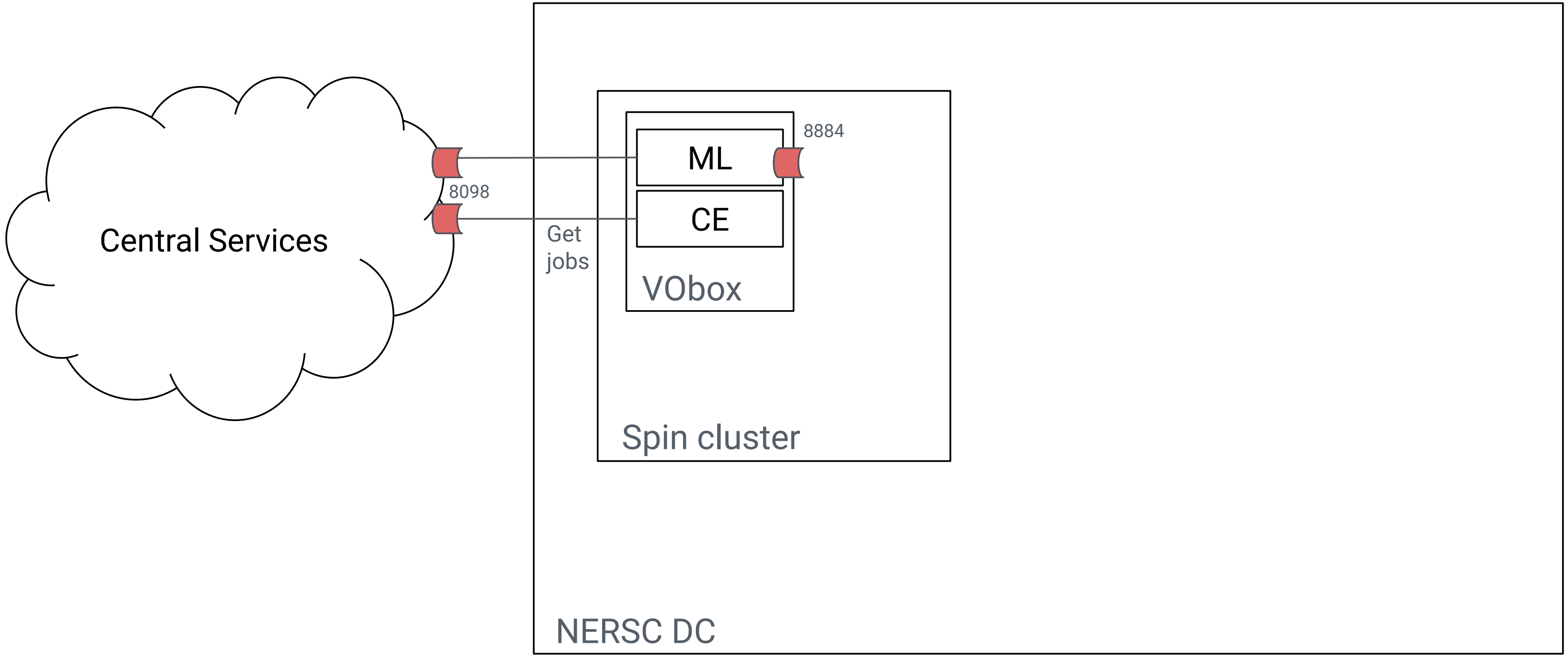
- Simple, just run CE on login nodes like Cori!
  - Login nodes don’t guarantee uptime
  - Admins recommend running a cron to keep the CE up

- NERSC suggested a new submission API and hosting CE on their K8s cluster

The SuperFacility API

- HTTP based API to manage jobs
- Uses JWT to authenticate
- Initially we were promised an easy security review process for getting an auth token
    - Policy is to receive 30 days job submission privileges
- SFAPI receives SLURM job specifications and sends them to the HPC system

Let’s use Kubernetes



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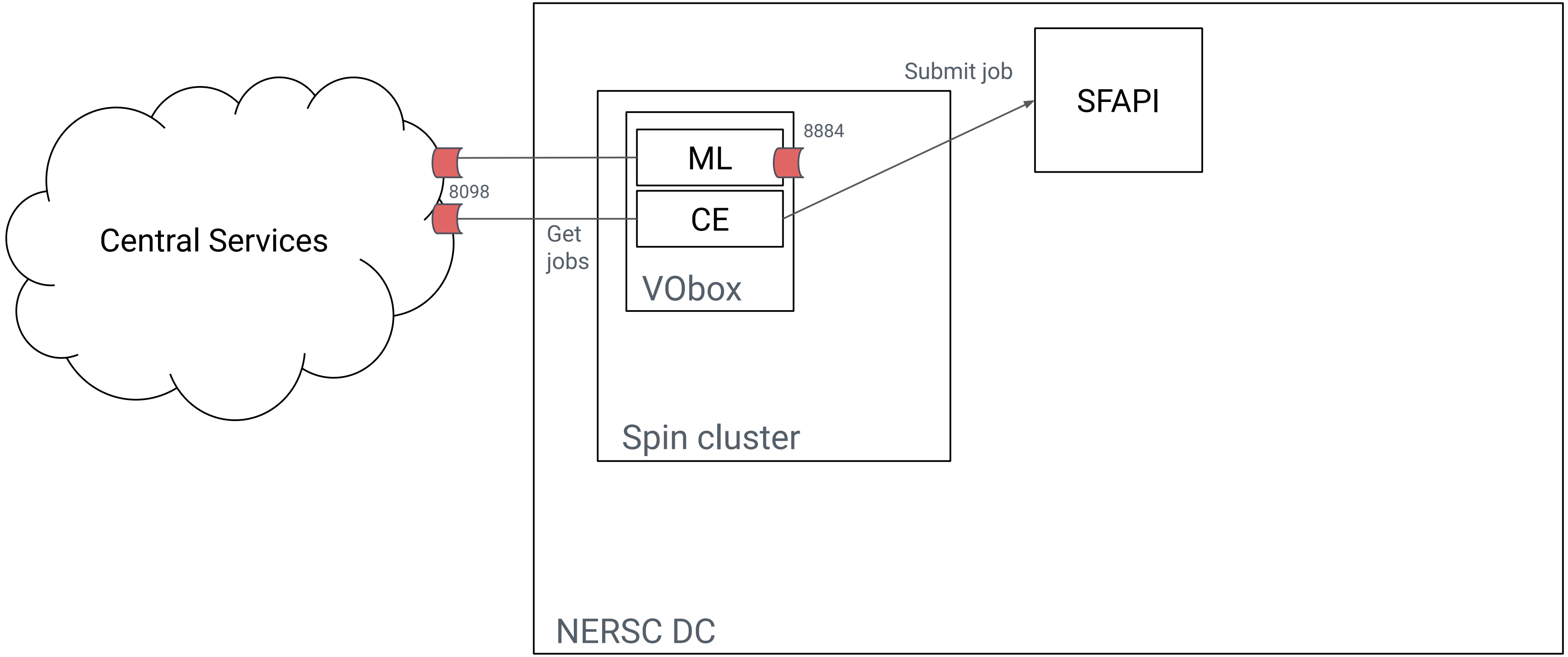

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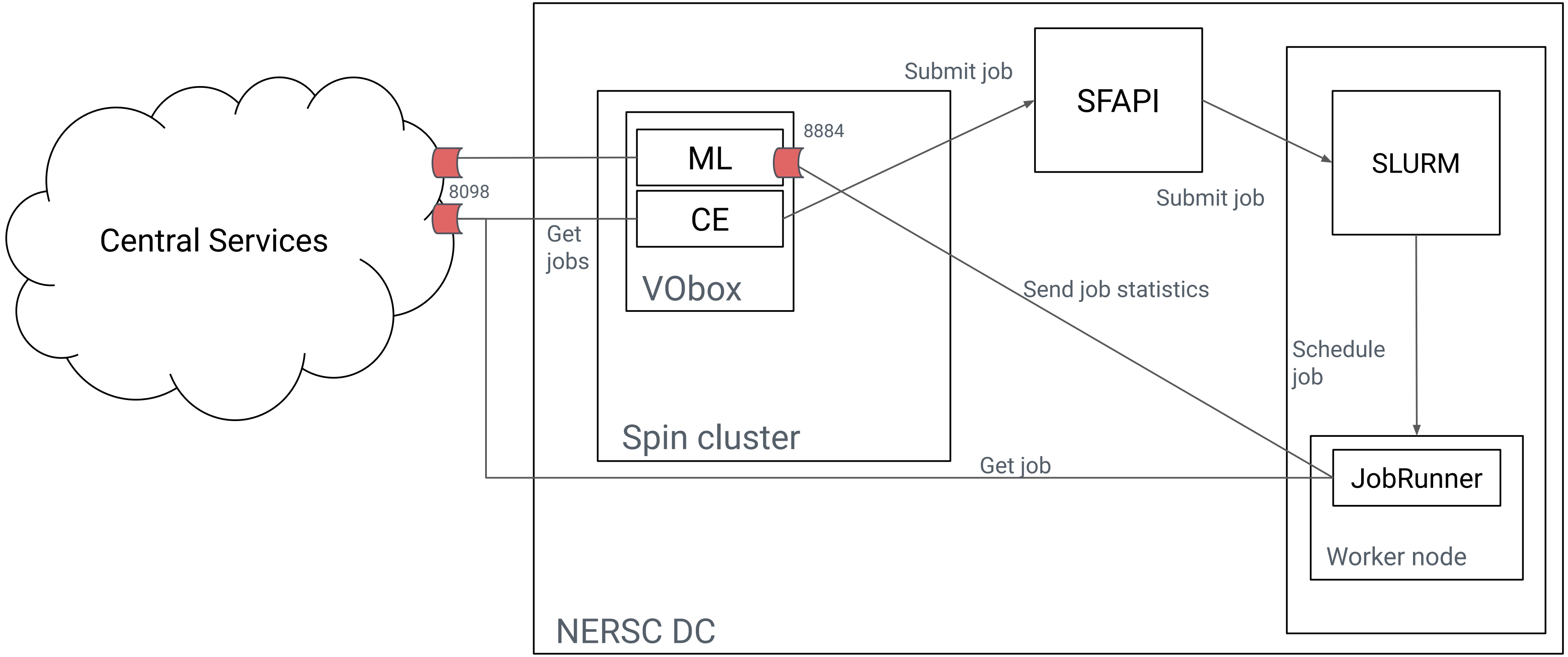
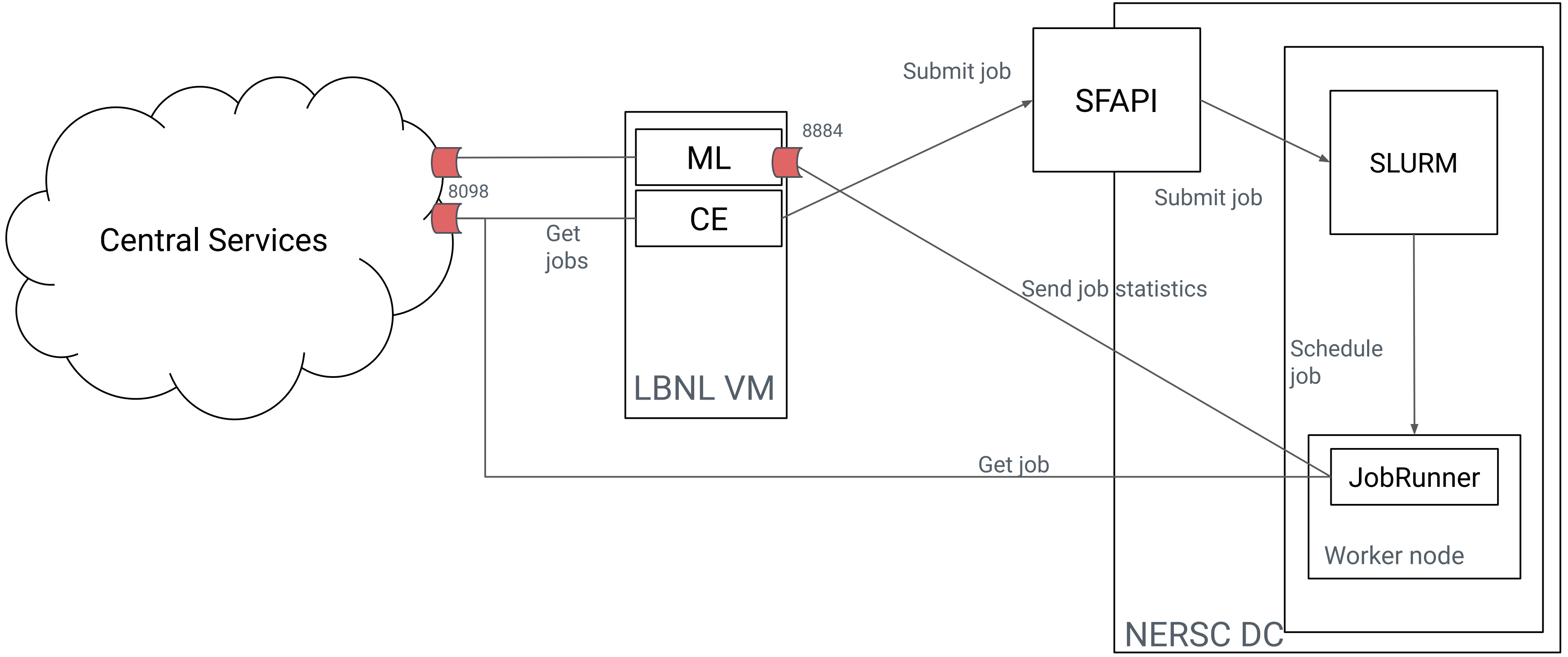


Running CE in unprivileged container

- Adapted the workflow to run inside of container based on CERN solution
- We couldn’t get ingress to route our traffic
  - Only certain ports are allowed
- The environment was proving too restrictive for no real benefits

VMs are still better



Move to an LBL VM

- Requested a VM in the LBL cluster to run the CE
- Technically hosted in the same institution, different organizations
- Root-less access to the VM
- Software initially running custom JAliEn with SFAPI support

Implementing the SFAPI

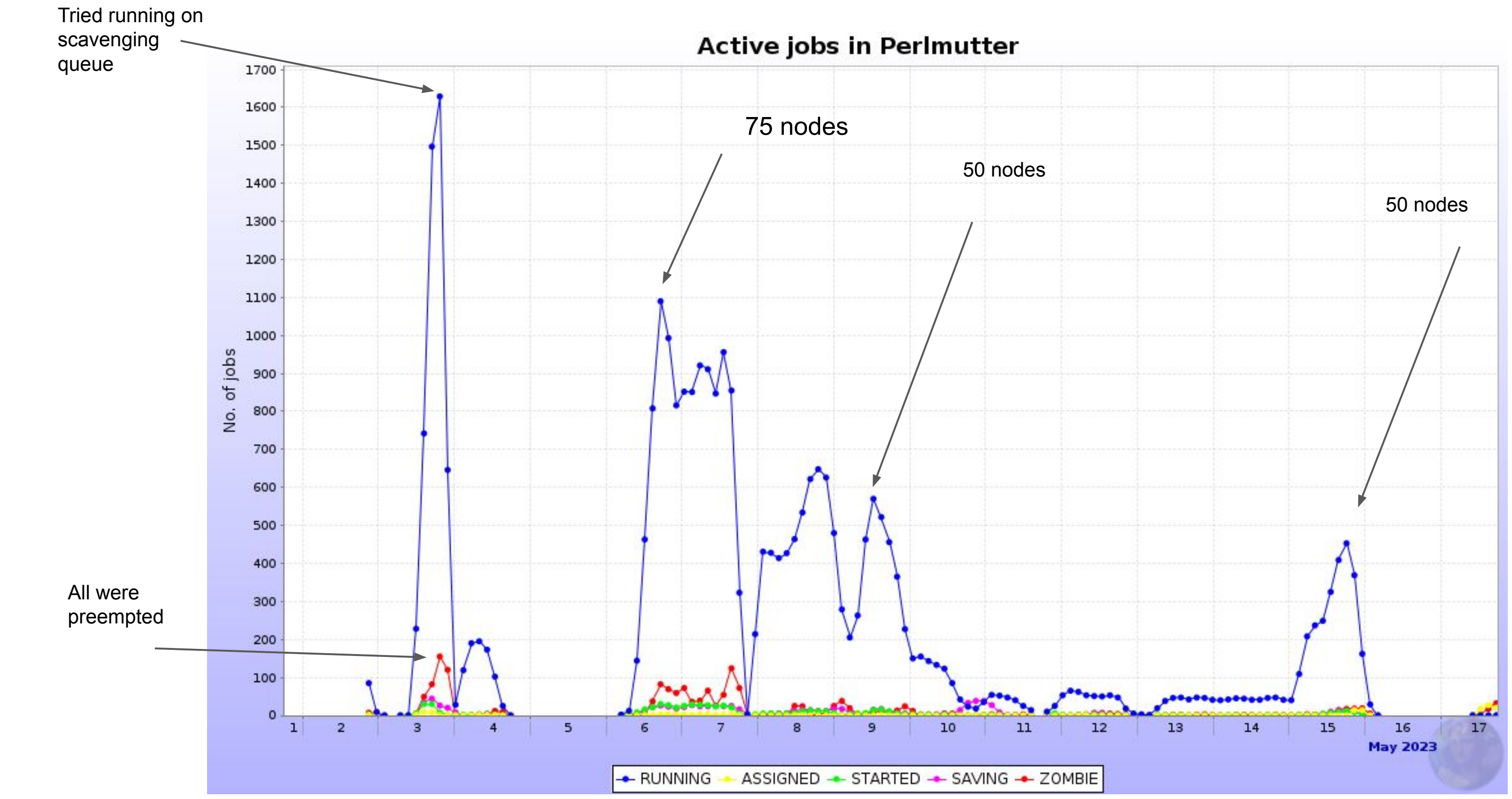
- Authentication is done before doing any request using a private key and client ID
  - To be configured every time the key expires

- GET active jobs
- GET queued jobs

- POST submit a job to a queue

- Implemented as a module the same as other BQ implementations in JAliEn

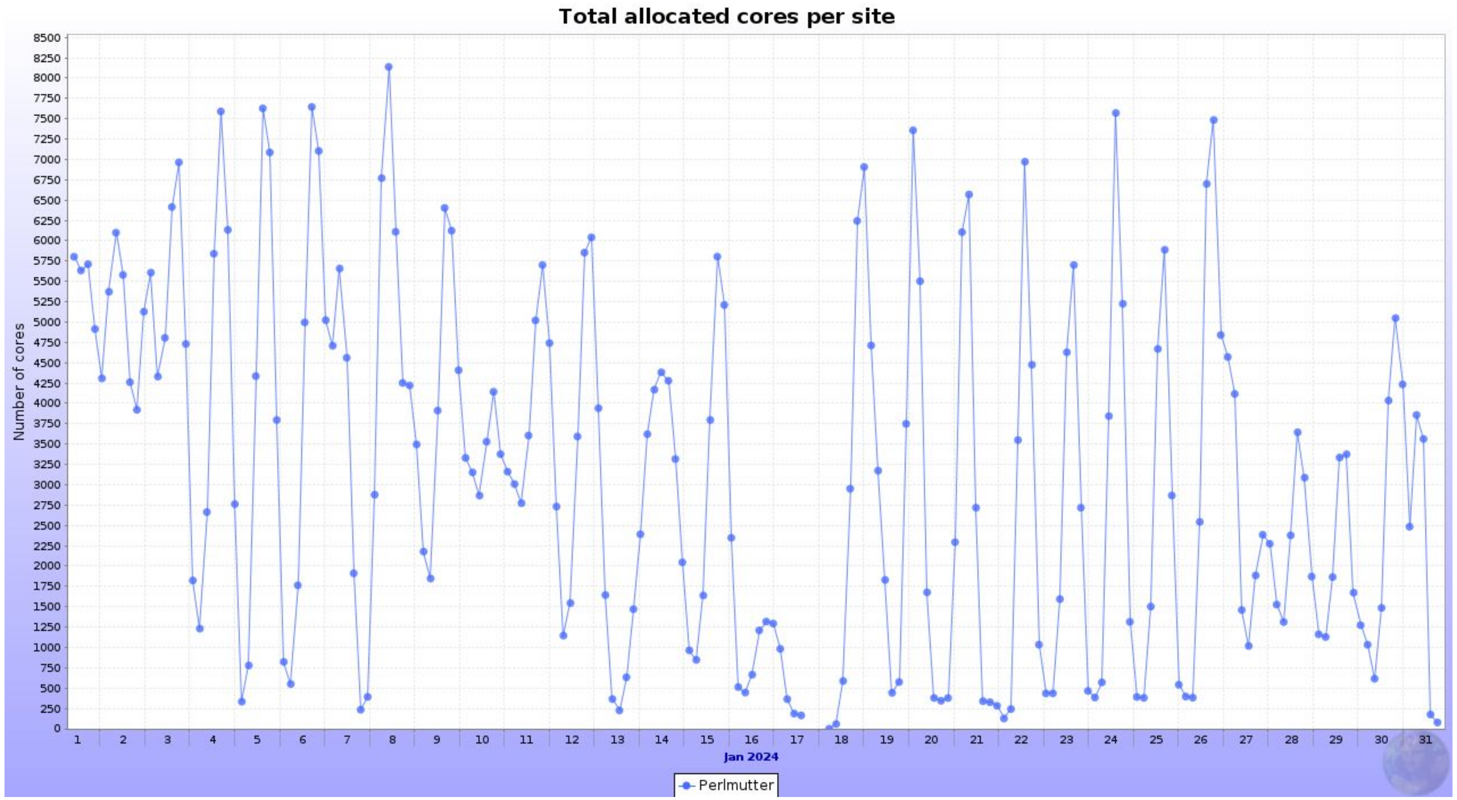
Early Perlmutter Operation



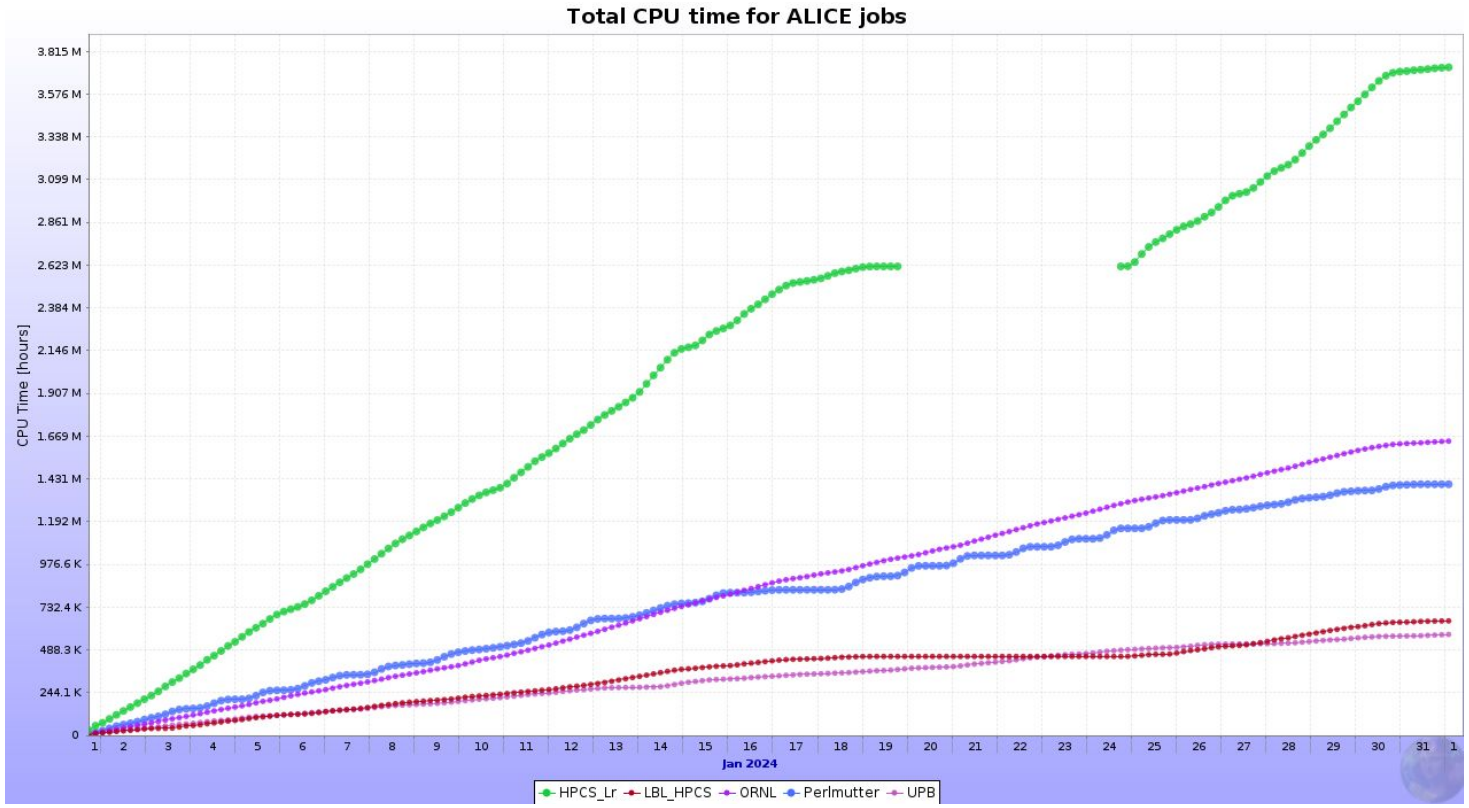
First Issues

- ulimits
  - Open files were running at ¼ than required
- CVMFS open files
  - Common issue for many high density sites
  - CVMFS would needlessly duplicate file descriptors
- Initial allocation was too small
  - Got an extension at the moment, but we scaled down job numbers

Getting Perlmutter to Run Steadily



Perlmutter CPUtime



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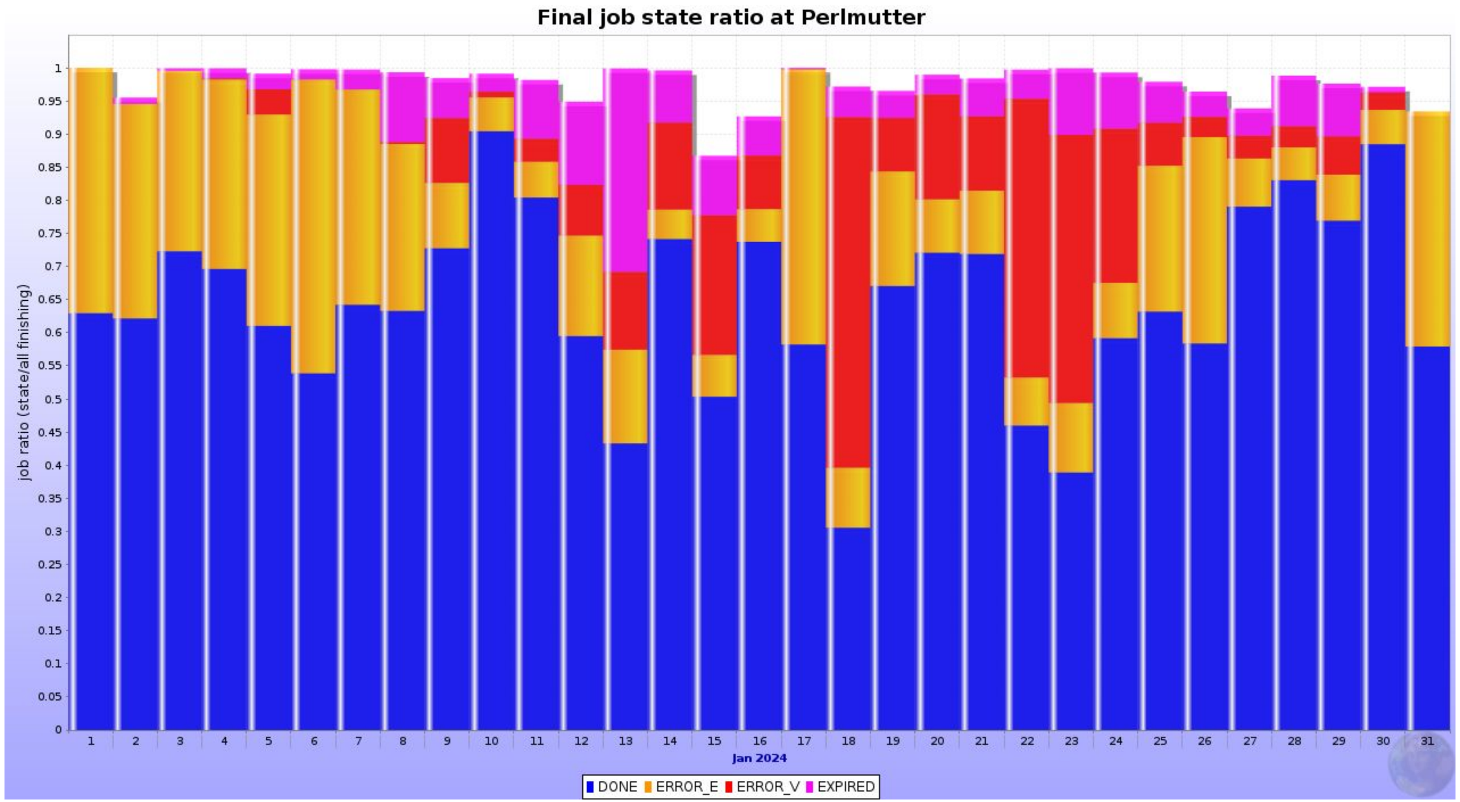

What are we running into now?

- Static TTL set in jobs does wastes valuable time on fast CPUs
- HPC testing doesn’t keep up to fast pace of JAliEn development
- Key management is still done by hand

Conclusion

- Integrated a new HPC to the grid

- Added a new job submission mechanism done through SFAPI

Future work

- Start the jobs from CMFS, we're using custom built JARs

- Look into running on Perlmutter GPU nodes