

Continuous Performance Monitoring of the Grid Library on a Supercomputer

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Our code base

- *Grid*: data parallel C++ container classes mapping efficiently to SIMD architectures including GPUs
<https://github.com/paboyle/Grid>
- *Hadrons*: Grid-based workflow management system for lattice field theory simulations
<https://github.com/aportelli/Hadrons>

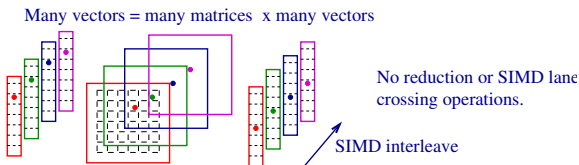


Figure: Grid architecture, from [hep-lat/1512.03487]

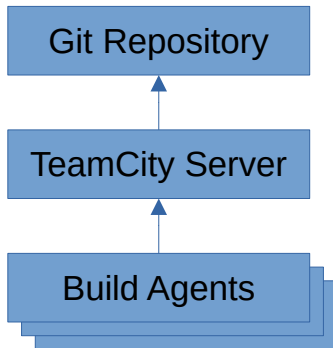
Tursa Computing cluster

- part of the *DiRAC High Performance Computing Facility*
- 178 compute nodes, each equipped with
 - two *AMD EPYC* processors
 - four *NVIDIA Ampere A100* accelerators
- interconnect
 - NVLink on each node running at 600 GB/s
 - Infiniband network between nodes at 200 GB/s (utilizing one network interface per GPU)
- jobs are run via Slurm scheduler from dedicated login nodes
- additional services (CPU nodes, storage, ...) available
- find out more at <https://dirac.ac.uk>

Goals

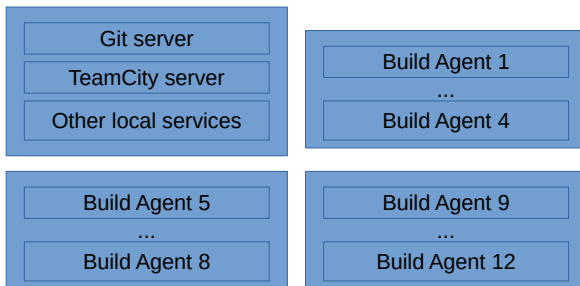
- **Continuous integration:** Notice breaking changes as soon as possible, avoid infamous “works on my machine”
- **Automatic deployment:** Improve reproducibility and simplify user experience
- **Performance monitoring:** Detect performance degradations caused by any part of the system

Jetbrains TeamCity Architecture



- Scalable to arbitrary number of build servers
- Communication via https

Dedicated CI/CD hardware



- Four servers, environment identical to the clusters login nodes
- Head server runs docker containers of various services, publicly visibly at `{git,ci}.dev.dirac.ed.ac.uk`
- Agents run on bare metal, not publicly visibly

Triggers for the CI system



- Each commit, including pending pull requests
→ Build Grid and Hadrons and run unittests
- Once per day:
→ deploy new production binaries if there were any changes
→ run benchmarks, using latest production binaries
- Benchmarking is run regardless of source code changes, thus effectively monitors the runtime environment as well.

Integration into the HPC cluster Tursa







- Problem: Build servers do not have GPUs
- Solution: GPU-based unittests and benchmarking jobs are submitted via SLURM to the computing cluster
- Finished jobs report back to TeamCity via a REST API


What does it look like?

On a GitHub pull request:

  **paboyle** merged commit **3f16366** into `paboyle:develop` on Feb 28 Hide details Revert











6 checks passed

✓	 Grid coverage build - AVX2 / clang-10 (Grid) TeamCity build finished Details
✓	 Grid coverage build - AVX2 / clang-10 (Grid) - merge TeamCity build finished Details
✓	 Grid test build - AVX2 / clang-10 (Grid) TeamCity build finished Details
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All Projects
Favorite Builds

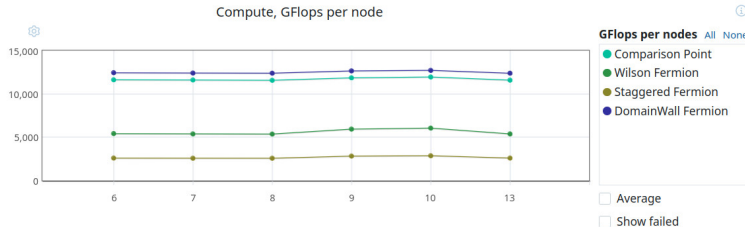
PROJECTS

- ▼  Lattice
 - ▼  Benchmarks
 - ☐ Run All
 - >  TursaCpu
 - ▼  TursaGpu
 - ▼ Benchmark_Grid
 - >  4 x NVIDIA A100-...
 - >  4 x NVIDIA A100-80
 - >  8 x NVIDIA A100-40
 - >  8 x NVIDIA A100-80
 - >  Grid
 - >  Hadrons

 Lattice /  Benchmarks /  TursaGpu /  Benchmark_Grid

4 x NVIDIA A100-40

Overview Change Log Problems **Statistics** Build Chains Flaky Tests 0



Stability

- All build artifacts are backed up to a cloud storage provider
- Configuration of TeamCity itself is tracked in a git repository

Hardening

- Build servers are not publicly visible, communication to main server is “one-way”
- Build agents run as dedicated user with limited permissions on the cluster, e.g., no access to research data

Future outlook

- Solution is scalable to multiple HPC clusters

This CI/CD solution was funded by the STFC DiRAC Facility

Questions?

for a live demo, come talk to me later, or visit
<https://ci.dev.dirac.ed.ac.uk>
(choose “Log in as guest”)



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