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AUTOTESTER2

Modernized Trilinos CI Testing

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Trilinos User-Developer Group Meeting 10/24/2024

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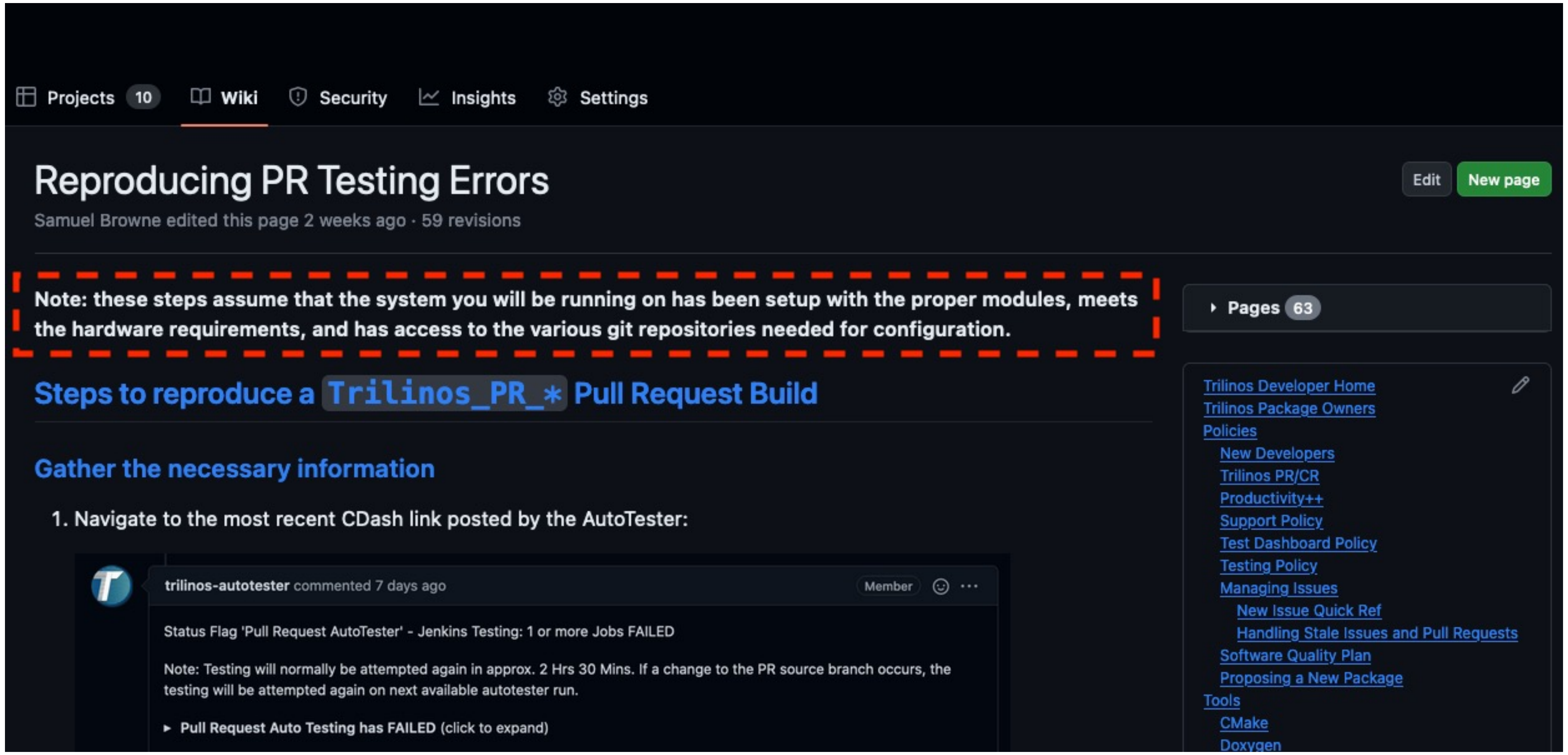
ENVIRONMENT MANAGEMENT

MANAGING TRILINOS BUILD ENVIRONMENTS

- Currently use a home-grown system called ‘GenConfig’
- Paired with third-party library modules that are maintained on our internal systems
- How do individual developers replicate pull request builds/tests?



Reproducing PR Testing Errors

Samuel Browne edited this page 2 weeks ago · 59 revisions

Note: these steps assume that the system you will be running on has been setup with the proper modules, meets the hardware requirements, and has access to the various git repositories needed for configuration.

Steps to reproduce a `Trilinos_PR_*` Pull Request Build

Gather the necessary information

1. Navigate to the most recent CDash link posted by the AutoTester:

trilinos-autotester commented 7 days ago — Member

Status Flag 'Pull Request AutoTester' - Jenkins Testing: 1 or more Jobs FAILED

Note: Testing will normally be attempted again in approx. 2 Hrs 30 Mins. If a change to the PR source branch occurs, the testing will be attempted again on next available autotester run.

▸ **Pull Request Auto Testing has FAILED** (click to expand)

- Trilinos Developer Home
- Trilinos Package Owners
- Policies
  - New Developers
  - Trilinos PR/CR
  - Productivity++
  - Support Policy
  - Test Dashboard Policy
  - Testing Policy
  - Managing Issues
    - New Issue Quick Ref
    - Handling Stale Issues and Pull Requests
  - Software Quality Plan
  - Proposing a New Package
- Tools
  - CMake
  - Doxygen

EXTERNALLY-UNAVAILABLE REQUIREMENTS

- 5/7 GenConfig-related repositories
- TPLs on hardware
- Hardware itself (thought we have no control over this aspect)

How can we provide the configuration tool and a software environment (TPLs) that work together to external partners?

MAKING GENCONFIG AVAILABLE TO THE COMMUNITY

- Continuing to use GenConfig (and related tooling) will require open-sourcing to make available to the broader community
- Open-source process is progressing, but is slow

GenConfig	LoadEnv	KeywordParser	SetEnvironment	DetermineSystem	ConfigParserEnhanced	SetProgramOptions
🟨	🟨	🟨	▨	🟨	🟩	🟩

🟨 Awaiting Acceptance	▨ Ready for GitHub	🟩 On GitHub

MAKING TPLS AVAILABLE TO THE COMMUNITY

- Currently a team (SEMS) within Sandia deploys third-party libraries, compilers, and MPIs to select systems that are used for automated testing
- Un-releasable to external partners for technical reasons
  - However, SEMS moving towards delivery of TPLs with containers
- Also unavailable to internal systems outside the scope of the support agreement

BLOCKED

CONTAINERS AS A MECHANISM FOR DISTRIBUTING TPLS

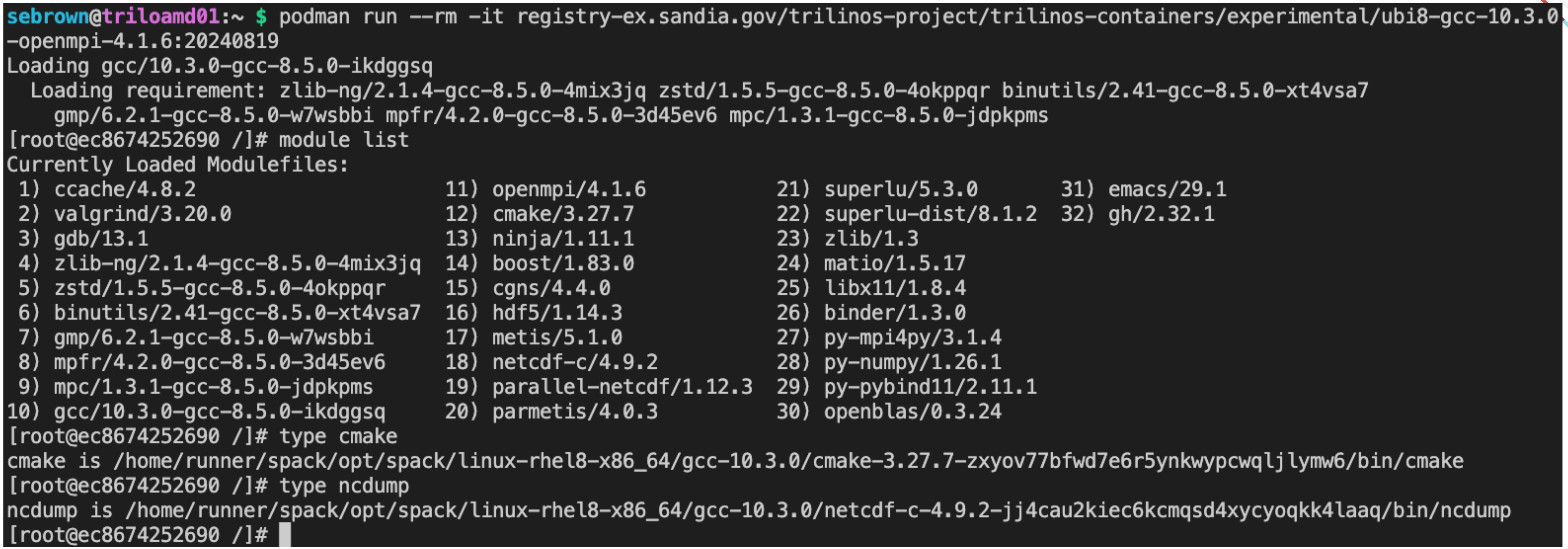
- Containers handily solve the third-party software problem
- There are limitations of reproducing novel software environments (e.g. DOE ATS systems), but these environments are not currently in pull request testing, and are outside the scope of this effort
- Containers *greatly* simplify the act of setting up build environments
  - Complexity is still there, but is largely handled within the Dockerfile that describes how to build the container image
  - **Complexity is largely removed from user workflow**

HOW TO RUN A CONTAINER

```
# Pull the image that you want to use from the registry
docker pull your-registry.yourdomain.com/yourimage

# Run the image
#   Remove container once it exits
#   Run interactively and attach tty
#   Run bash as the container entrypoint
docker run --rm -it --entrypoint bash yourimage
```

EXAMPLE



```
sebrown@triloamd01:~ $ podman run --rm -it registry-ex.sandia.gov/trilinos-project/trilinos-containers/experimental/ubi8-gcc-10.3.0
-openmpi-4.1.6:20240819
Loading gcc/10.3.0-gcc-8.5.0-ikdggsq
  Loading requirement: zlib-ng/2.1.4-gcc-8.5.0-4mix3jq zstd/1.5.5-gcc-8.5.0-4okppqr binutils/2.41-gcc-8.5.0-xt4vsa7
    gmp/6.2.1-gcc-8.5.0-w7wsbbi mpfr/4.2.0-gcc-8.5.0-3d45ev6 mpc/1.3.1-gcc-8.5.0-jdpkpms
[root@ec8674252690 /]# module list
Currently Loaded Modulefiles:
 1) ccache/4.8.2                    11) openmpi/4.1.6          21) superlu/5.3.0      31) emacs/29.1
 2) valgrind/3.20.0                 12) cmake/3.27.7           22) superlu-dist/8.1.2 32) gh/2.32.1
 3) gdb/13.1                        13) ninja/1.11.1           23) zlib/1.3
 4) zlib-ng/2.1.4-gcc-8.5.0-4mix3jq 14) boost/1.83.0           24) matio/1.5.17
 5) zstd/1.5.5-gcc-8.5.0-4okppqr    15) cgns/4.4.0             25) libx11/1.8.4
 6) binutils/2.41-gcc-8.5.0-xt4vsa7 16) hdf5/1.14.3            26) binder/1.3.0
 7) gmp/6.2.1-gcc-8.5.0-w7wsbbi     17) metis/5.1.0            27) py-mpi4py/3.1.4
 8) mpfr/4.2.0-gcc-8.5.0-3d45ev6    18) netcdf-c/4.9.2         28) py-numpy/1.26.1
 9) mpc/1.3.1-gcc-8.5.0-jdpkpms     19) parallel-netcdf/1.12.3 29) py-pybind11/2.11.1
10) gcc/10.3.0-gcc-8.5.0-ikdggsq    20) parmetis/4.0.3         30) openblas/0.3.24
[root@ec8674252690 /]# type cmake
cmake is /home/runner/spack/opt/spack/linux-rhel8-x86_64/gcc-10.3.0/cmake-3.27.7-zxyov77bfwd7e6r5ynkwypcwqljlymw6/bin/cmake
[root@ec8674252690 /]# type ncdump
ncdump is /home/runner/spack/opt/spack/linux-rhel8-x86_64/gcc-10.3.0/netcdf-c-4.9.2-jj4cau2kiec6kcmqsd4xycyoqkk4laaq/bin/ncdump
[root@ec8674252690 /]#
```

Note that all TPLs are “Just There”, with no module load, source, etc. All (ish) of the complexity is baked into the container recipe itself.

Can now clone Trilinos, or any other code you wish to develop.

HOW TO MOUNT YOUR LOCAL CODE INTO A CONTAINER

```
docker run --rm -it --entrypoint bash \
--mount type=bind,src=/path/on/your/machine,dst=/path/in/container \
yourimage
```

Allows you to get data in/out of container through the mounted directory

Depends on host filesystem (e.g. can have some issues when mounting a Windows directory into a Linux container)

Extension: It is possible to point VSCode at a container image and have it boot said image, mount your code project for you, and then place your terminal in the running container.

CONTAINERS HELP ENSURE CONSISTENCY

Cons

- There is overhead in learning to use containerized development environments
- Containers suffer a large performance hit for crossing CPU architectures (e.g. running an x86_64 container on an Apple Silicon MacBook)

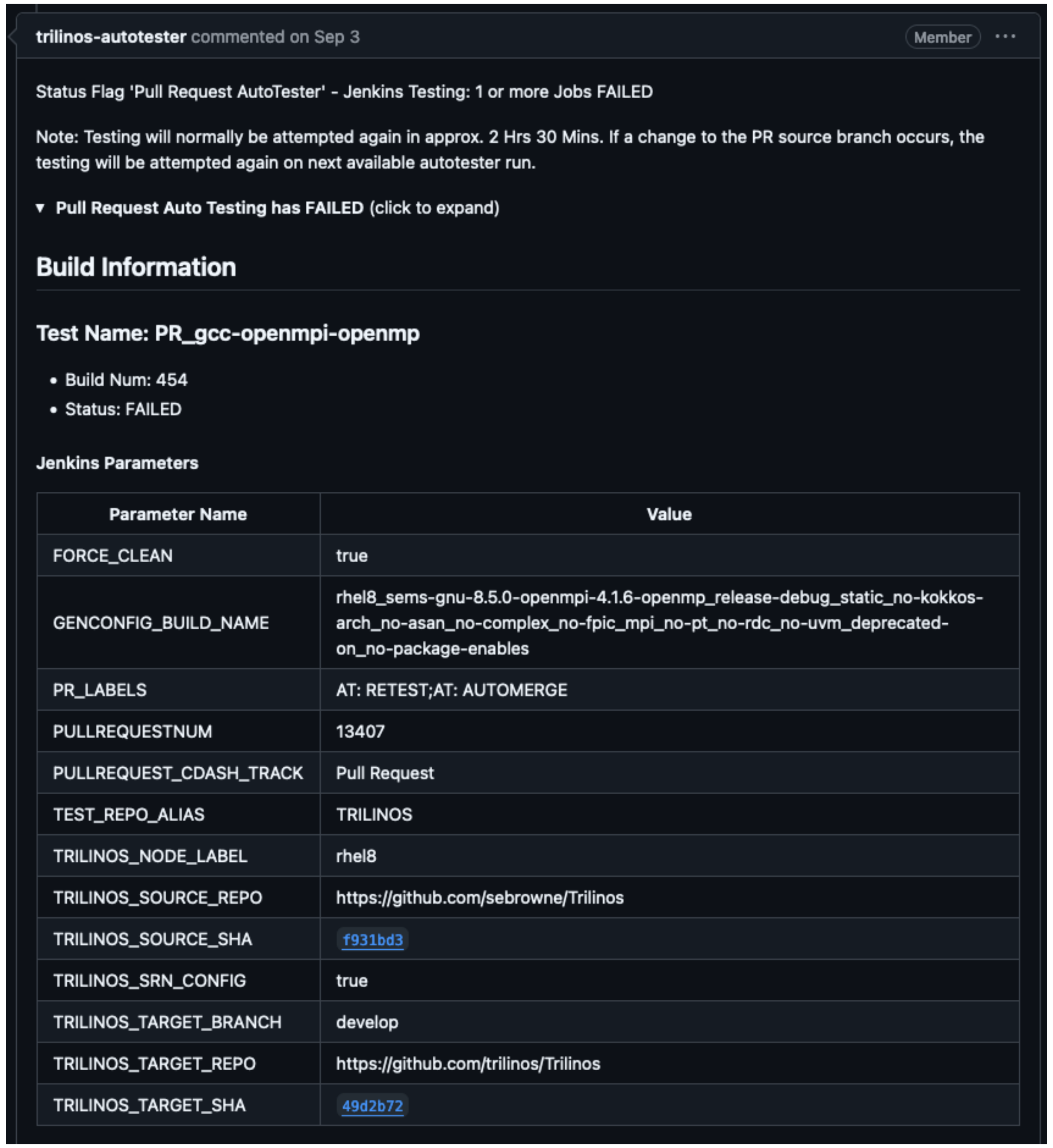
Pros

- Near-perfect reproducibility between container runs
- Ability to easily share development environments between developers
- Anybody can create a new container on any machine with compatible architecture
- Can take container used for “validation” runs (PR testing) and run locally on developer machines

GITHUB ACTIONS

CHECKS INTERFACE

OLD (AT1)



trilinos-autotester commented on Sep 3 Member ···

Status Flag 'Pull Request AutoTester' - Jenkins Testing: 1 or more Jobs FAILED

Note: Testing will normally be attempted again in approx. 2 Hrs 30 Mins. If a change to the PR source branch occurs, the testing will be attempted again on next available autotester run.

▾ **Pull Request Auto Testing has FAILED** (click to expand)

Build Information

Test Name: PR_gcc-openmpi-openmp

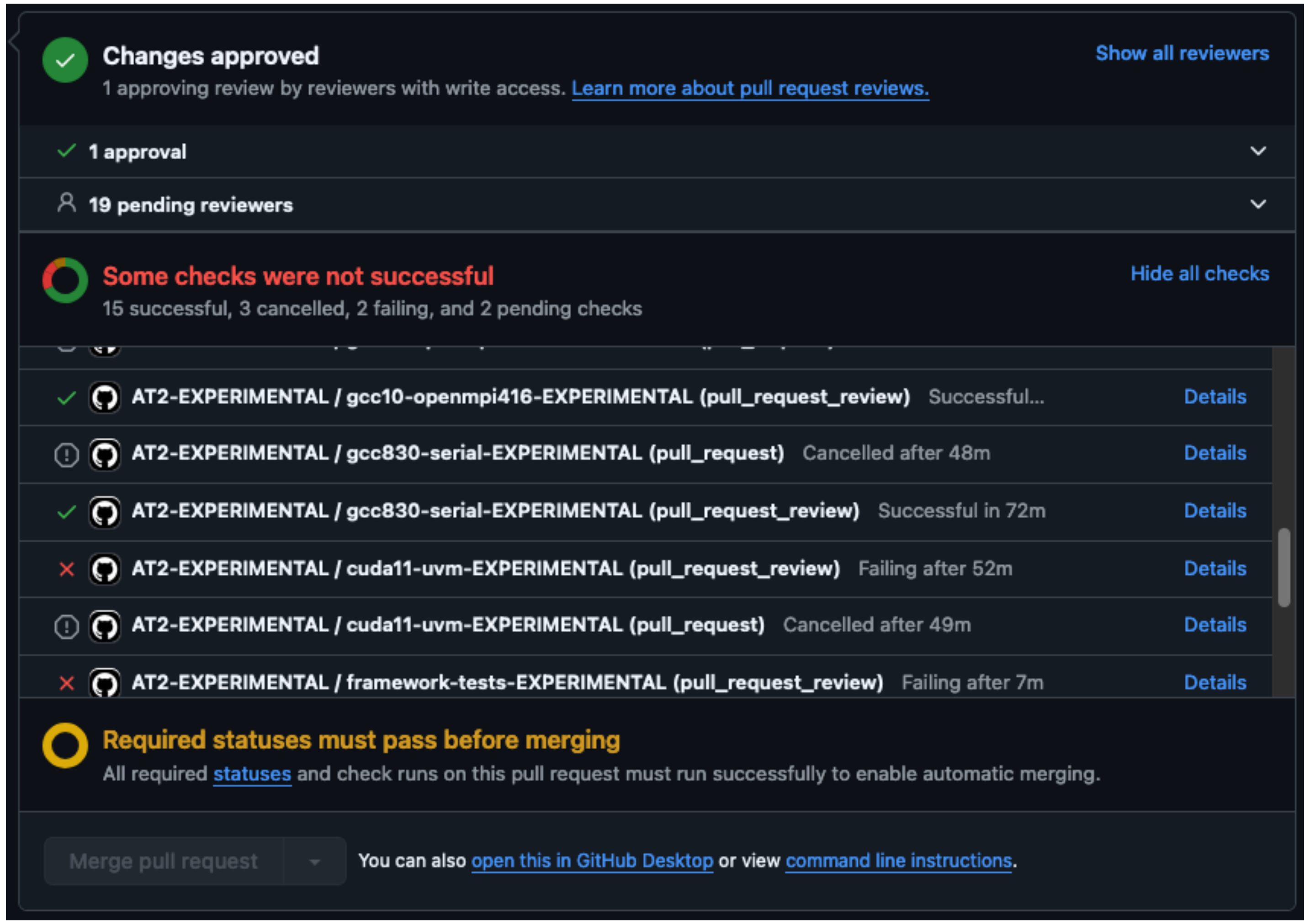
- Build Num: 454
- Status: FAILED

Jenkins Parameters

Parameter Name	Value
FORCE_CLEAN	true
GENCONFIG_BUILD_NAME	rhel8_sems-gnu-8.5.0-openmpi-4.1.6-openmp_release-debug_static_no-kokkos-arch_no-asan_no-complex_no-fpic_mpi_no-pt_no-rdc_no-uvm_deprecated-on_no-package-enables
PR_LABELS	AT: RETEST;AT: AUTOMERGE
PULLREQUESTNUM	13407
PULLREQUEST_CDASH_TRACK	Pull Request
TEST_REPO_ALIAS	TRILINOS
TRILINOS_NODE_LABEL	rhel8
TRILINOS_SOURCE_REPO	https://github.com/sebrowne/Trilinos
TRILINOS_SOURCE_SHA	f931bd3
TRILINOS_SRN_CONFIG	true
TRILINOS_TARGET_BRANCH	develop
TRILINOS_TARGET_REPO	https://github.com/trilinos/Trilinos
TRILINOS_TARGET_SHA	49d2b72

…

NEW (AT2)



✓ **Changes approved**
1 approving review by reviewers with write access. Learn more about pull request reviews.
Show all reviewers

✓ **1 approval**

19 pending reviewers

Some checks were not successful
15 successful, 3 cancelled, 2 failing, and 2 pending checks
Hide all checks

✓ **AT2-EXPERIMENTAL / gcc10-openmpi416-EXPERIMENTAL (pull_request_review)** Successful… Details

ⓘ **AT2-EXPERIMENTAL / gcc830-serial-EXPERIMENTAL (pull_request)** Cancelled after 48m Details

✓ **AT2-EXPERIMENTAL / gcc830-serial-EXPERIMENTAL (pull_request_review)** Successful in 72m Details

✗ **AT2-EXPERIMENTAL / cuda11-uvm-EXPERIMENTAL (pull_request_review)** Failing after 52m Details

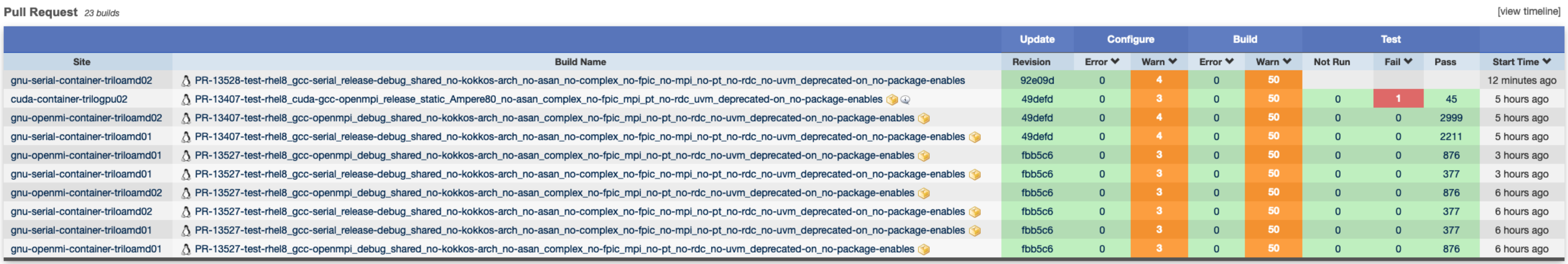
ⓘ **AT2-EXPERIMENTAL / cuda11-uvm-EXPERIMENTAL (pull_request)** Cancelled after 49m Details

✗ **AT2-EXPERIMENTAL / framework-tests-EXPERIMENTAL (pull_request_review)** Failing after 7m Details

Required statuses must pass before merging
All required statuses and check runs on this pull request must run successfully to enable automatic merging.

You can also open this in GitHub Desktop or view command line instructions.

CDASH SNEAK PEEK



Pull Request *23 builds* [view timeline]

		Update	Configure		Build		Test			
Site	Build Name	Revision	Error	Warn	Error	Warn	Not Run	Fail	Pass	Start Time
gnu-serial-container-triloamd02	PR-13528-test-rhel8_gcc-serial_release-debug_shared_no-kokkos-arch_no-asan_no-complex_no-fpic_no-mpi_no-pt_no-rdc_no-uvm_deprecated-on_no-package-enables	92e09d	0	4	0	50				12 minutes ago
cuda-container-trilogpu02	PR-13407-test-rhel8_cuda-gcc-openmpi_release_static_Ampere80_no-asan_complex_no-fpic_mpi_pt_no-rdc_uvm_deprecated-on_no-package-enables	49defd	0	3	0	50	0	1	45	5 hours ago
gnu-openmi-container-triloamd02	PR-13407-test-rhel8_gcc-openmpi_debug_shared_no-kokkos-arch_no-asan_complex_no-fpic_mpi_no-pt_no-rdc_no-uvm_deprecated-on_no-package-enables	49defd	0	4	0	50	0	0	2999	5 hours ago
gnu-serial-container-triloamd01	PR-13407-test-rhel8_gcc-serial_release-debug_shared_no-kokkos-arch_no-asan_no-complex_no-fpic_no-mpi_no-pt_no-rdc_no-uvm_deprecated-on_no-package-enables	49defd	0	4	0	50	0	0	2211	5 hours ago
gnu-openmi-container-triloamd01	PR-13527-test-rhel8_gcc-openmpi_debug_shared_no-kokkos-arch_no-asan_complex_no-fpic_mpi_no-pt_no-rdc_no-uvm_deprecated-on_no-package-enables	fbb5c6	0	3	0	50	0	0	876	3 hours ago
gnu-serial-container-triloamd01	PR-13527-test-rhel8_gcc-serial_release-debug_shared_no-kokkos-arch_no-asan_no-complex_no-fpic_no-mpi_no-pt_no-rdc_no-uvm_deprecated-on_no-package-enables	fbb5c6	0	3	0	50	0	0	377	3 hours ago
gnu-openmi-container-triloamd02	PR-13527-test-rhel8_gcc-openmpi_debug_shared_no-kokkos-arch_no-asan_complex_no-fpic_mpi_no-pt_no-rdc_no-uvm_deprecated-on_no-package-enables	fbb5c6	0	3	0	50	0	0	876	6 hours ago
gnu-serial-container-triloamd02	PR-13527-test-rhel8_gcc-serial_release-debug_shared_no-kokkos-arch_no-asan_no-complex_no-fpic_no-mpi_no-pt_no-rdc_no-uvm_deprecated-on_no-package-enables	fbb5c6	0	3	0	50	0	0	377	6 hours ago
gnu-serial-container-triloamd01	PR-13527-test-rhel8_gcc-serial_release-debug_shared_no-kokkos-arch_no-asan_no-complex_no-fpic_no-mpi_no-pt_no-rdc_no-uvm_deprecated-on_no-package-enables	fbb5c6	0	3	0	50	0	0	377	6 hours ago
gnu-openmi-container-triloamd01	PR-13527-test-rhel8_gcc-openmpi_debug_shared_no-kokkos-arch_no-asan_complex_no-fpic_mpi_no-pt_no-rdc_no-uvm_deprecated-on_no-package-enables	fbb5c6	0	3	0	50	0	0	876	6 hours ago

UNAPPROVED USERS

```
[] Failure Status for user dependabot[bot]: 404 Not Found
[] Initiating User dependabot[bot] is not approved to run jobs on this
machine.
[] AT2: Please have someone from Developers trigger this workflow
[] Job is not approved
```

“SPECIAL” DIRECTORIES

```
[] .github directory was modified, requiring special approval...
[] AT2: latest special approval: No special approval found
[] AT2: Please have someone from framework review this PR and apply the
AT2-SpecialApprove label
```

** The workflow(s) will then need to be manually re-run

ACTIONS VS JENKINS-BASED CI

Cons

- Load balancing is more difficult without an “orchestration” tool (currently manually assign containers to hardware)
  - OpenShift/Kubernetes has potential to help address this

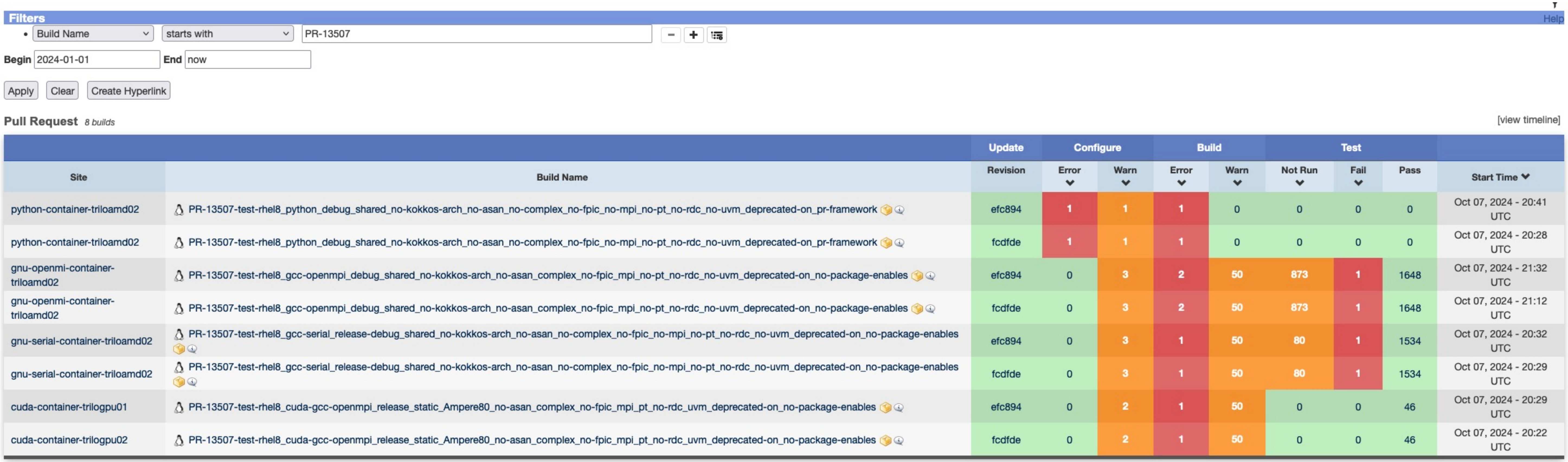
Pros

- Transparency about run stages and state
- Much more configuration-as-code under test (e.g. changing a CI configuration in the .github files is ”self-testing”)
- Ability to re-run only specific checks (e.g. “only the GCC check failed, it looks like a load issue, let’s try re-running it”)
- Jobs are queued immediately, and queued state is visible

INTERACTIVE DEMO

https://github.com/trilinos/Trilinos/actions/runs/11223351354?pr=13507

FILTERED CDASH OUTPUT EXAMPLE



- Build Name | starts with | PR-13507

Begin 2024-01-01 End now

Pull Request *8 builds*

		Update	Configure		Build		Test			
Site	Build Name	Revision	Error	Warn	Error	Warn	Not Run	Fail	Pass	Start Time
python-container-triloamd02	PR-13507-test-rhel8_python_debug_shared_no-kokkos-arch_no-asan_no-complex_no-fpic_no-mpi_no-pt_no-rdc_no-uvm_deprecated-on_pr-framework	efc894	1	1	1	0	0	0	0	Oct 07, 2024 - 20:41 UTC
python-container-triloamd02	PR-13507-test-rhel8_python_debug_shared_no-kokkos-arch_no-asan_no-complex_no-fpic_no-mpi_no-pt_no-rdc_no-uvm_deprecated-on_pr-framework	fcdfde	1	1	1	0	0	0	0	Oct 07, 2024 - 20:28 UTC
gnu-openmi-container-triloamd02	PR-13507-test-rhel8_gcc-openmpi_debug_shared_no-kokkos-arch_no-asan_complex_no-fpic_mpi_no-pt_no-rdc_no-uvm_deprecated-on_no-package-enables	efc894	0	3	2	50	873	1	1648	Oct 07, 2024 - 21:32 UTC
gnu-openmi-container-triloamd02	PR-13507-test-rhel8_gcc-openmpi_debug_shared_no-kokkos-arch_no-asan_complex_no-fpic_mpi_no-pt_no-rdc_no-uvm_deprecated-on_no-package-enables	fcdfde	0	3	2	50	873	1	1648	Oct 07, 2024 - 21:12 UTC
gnu-serial-container-triloamd02	PR-13507-test-rhel8_gcc-serial_release-debug_shared_no-kokkos-arch_no-asan_no-complex_no-fpic_no-mpi_no-pt_no-rdc_no-uvm_deprecated-on_no-package-enables	efc894	0	3	1	50	80	1	1534	Oct 07, 2024 - 20:32 UTC
gnu-serial-container-triloamd02	PR-13507-test-rhel8_gcc-serial_release-debug_shared_no-kokkos-arch_no-asan_no-complex_no-fpic_no-mpi_no-pt_no-rdc_no-uvm_deprecated-on_no-package-enables	fcdfde	0	3	1	50	80	1	1534	Oct 07, 2024 - 20:29 UTC
cuda-container-trilogpu01	PR-13507-test-rhel8_cuda-gcc-openmpi_release_static_Ampere80_no-asan_complex_no-fpic_mpi_pt_no-rdc_uvm_deprecated-on_no-package-enables	efc894	0	2	1	50	0	0	46	Oct 07, 2024 - 20:29 UTC
cuda-container-trilogpu02	PR-13507-test-rhel8_cuda-gcc-openmpi_release_static_Ampere80_no-asan_complex_no-fpic_mpi_pt_no-rdc_uvm_deprecated-on_no-package-enables	fcdfde	0	2	1	50	0	0	46	Oct 07, 2024 - 20:22 UTC

CONCLUSIONS

- Containers + GitHub Actions will be the CI testing driver technologies moving forwards
- Containers allow distribution of exact CI testing environments to any collaborator, internal or external
- Containers allow for testing of any containerized software stack in a similar manner (e.g. SEMS, AUE)
- GitHub Actions will allow for higher levels of transparency, hopefully fostering better developer confidence in CI
- AT2 system will allow for individual re-runs in case of system instability

Containers will be an important tool for all developers moving forwards

Thank you to the AutoTester2 team from SEMS, as well as the CSRI system admins for all of their work on enabling this system!

DISCUSSION