

KubeCon

CloudNativeCon

North America 2024





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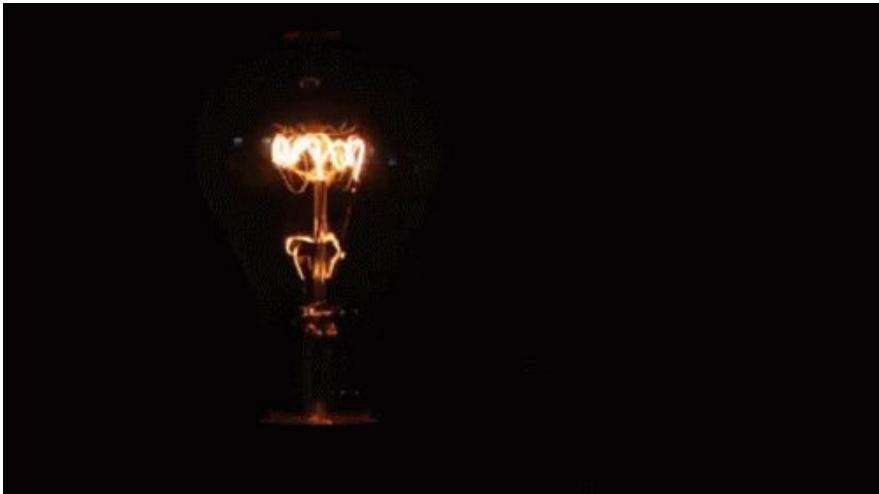
North America 2024

Achieving and Maintaining a Healthy CI with Zero Test Flakes

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(Google)*

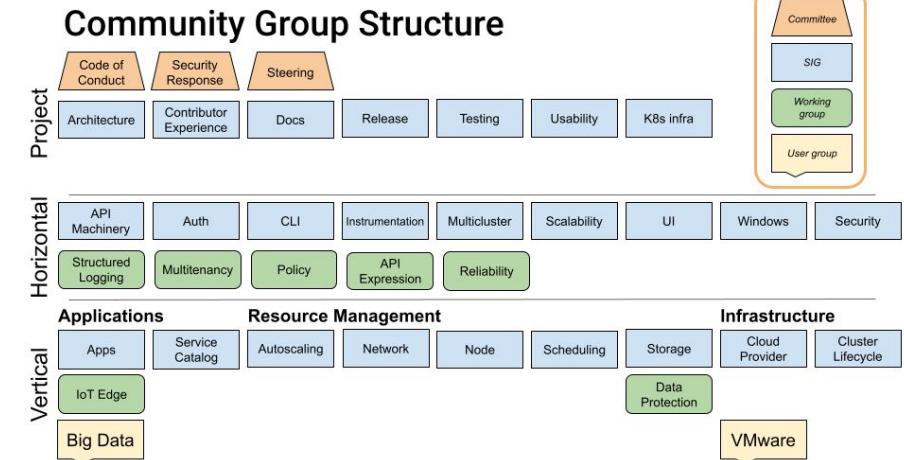
The Challenge of Flaky Tests

- Flaky tests pass or fail intermittently without code changes, undermining confidence in the CI system.
- They waste valuable developer time and resources on investigating false positives or negatives.
- Flaky tests can delay releases and hinder the ability to deliver high-quality software consistently.



Kubernetes Project Structure

- **No separate "quality/testing team"** - responsibility for testing is shared across various SIGs (Special Interest Groups).
- SIGs own horizontal or vertical areas of the project, ensuring comprehensive test coverage.
- Collaboration and solidarity between SIGs are essential for maintaining high-quality standards.



Quality Starts Before Code is Merged



- Clear design (KEPs) and thorough code reviews are crucial for preventing bugs and ensuring maintainability.
- Good testing strategy with a variety of testing methods, such as unit testing, integration testing, system testing, and user acceptance testing
- New features and bug fixes must be accompanied by comprehensive tests to prevent regressions.

Identifying and Addressing the Root Causes

- **Test Isolation:** Ensure tests are independent and do not interfere with each other.
- **Resource Management:** Properly manage the infrastructure,
- **Timing Issues:** Address race conditions and timing dependencies that can lead to unpredictable behavior.
- **Environmental Factors:** Control external dependencies and ensure consistent test environments



Building a Culture of Quality

- Write tests during the development to ensure testability and prevent regressions.
- Run tests on every commit and periodically.
- Revert over Fix Forward: When regressions occur, prioritize reverting the problematic change over immediate fixes.
- Backport Policies: Ensure that only critical fixes and regressions are backported to relevant release branches and avoid unnecessary risks.



Leveraging the Kubernetes Ecosystem

- **Kubernetes Test Infrastructure:** Utilize the project's robust testing infrastructure for running tests at scale.
- **Prow:** Kubernetes' CI system for automating builds, tests, and deployments.
- **TestGrid:** A tool for visualizing test results and identifying flaky tests.
- **k8s-triage:** A tool for analyzing test failures and identifying patterns.





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Tooling to Tackle Flakes



Tackling Flakes



Where do you see failures?

- PRs (presubmits)
 - PRs (postsubmits)
 - Periodics

Debug with logs, artifacts,
etc.

Review required Show all reviewers
At least 1 approving review is required by reviewers with write access. [Learn more about pull request reviews.](#)

2 pending reviewers

Some checks were not successful Hide all checks
1 failing, 1 pending, and 1 successful checks

| Check Status | Description | Details |
|--|---|-------------------------|
| ✗ test-testgrid-npm | Job failed. | BaseSHA:34a05f11e01d... |
| ● tide | Pending — Not mergeable. Job test-testgrid-npm has not succeeded. | Details |
| ✓ EasyCLA | EasyCLA check passed. You are authorized to contribute. | Required Details |

Merging is blocked

↓

test-testgrid-npm #1850060098676723712

Prow has been successfully migrated to community Infrastructure on the 22nd of August. Updates on [groups/kubernetes.io/dev](#)

[Job History](#) [PR History](#) [Artifacts](#)

Test started 10/25/2024 **failed** after 2m23s. ([more info](#))

Build Log

Show all hidden lines [Raw build-log.txt](#)

```
⋮ 33 skipped lines...
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34
35 (!) `this` has been rewritten to `undefined`
36 https://rollupjs.org/guide/en/error-this-is-undefined
37 node_modules/@protobuf-ts/runtime-rpc/build/es2015/test-transport.js
38 i: var __awaiter = (this && this.__awaiter) || function (thisArg, _arguments, P, generator) {
39
40 o: 0 < arguments.length ? new Promise((resolve, reject) => {
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42 r: resolve(generator(..._arguments));
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44 e: r.catch(reject);
45
46 n: e;
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48 s: !r;
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Tackling Flakes

New failure, or flaky test?

- Need other clues to debug:
 - Has this happened before?
 - When did it start?
 - What's it affecting?
- Different tools to tackle flakes



Prowjob History

Quick history of 1 job

- Linked from logs
- Limited details

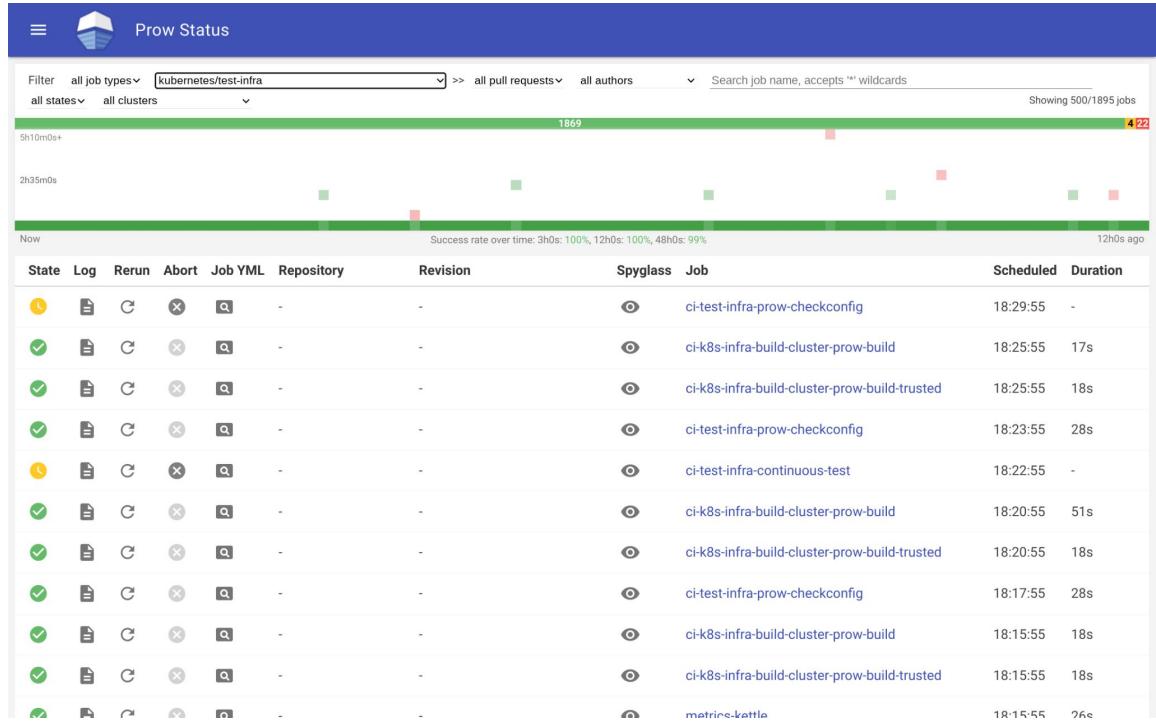
The image shows two screenshots of the Prow UI. The top screenshot displays a summary card for a job named "pull-test-infra-unit-test #1849508371200217088". The card includes a logo, the job name, and a message stating "Prow has been successfully migrated to community Infrastructure". Below the card are two buttons: "Job History" (underlined in red) and "PR History". A downward arrow points from this card to a second screenshot, which is a detailed table of "Job History: pr-logs/directory/pull-test-infra-unit-test". The table has columns for Build, Revision, Started, Duration, and Result. It lists 12 entries, each with a unique build ID, revision hash, start time, duration, and result status (all SUCCESS). The table is styled with alternating green and white rows.

| Build | Revision | Started | Duration | Result |
|----------------------|-----------------------------------|-----------------|----------|---------|
| 1855068054023573504 | #33779 (11c3f37) by dims | 18:01:26 | 4m59s | SUCCESS |
| 1855033461899792384 | #33775 (6014dd4) by tklauser | 15:44:02 | 5m46s | SUCCESS |
| 1854994366054010880 | #33778 (e0db671) by jimangel | 13:08:37 | 5m0s | SUCCESS |
| 18549342111422484480 | #33777 (acf5be3) by jsafrane | 09:41:01 | 4m34s | SUCCESS |
| 1854935225168039936 | #33777 (fce86ee) by jsafrane | 09:13:36 | 5m1s | SUCCESS |
| 1854904946156113920 | #33776 (237a889) by dims | 07:13:17 | 6m53s | SUCCESS |
| 1854846684903772160 | #33762 (38d988a) by openshift-bot | 03:21:47 | 5m0s | SUCCESS |
| 1854570963400658944 | #33774 (a5f30bf) by dims | Nov 07 09:07:02 | 6m38s | SUCCESS |
| 1854529110282342400 | #33773 (64b9a9e) by neolit123 | Nov 07 06:19:53 | 5m22s | SUCCESS |
| 1854526115201159168 | #33773 (64b9a9e) by neolit123 | Nov 07 06:07:59 | 5m16s | SUCCESS |
| 1854520970732113920 | #33772 (38e627c) by dims | Nov 07 05:47:31 | 5m6s | SUCCESS |
| 1854515862619295744 | #33771 (6975e65) by dims | Nov 07 05:27:15 | 4m42s | SUCCESS |

Prowjob History

Recent job history

- Quick overview
- Filter results
- Limited history



TestGrid: Visual history

testgrid.k8s.io

- Patterns over time
 - Customizable
 - Tests (rows) vs. runs (columns)

Summary tab

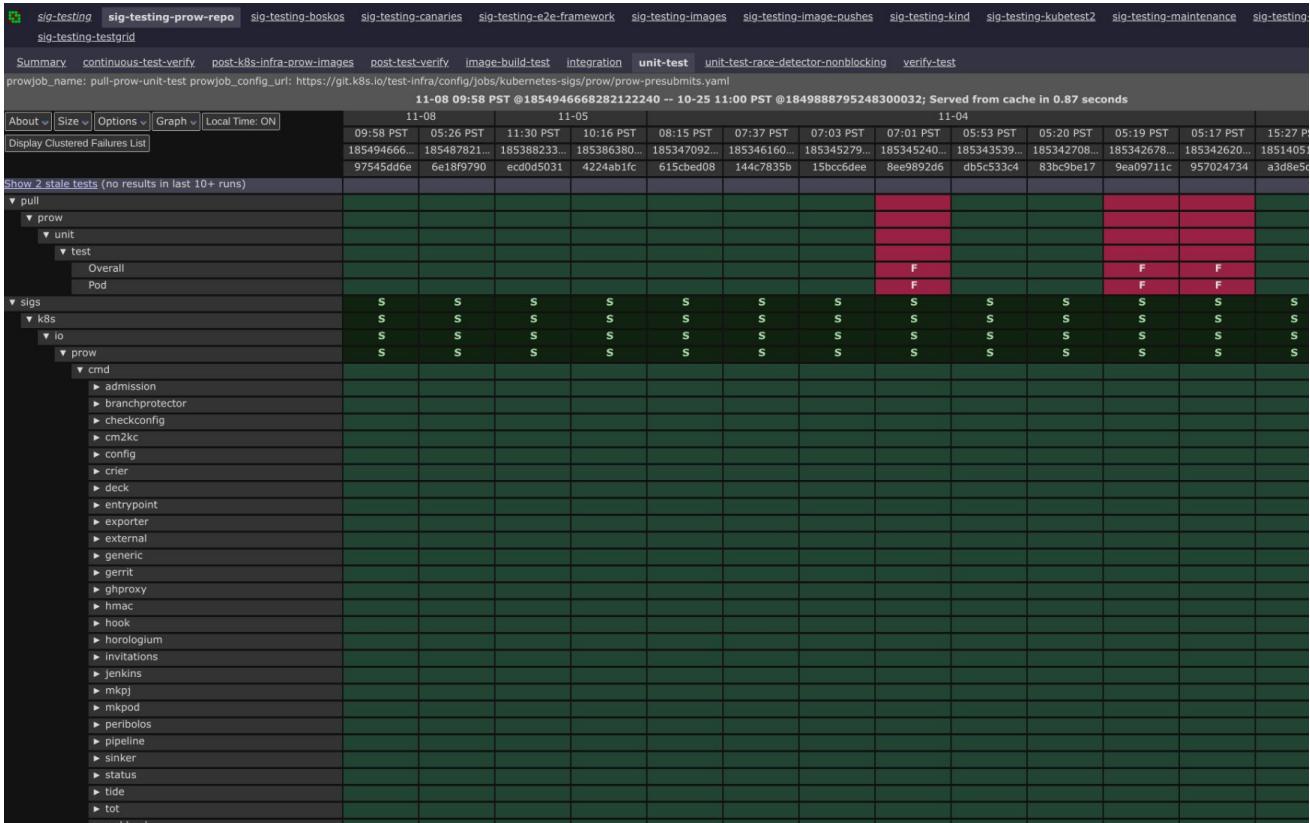
- Quick job(s) status
 - Recent stats
 - Alerts / failed rows



TestGrid

Example:

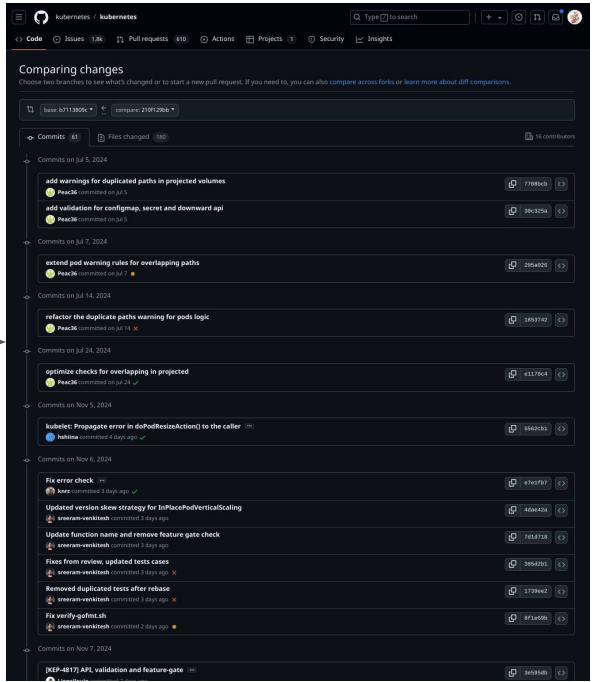
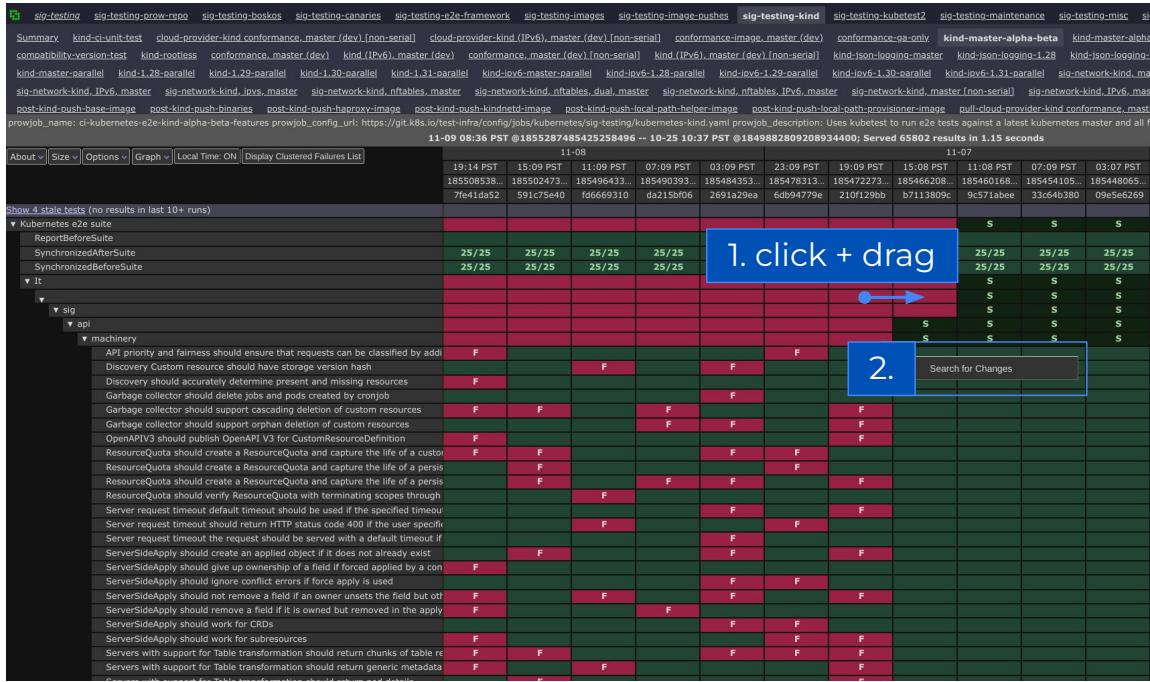
- Flaky...
- But overall,
not on tests



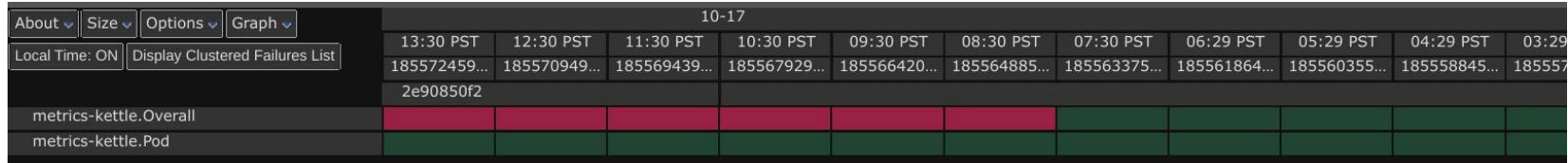
TestGrid



- Flaky tests...Clear pass > fail boundary
 - Find code changes between runs



- Email alerts when tab starts failing



 noreply+testgrid@google.com <noreply+testgrid@google.com> Oct 17, 2024, 1:32:35 PM   

to k8s-infra-oncall@google.com, kubernetes-sig-testing-alerts@googlegroups.com

New TestGrid alerts at [sig-testing-misc#metrics-kettle](#) since commit/f142a6db6.

Found 1 failing rows in metrics-kettle: 1 new, 0 other **1 new Test Failures in metrics-kettle**.

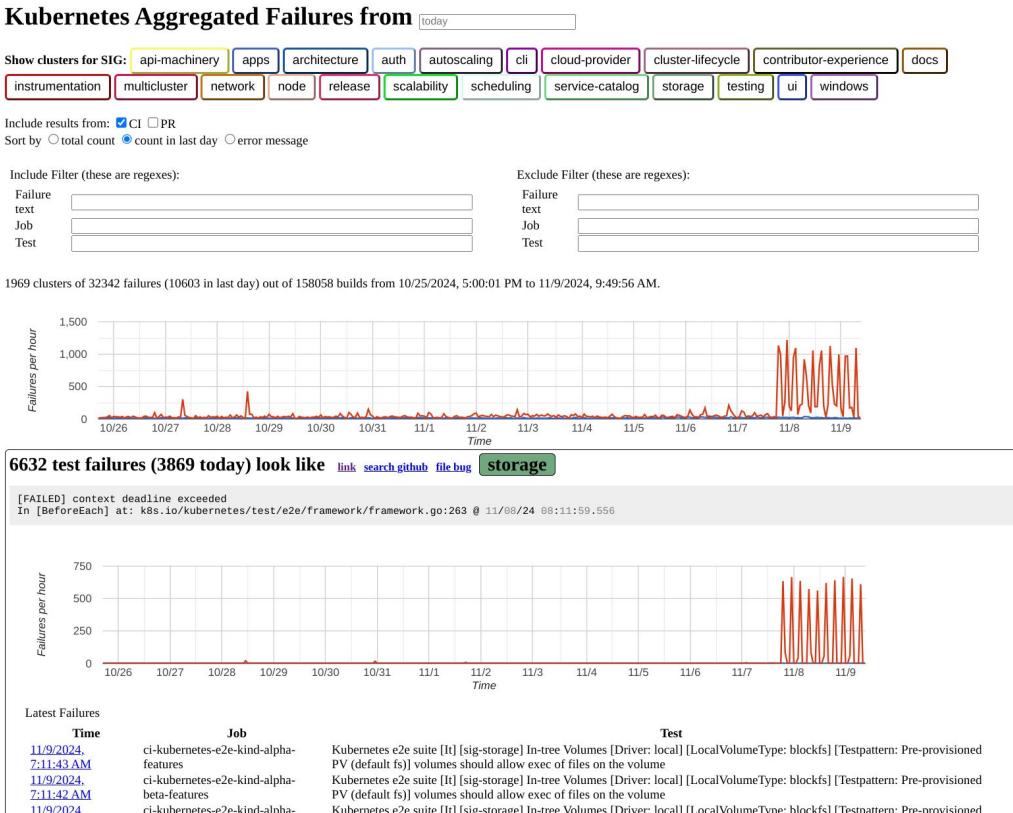
- Test **metrics-kettle.Overall** has failed 6 times since it last passed at commit/eca0b3643. It started failing between commit/eca0b3643 (Thu Oct 17 07:30 PDT) and commit/f142a6db6 (Thu Oct 17 08:30 PDT):

TestGrid Link: <https://testgrid.k8s.io/sig-testing-misc#metrics-kettle>

Triage: Clustered failures

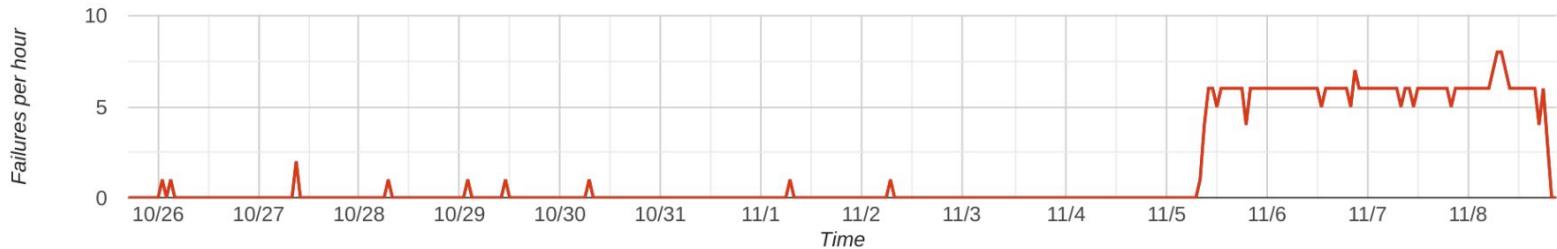
go.k8s.io/triage

- Cluster similar failure messages across jobs
- Filter results



501 test failures (136 today) look like [link](#) [search github](#) [file bug](#)

```
error during ./hack/e2e-internal/e2e-up.sh: exit status 2
```



Latest Failures

| Time | Job | Test |
|---------------------------------------|--|------|
| 11/8/2024, 7:12:55 PM | ci-kubernetes-e2e-gci-gce-autoscaling-migs-hpa | Up |
| 11/8/2024, 7:03:55 PM | ci-kubernetes-e2e-autoscaling-hpa-cpu | Up |
| 11/8/2024, 7:02:56 PM | ci-kubernetes-e2e-gci-gce-autoscaling-hpa-cm | Up |
| 11/8/2024, 6:41:55 PM | ci-kubernetes-e2e-gci-gce-autoscaling-migs-hpa | Up |
| 11/8/2024, 6:32:55 PM | ci-kubernetes-e2e-autoscaling-hpa-cpu | Up |

- Failed in 14 Jobs ►
- Failed in 1 Test ▼
 - - - - - - [REDACTED] 501 Up ►

Triage

501 test failures (136 today) look like [link](#) [search github](#) [file bug](#)

error during ./hack/e2e-internal/e2e-up.sh: exit status 2

kubernetes / kubernetes

Issues 1.8k Pull requests 608 Actions Projects 1 Security Insights

Add a title

Failure cluster [10593569...]

Add a description

Write Preview

Failure cluster [10593569f958de2147a5](https://go.k8s.io/triage#10593569f958de2147a5)

Error text:
"
error during ./hack/e2e-internal/e2e-up.sh: exit status 2
"
Recent failures:
[11/8/2024, 7:12:55 PM ci-kubernetes-e2e-gce-autoscaling-migs-hpa](https://prow.k8s.io/view/gs/kubernetes-ci-logs/logs/ci-kubernetes-e2e-gce-autoscaling-migs-hpa/1855086135550676992)
[11/8/2024, 7:03:55 PM ci-kubernetes-e2e-autoscaling-hpa-cpu](https://prow.k8s.io/view/gs/kubernetes-ci-logs/logs/ci-kubernetes-e2e-autoscaling-hpa-cpu/1855083870748151808)
[11/8/2024, 7:02:56 PM ci-kubernetes-e2e-gce-autoscaling-hpa-cm](https://prow.k8s.io/view/gs/kubernetes-ci-logs/logs/ci-kubernetes-e2e-gce-autoscaling-hpa-cm/1855083619333181440)
[11/8/2024, 6:41:55 PM ci-kubernetes-e2e-gce-autoscaling-migs-hpa](https://prow.k8s.io/view/gs/kubernetes-ci-logs/logs/ci-kubernetes-e2e-gce-autoscaling-migs-hpa/185507833445615488)
[11/8/2024, 6:32:55 PM ci-kubernetes-e2e-autoscaling-hpa-cpu](https://prow.k8s.io/view/gs/kubernetes-ci-logs/logs/ci-kubernetes-e2e-autoscaling-hpa-cpu/185507833445615488)

Assignees
No one assigned

Labels
None yet

Projects
None yet

Milestone
No milestone

Development
Shows branches and pull requests linked to this issue.

Tackling Flakes

Approach is:

- Multi-pronged
- Linked
- Push and pull
- Communicating

Regardless: prevention > cure





KubeCon



CloudNativeCon

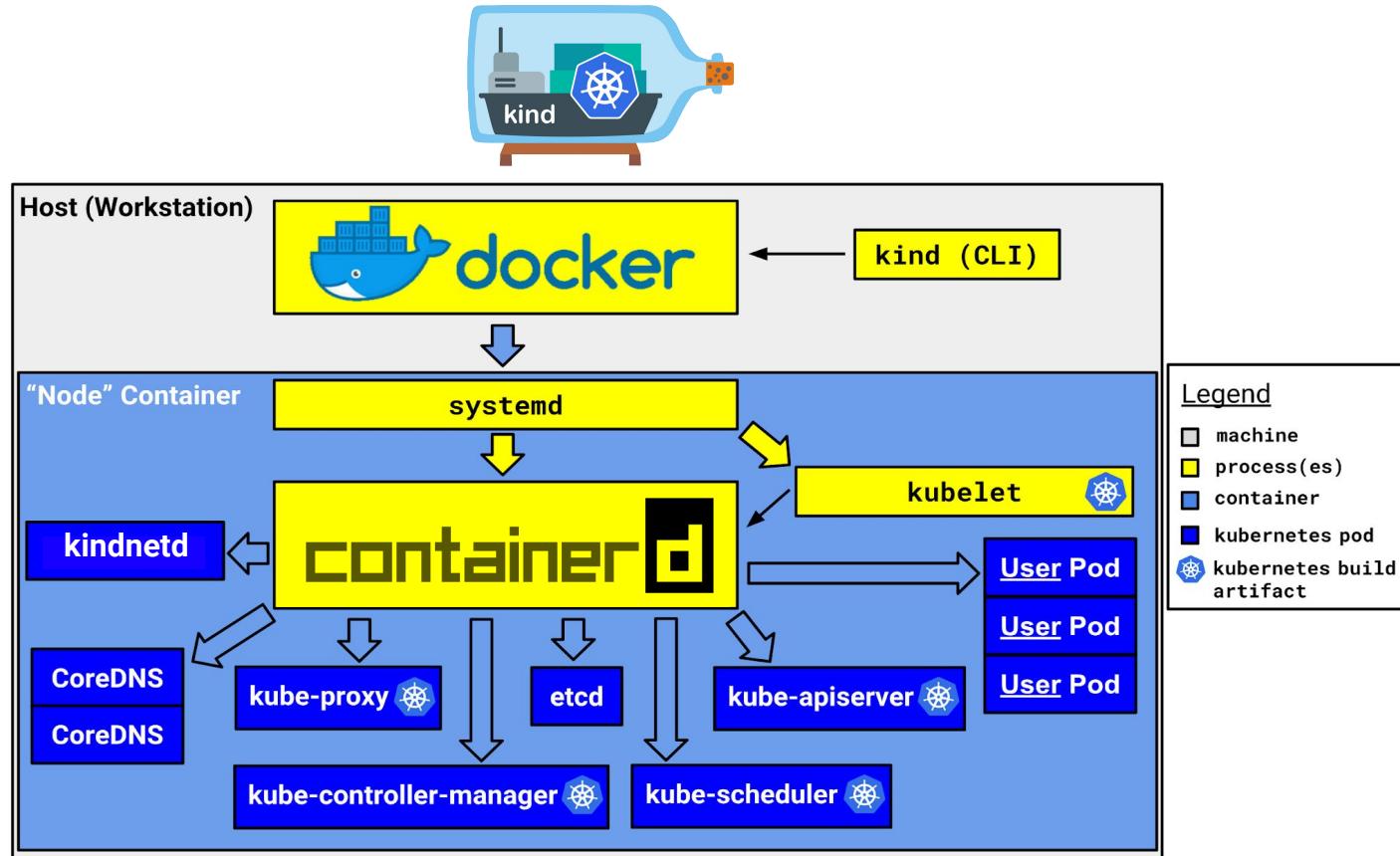
North America 2024

Infrastructure

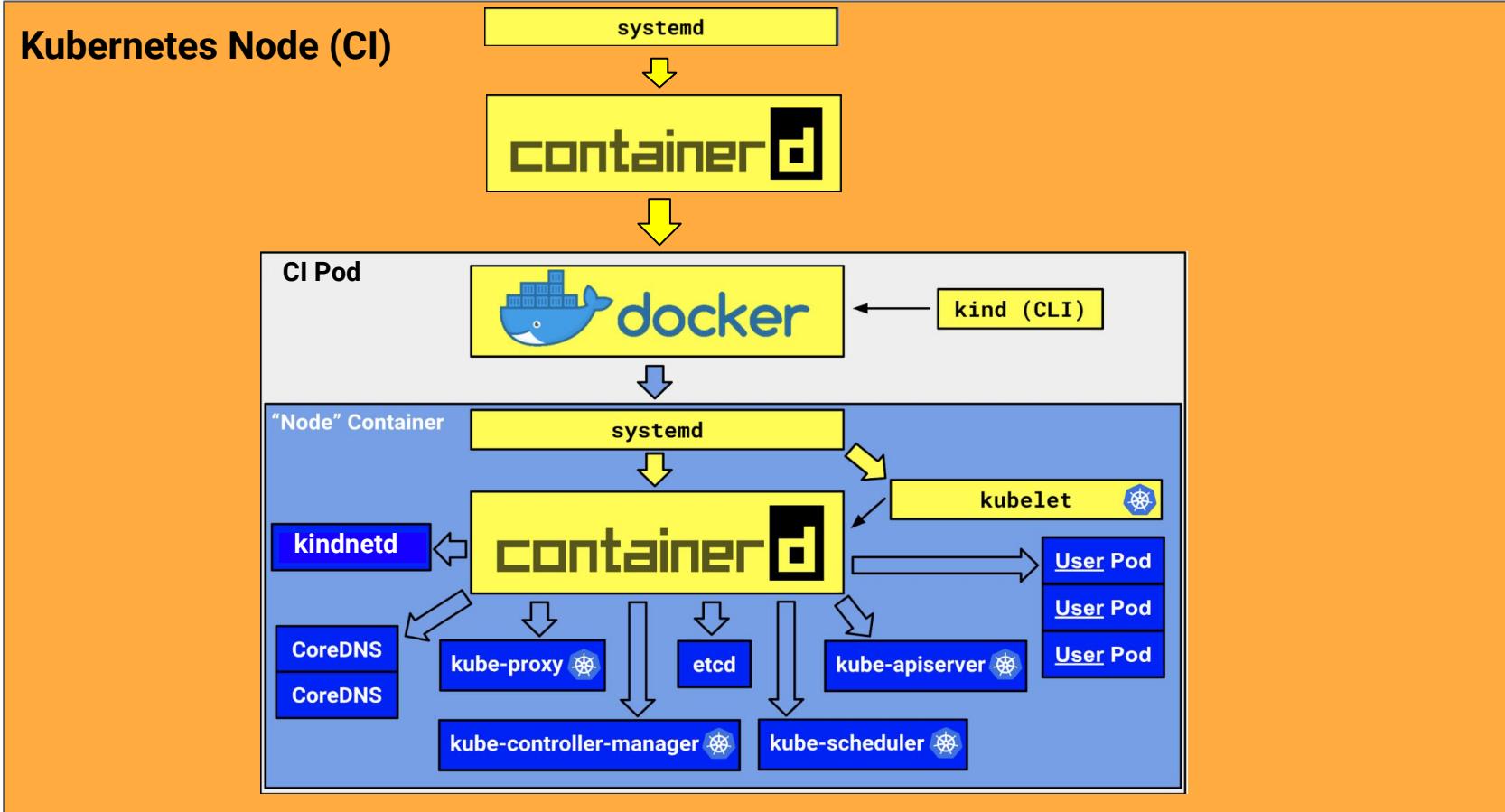


**Developers need to trust that test failures
are due to the code under test and not the
CI infrastructure.**

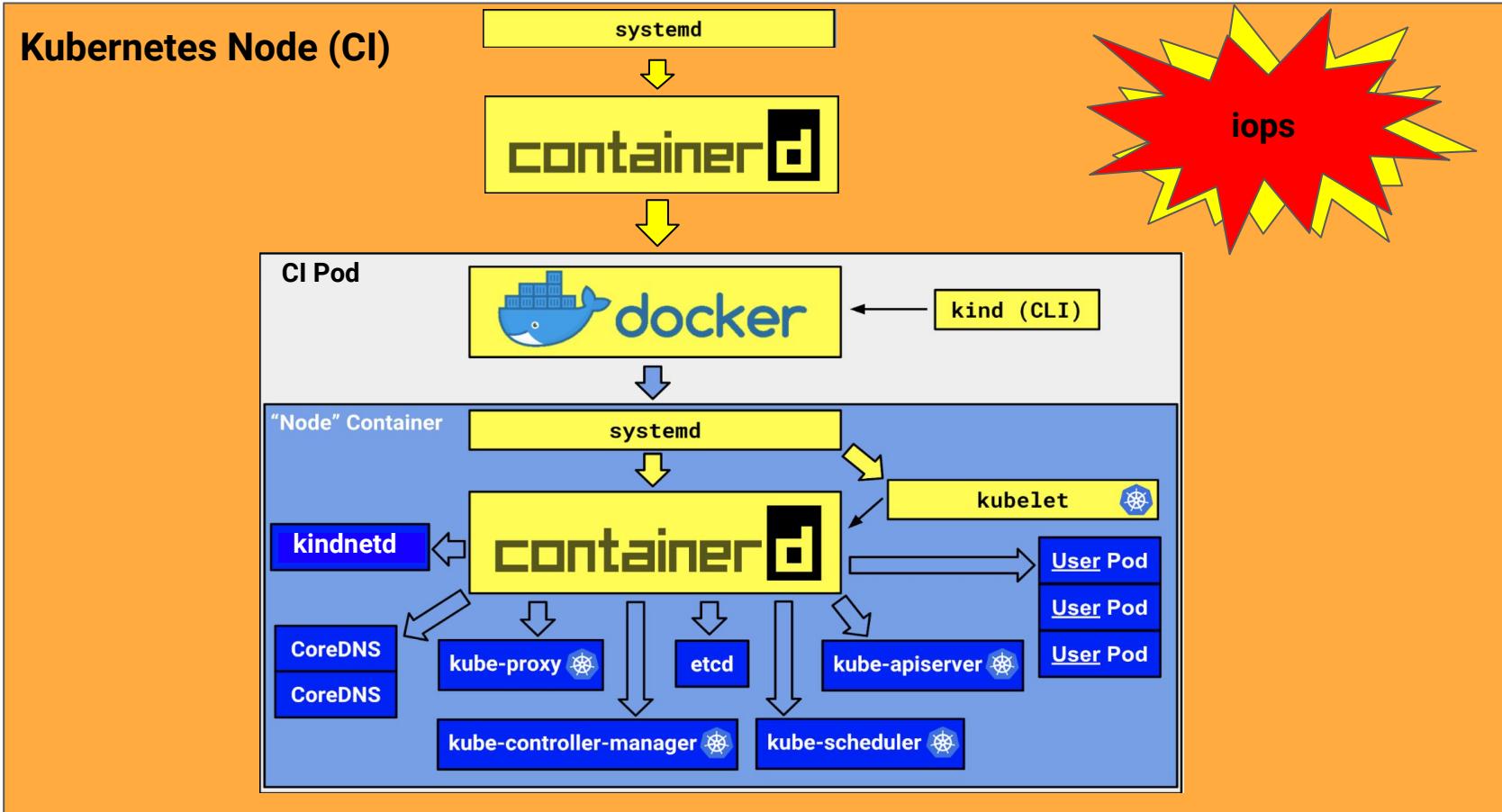
Infrastructure



Infrastructure



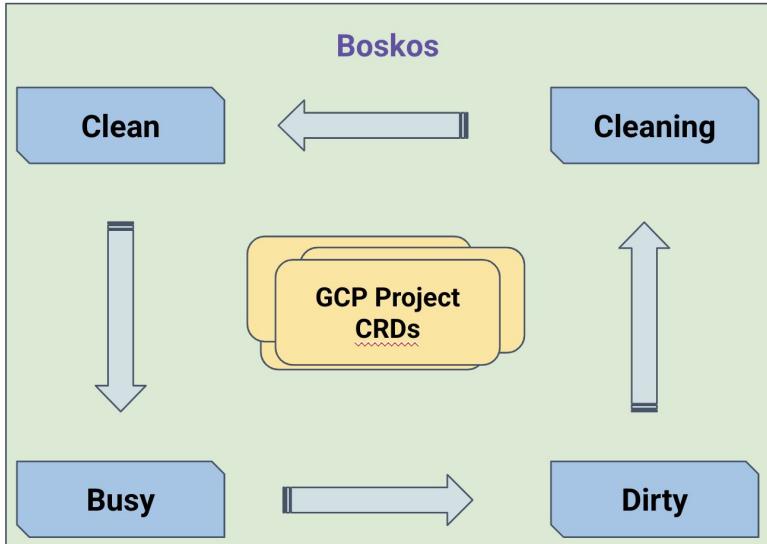
Infrastructure



- Avoid resource contention
 - Set requests and limits for CI workloads
 - Consider I/O needs
 - Measure measure measure
 - GOMAXPROCS
- Lots of Kernel APIs are not namespaced 
 - Watch out for leaky privileged containers
 - binfmt_misc, inotify limits, ...

Reliable Infrastructure

- <https://sigs.k8s.io/boskos>
 - Lease external CI resources with heartbeat + TTL
 - Automatic cleanup
- Monitoring and alerting (grafana / prometheus)
 - Stay ahead of resource consumption



Conclusion

- Eliminating flaky tests is crucial for achieving a robust CI pipeline.
- A holistic approach to quality, starting with design and code reviews, is essential.
- Collaboration and **shared responsibility** for testing are key to success.
- By adopting best practices and leveraging the right tools, the Kubernetes project delivers high-quality software consistently.

Conclusion



Get Involved!

Find us at:

GitHub: github.com/kubernetes/test-infra

Slack: #sig-testing slack.k8s.io

Biweekly meeting (Tuesdays @ 10am PT)

- See #sig-testing for link + agenda



Questions?

Thanks!



(If you want, leave us
feedback!)