The Great “k8s.gcr.io” Vanity Domain Flip

Linus Arver (Google)
Stephen Augustus (VMware)

Who We Are

Linus Arver

Container Image Promoter Maintainer
WG K8s Infra contributor
Software Engineer, Google

Stephen Augustus

SIG Release Chair
Kubernetes Release Manager
Senior OSS Engineer, VMware

The Great “k8s.gcr.io” VDF

Overview

- Historical context & rationale
- Infrastructural changes
  - How the promoter works
  - How it’s tested
- Lessons learned

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What is “k8s.gcr.io”?

- Vanity domain: essentially, it’s a **human-friendly name** to a **folder** that contains container (Docker) images.
  - **google-containers** (old)
  - **k8s-artifacts-prod** (new)
- The “**k8s.gcr.io**” name is widely used throughout the Kubernetes codebase and configuration logic.
- The **flip** that happened this July made the name point from **google-containers** to **k8s-artifacts-prod.**

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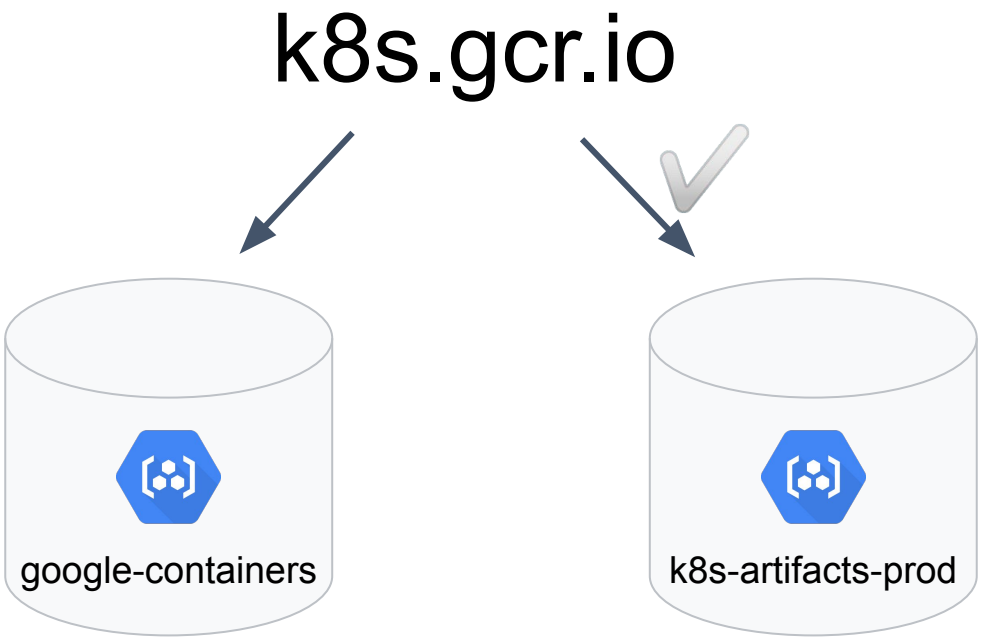
Summary of the vanity domain flip



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Is that it?

- Infrastructure improvements (e.g., the promoter) were not trivial
- This gave us an opportunity to improve production (and testing!) hygiene, such as:
  - Security
  - Auditability
  - Backups

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Historical timeline

- 2018: Internal image promoter released for Googlers
- Early 2020: OSS Container Image Promoter is an improved version of the internal promoter
  - Same idea as internal promoter, but with added **infrastructure**
  - **Auditing + backups!**
- July 24, 2020: Domain flipped to use **k8s-artifacts-prod**!

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Why did Google need an internal promoter?

- Tighten security posture
- Reduce risk of human error
- Make production changes auditable

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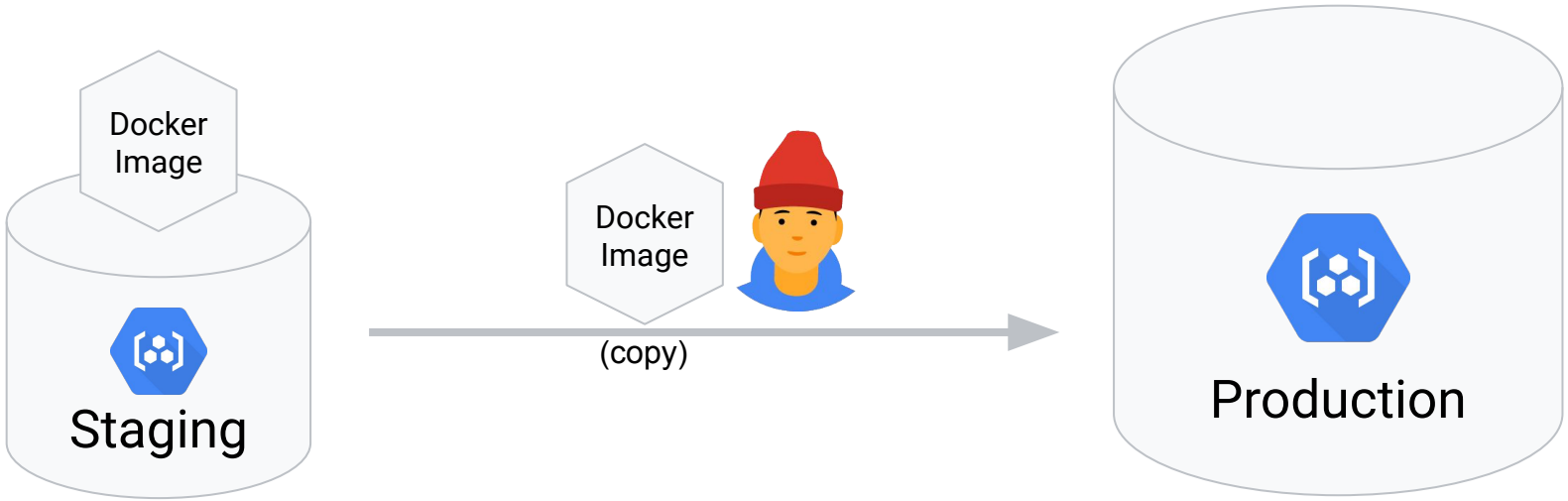
A long time ago (circa 2018), Googlers manually copied images to production (for the community)



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Why the old (manual way) was problematic…!

Questionable security

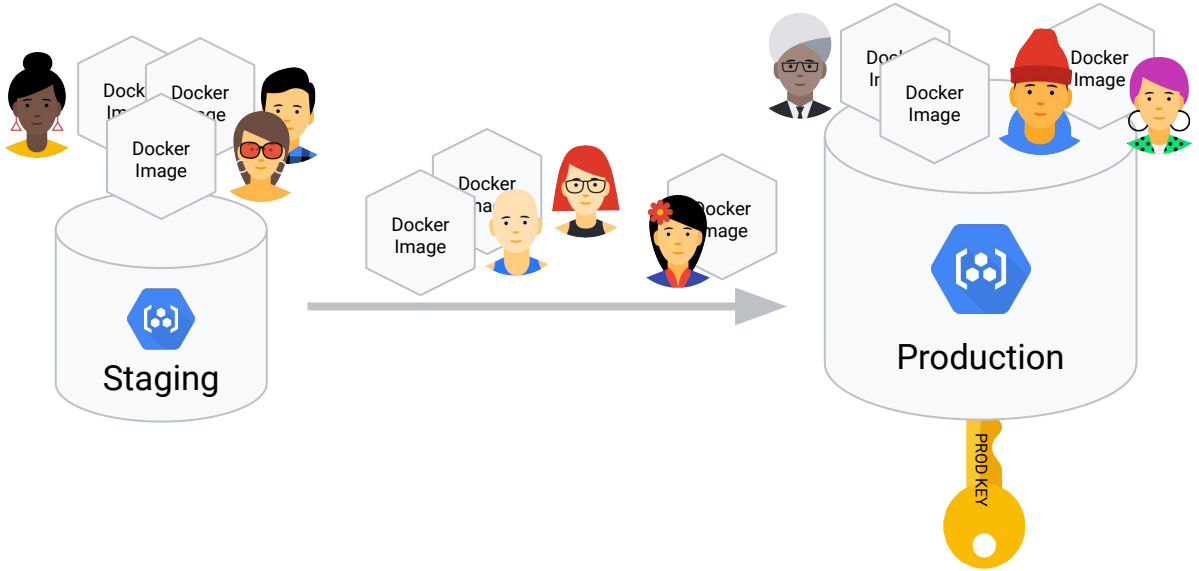
overbroad production access

No history

cannot tell who promoted which image

Manual

Incurs human toil for pushing images



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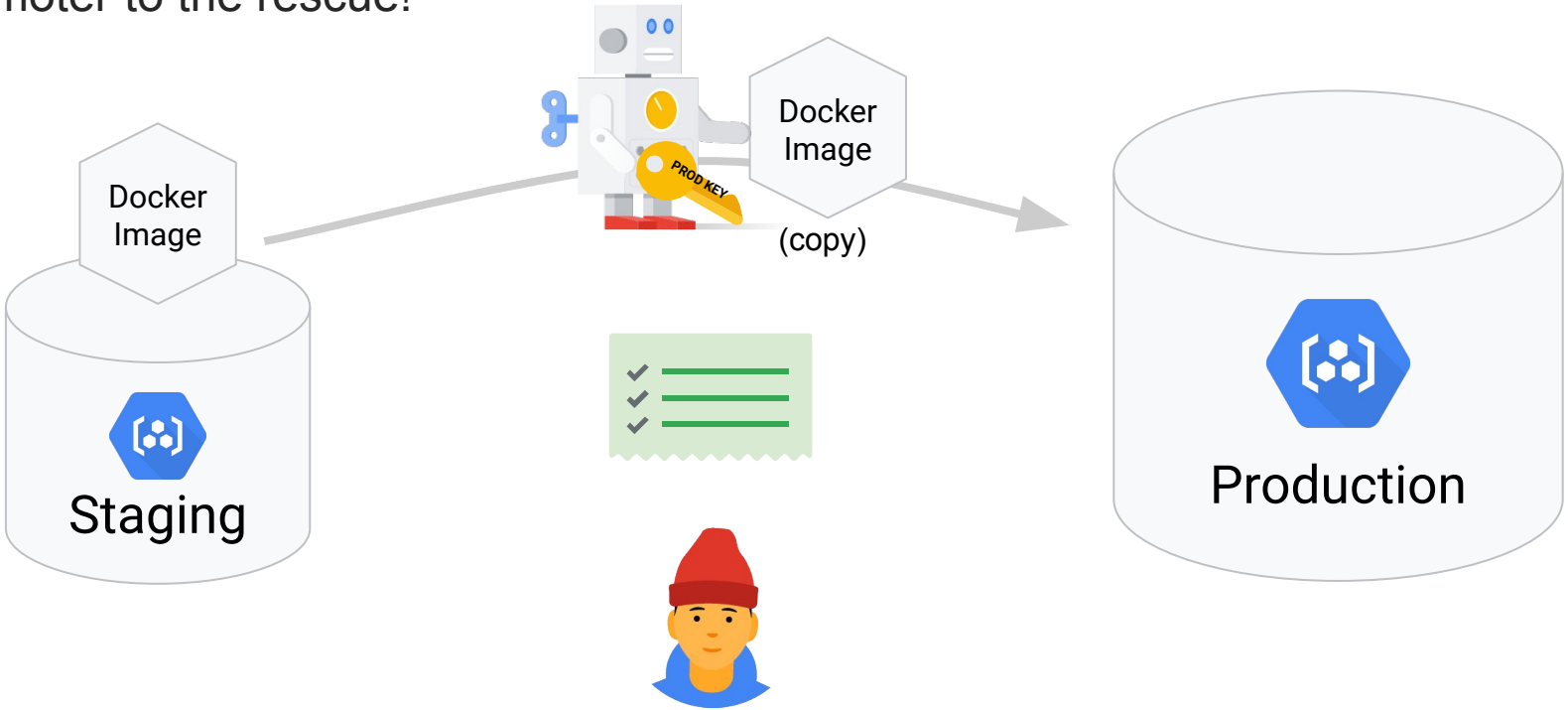
Promoter to the rescue!



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Promoter to the rescue!

More secure
only the promoter has access to prod key

Full history
promoter manifest kept in version control

Automatic
runs as a postsubmit

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The OSS Promoter

- It’s the open-source rewrite (Golang) of the internal promoter (Python)
- Performance-oriented
  - Promoter manifests specify ~30K images to promote, or 90K if you consider the 3 target regions
  - We take ~30 seconds to read all 90K (30K * 3 regions) image metadata from GCR
- “Edge” data structure for simplicity and correctness

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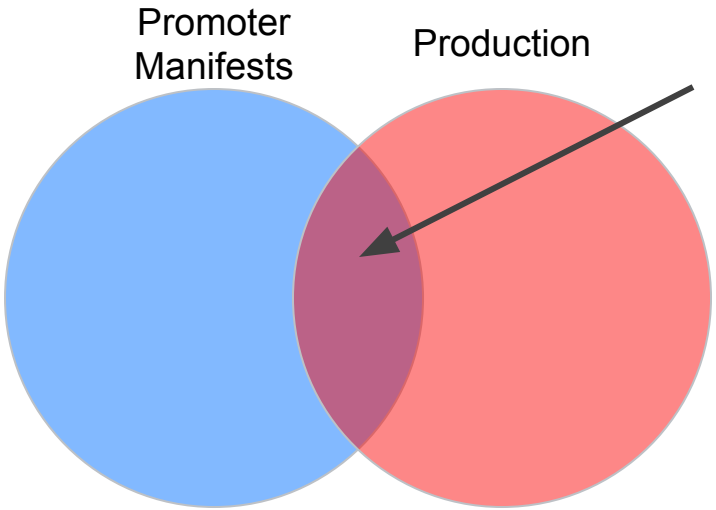
The OSS Promoter: Performance optimizations

- Read images in promoter manifests
- Read images in production GCR
- Remove unnecessary promotions (purple)
- Only promote what's left (blue)



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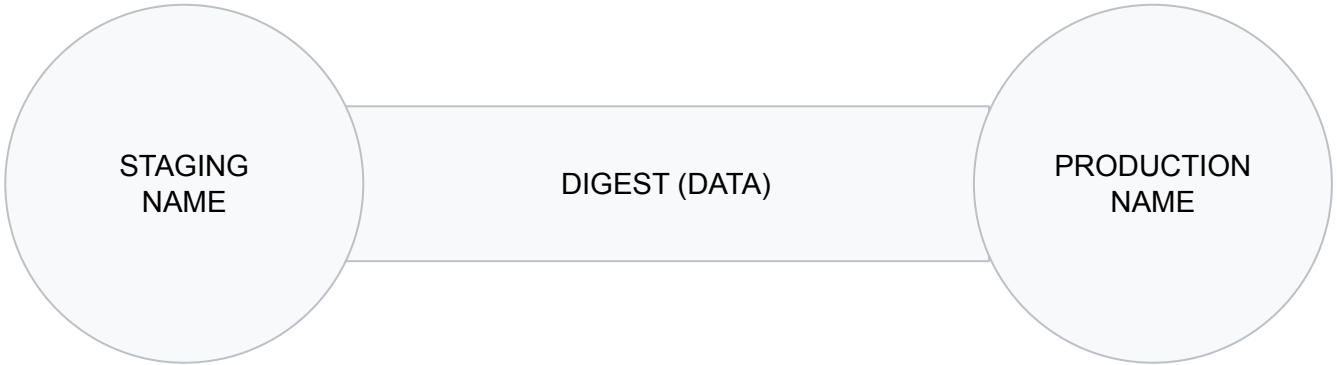
The OSS Promoter: “Edge” data structure

- A promotion “edge” represents the idea of a “copy”, but without the notion of time
- "Edge" has 3 parts = staging GCR "vertex", digest "edge", production GCR "vertex"



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The OSS Promoter: “Edge” data structure

> Promote gcr.io/staging/foo@sha256:0xabc to gcr.io/production/path/to/foo:1.0

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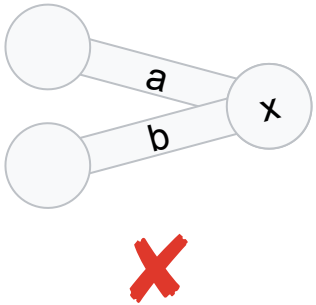
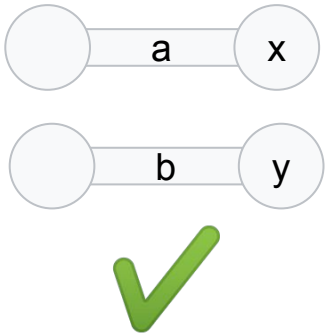
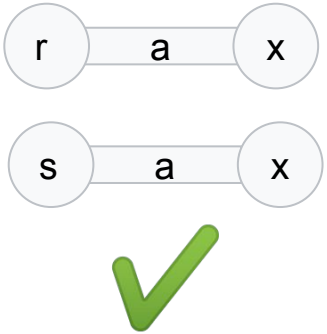
The OSS Promoter: “Edge” data structure

- Checking against tag overwrites, where "overwrite" means putting a different image into a production name
- However, copying the same image from multiple locations into the same production endpoint is OK (redundancy!)







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The OSS Promoter: How it really works

1. Gather set of promoter manifests
2. Convert desired promotions as promotion edges
3. Remove edges that are illegal (tag overwrite) or unnecessary (redundant)
4. "Actuate" each promotion edge with an image copy

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The OSS Promoter: Supporting Cast

- Additional infrastructure:
  - **Image auditing**
  - **Backups**

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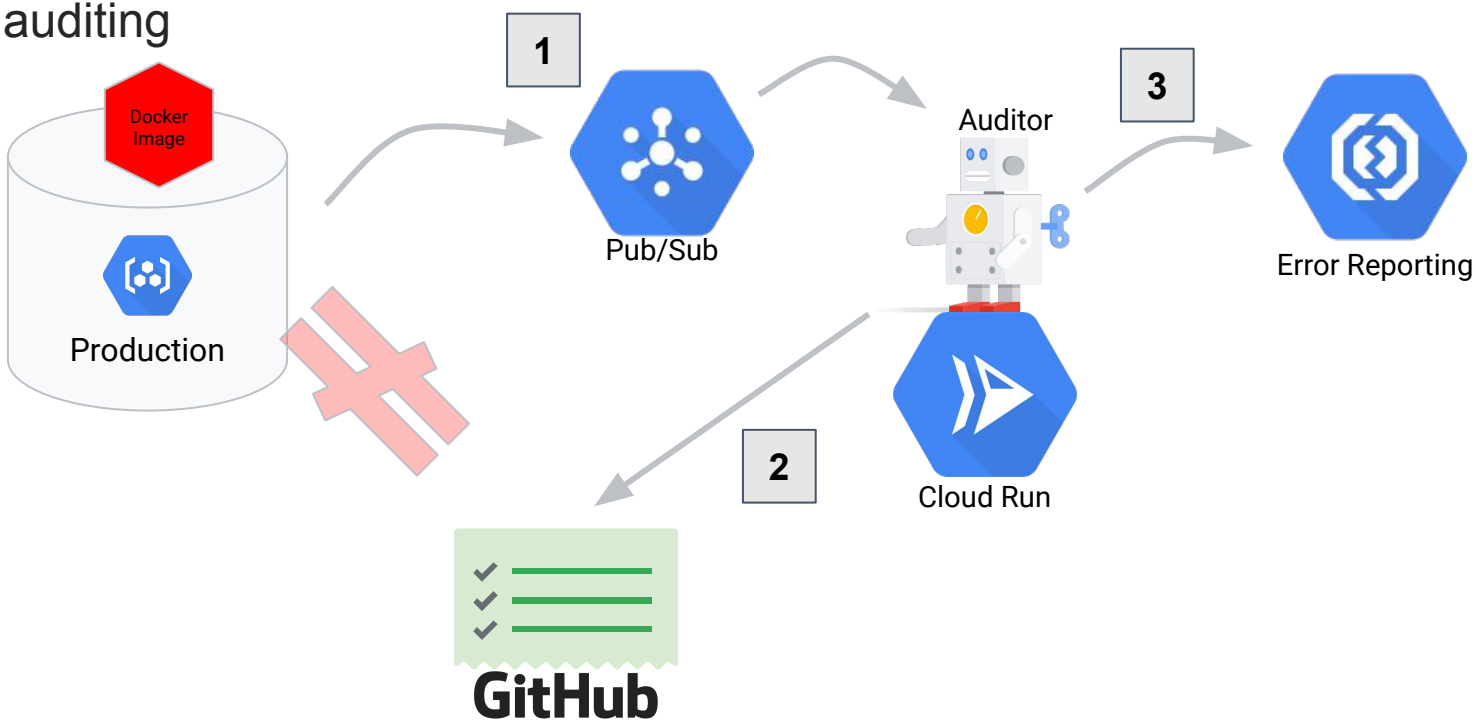
Image auditing



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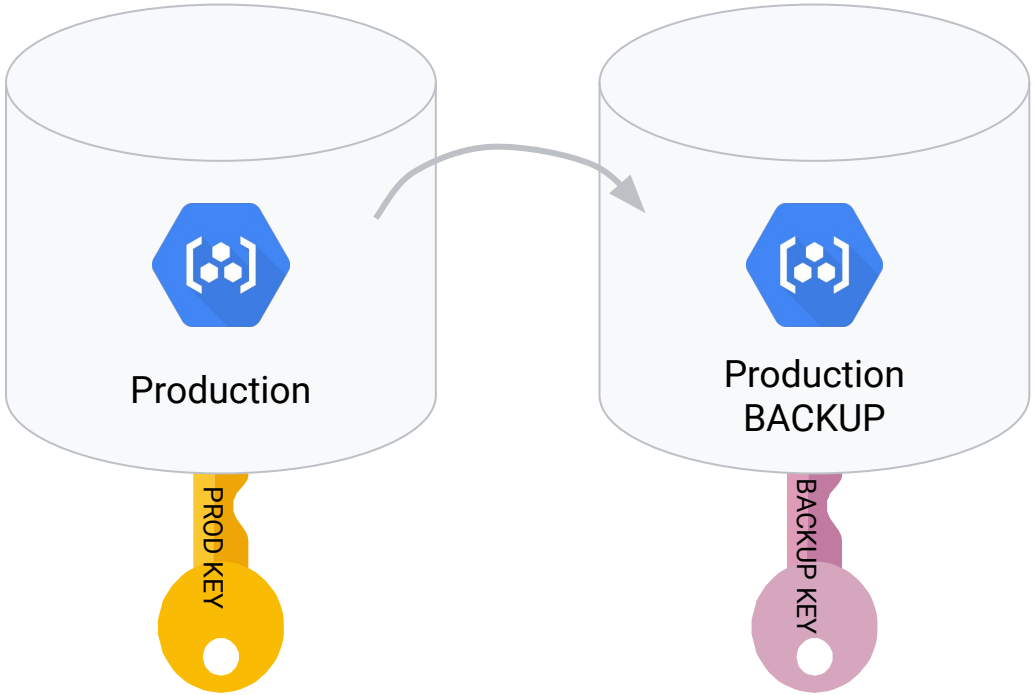
Backups!

Regular
runs every 12 hours, full copy

Simple
Single job

Secure
uses a different key



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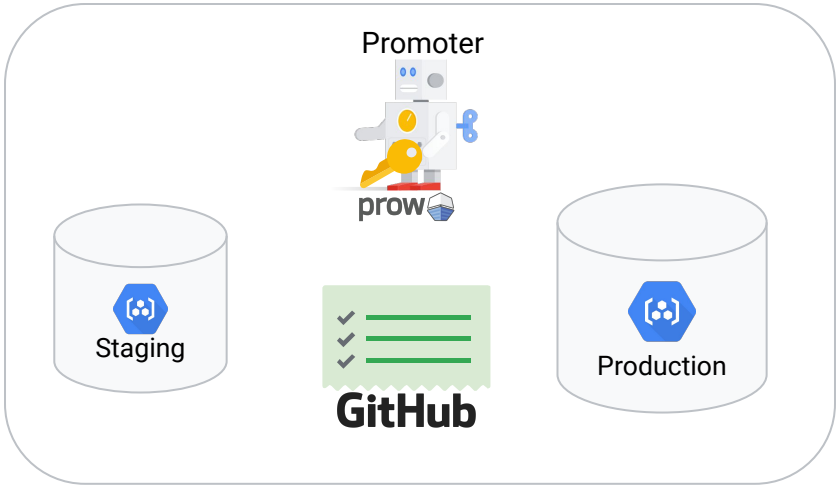
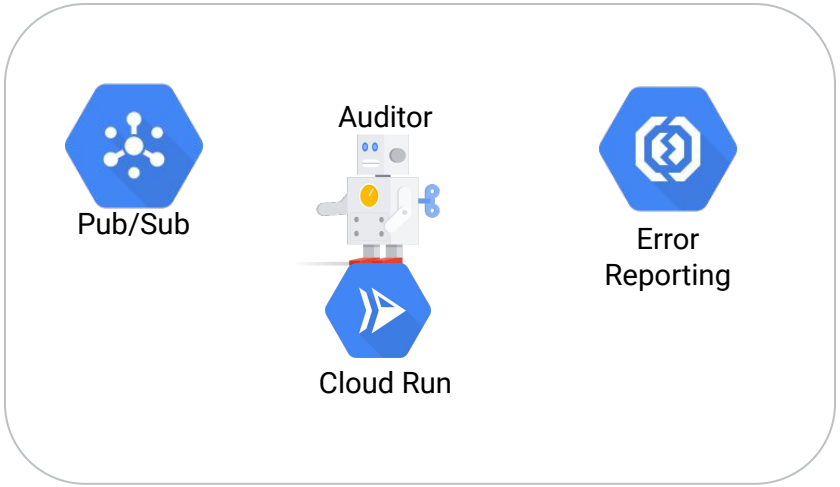
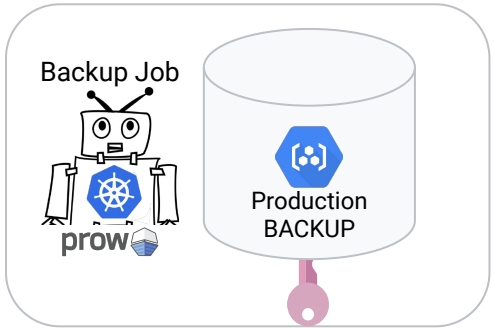




Infrastructure review



...but what about tests?

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The OSS Promoter: Tests

- Standard unit tests (no extra sauce, just the standard “**testing**” package)
- Custom E2E test framework
  - Fully replicated promotion stack against real GCR endpoints
  - Fully replicated auditing stack with Pub/Sub, Cloud Run, Error Reporting
  - Fully replicated backup stack

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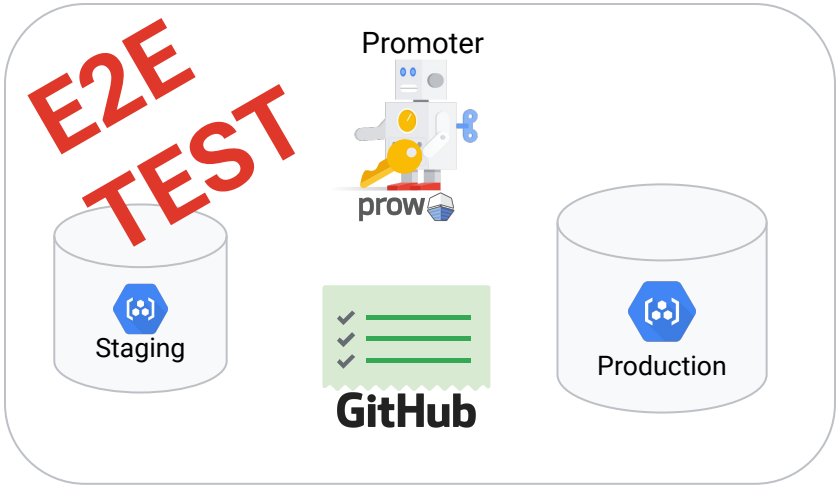
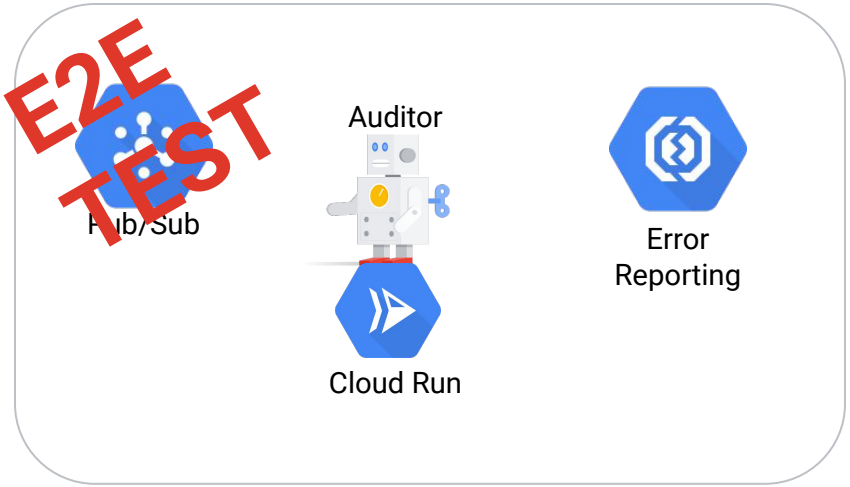
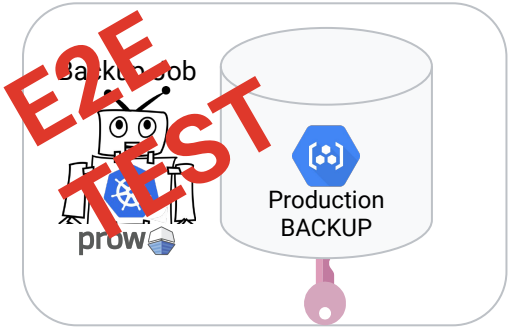




E2E tests have fully replicated environments!



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History of flip attempts

- 1st attempt: April 1, 2020
  - Rolled back due to a Google configuration issue
- 2nd attempt: June 22, 2020
  - Rolled back due to billing error
- 3rd attempt: July 24, 2020
  - ...it worked!

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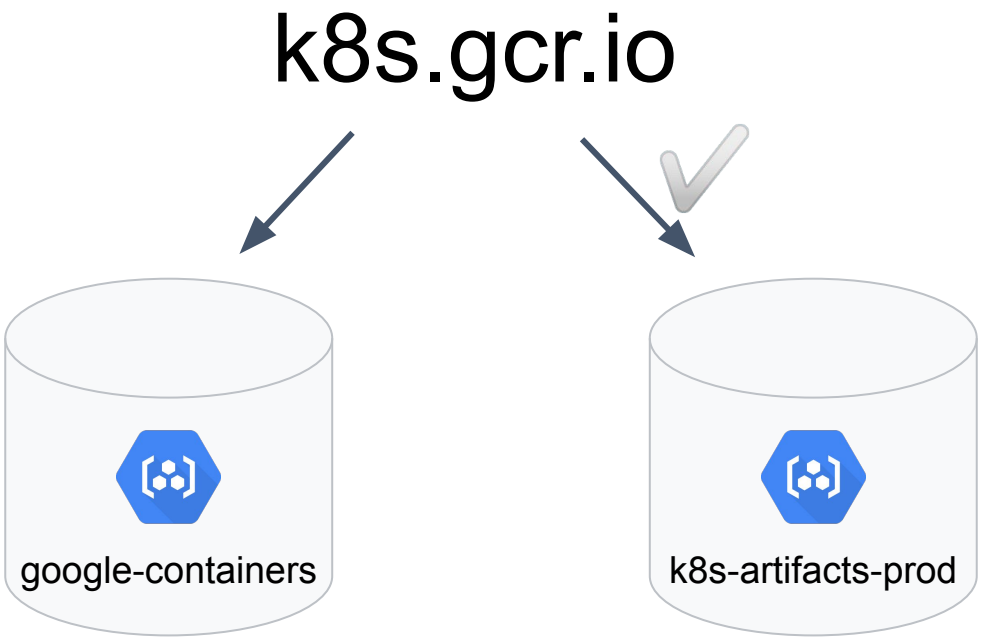

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Is that it? Nope!

- Develop tooling for creating staging projects
- Enable image pushing to staging projects via GCB and GitHub postsubmit
- Lots of bash script cleanup
- Migrating portions of the Kubernetes release process to Community infra

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What’s Next?

- Create a tool that does both image and file promotion
- Deduplicate common Release Engineering libraries
- Support Google Cloud **Artifact Registry** (the next generation of Container Registry)
- Grow the set of promotion tool maintainers (help us!)
- Improve vulnerability scanning for images

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Lessons learned

- Infrastructural changes (esp. changing legacy code) takes time, but the rewards are worth it
- “If it is not tested, it is broken” -- Tim Hockin
- It takes a village

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Getting involved!

The container image promoter (and other artifact promotion tools) are maintained by SIG Release’s Release Engineering subproject and WG K8s Infra.

- Promotion tooling:
  - https://sigs.k8s.io/k8s-container-image-promoter
  - https://git.k8s.io/release
- SIG Release: https://git.k8s.io/community/sig-release
- WG K8s Infra: https://git.k8s.io/community/wg-k8s-infra
- SIG Release repo: https://git.k8s.io/sig-release
- Promoter manifests location: https://git.k8s.io/k8s.io


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