Immutable Infrastructure

<<< Shift Left <<<

Rethinking Configuration in the Age of Easy Redeployment

RackN, Inc

February, 2018

Note: Graphics mainly from http://pexels.com

Your Humble Presenter

I'm all about automating infrastructure.

Involved in Open Ops Software:

Digital Rebar Project
Kubernetes ClusterOps SIG
OpenStack Board

Rob Hirschfeld (aka @zehicle)
Co-Founder of RackN
rob@rackn.com

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Storytime! “Self-Bootstrapping Kubernetes”

Kubecon in Nov 2017 we created this demo

Simple “immutable” Idea:

1) **In Memory Boot Machines**
2) **Install Docker**
3) **Elect Leader**
4) **Run Kubeadm on Leader**
5) **Run Kubeadm on Remainder**

But….it’s shockingly hard to maintain.

Dependencies breaks the installation

And they are constantly changing.

Storytime! “Self-Bootstrapping Kubernetes”

So, while it’s pretty cool,
it’s not “real” immutability

Presentation & Demo
https://youtu.be/OowxF6GqK4I

Why is configuration fragile?

Why is ~~configuration~~ mutation fragile?

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But... I ❤ Infrastructure as Code?! Sorry. Mutability adds complexity

Traditional "build-in place" approaches

- **Have hidden dependency graphs**
- **Create variation between environments**
- **Are harder to "lock down" due to config**

AND OMG... updates and patches are even harder

- **Idempotent operations are difficult**
- **Roll backward is next to impossible!**
- **Creating indeterminate state**

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Traditional "build-in place" approaches

- Have hidden dependency graphs
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Let's lock it down!

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What is Immutable Infrastructure?

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Pre-deploy configured

What is ~~Immutable~~ Infrastructure?

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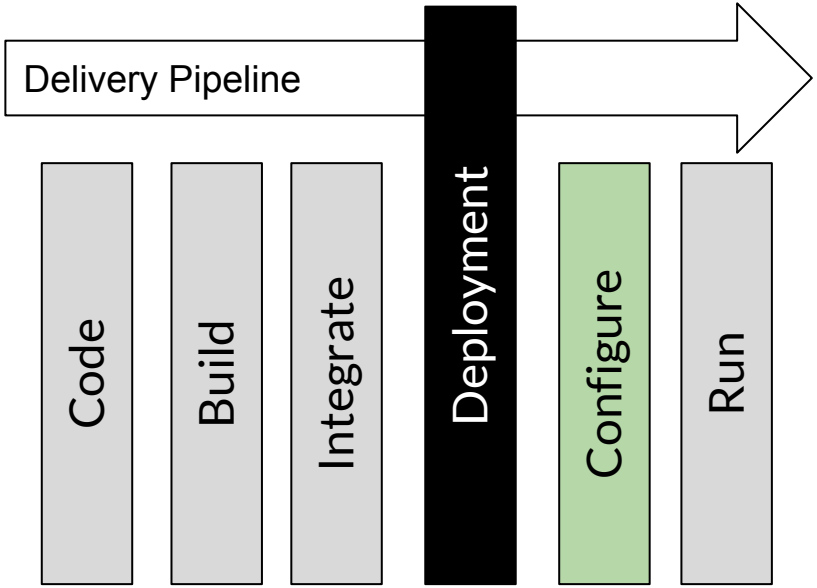
Traditional Deploy and Configure

System is configured *in situ* from a least common denominator baseline.

This can be "immutable-like" under the right conditions.

We'll come back to that...



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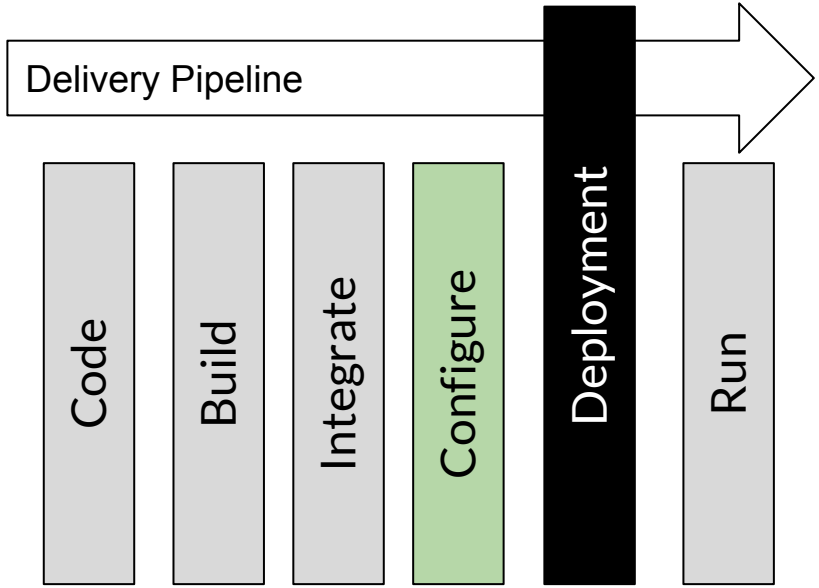
Shifting Configuration BEFORE Deployment

In our ideal delivery pipeline, configuration is *before* deployment.

Running systems are delivered as a complete runnable unit for deployment.

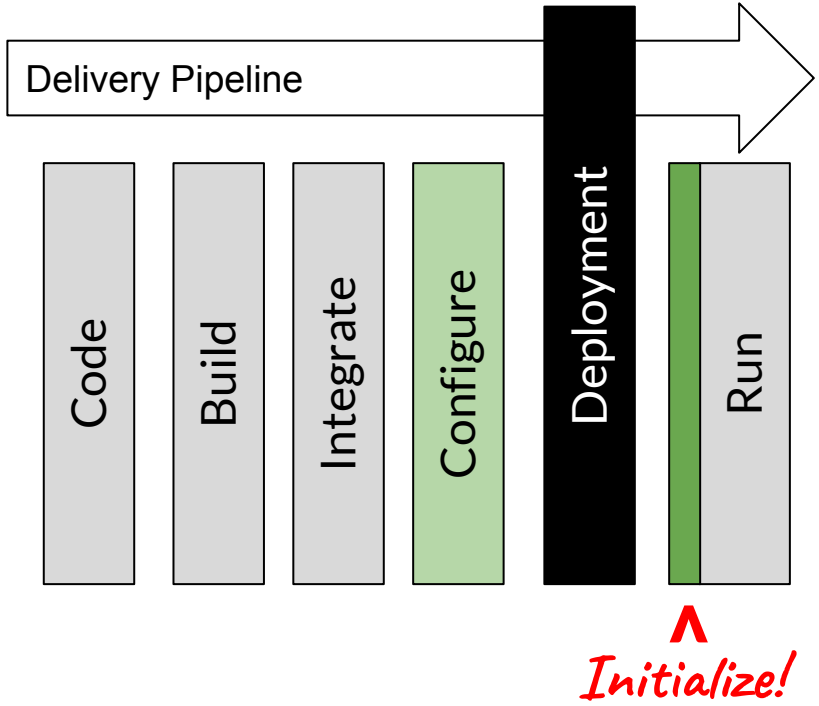


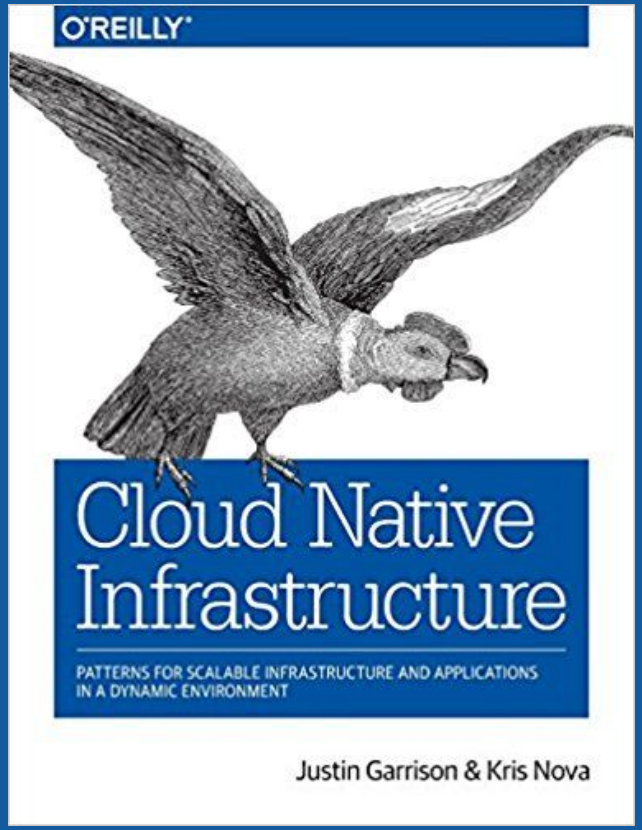
Shifting Configuration BEFORE Deployment

In reality, it's very hard to create a distinct artifact for every running instance; instead, we create incremental versions.

So we do *some* initialization of the reusable versioned instance.

Cloud init is the most commonly known pattern for this.





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Cloud Native Infrastructure

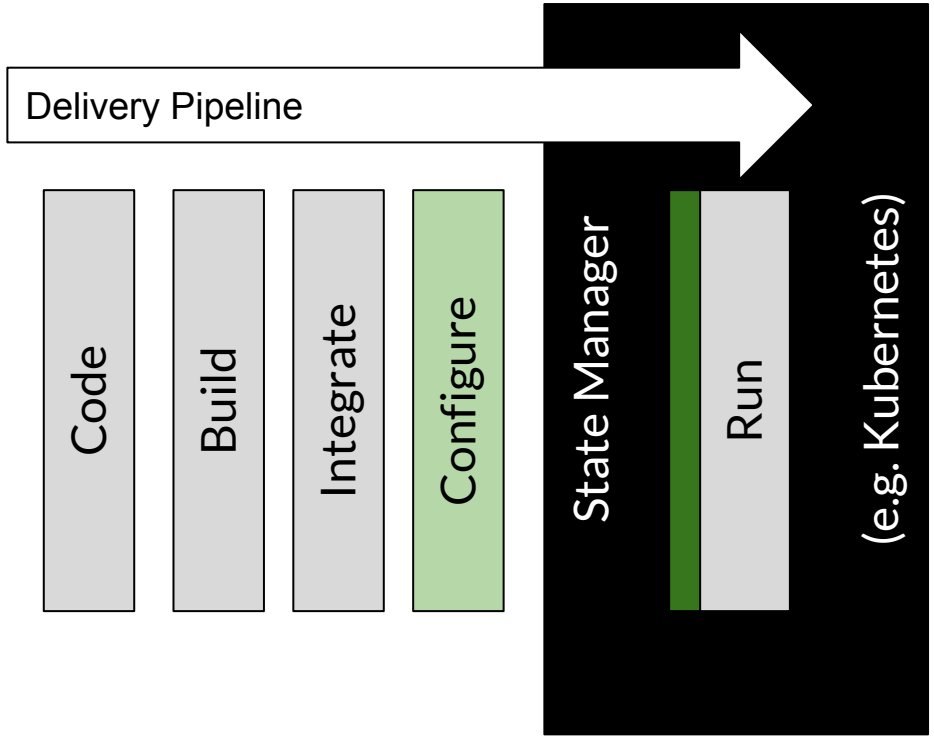
CNIbook.info
Justin Garrison & Kris Nova

“Infrastructure as software”

Which Enables... Delegating Operations

If you can make your artifacts immutable then you can delegate management of them to a platform like Kubernetes.

Kubernetes does not configure infrastructure. It maintains state based on a manifest.



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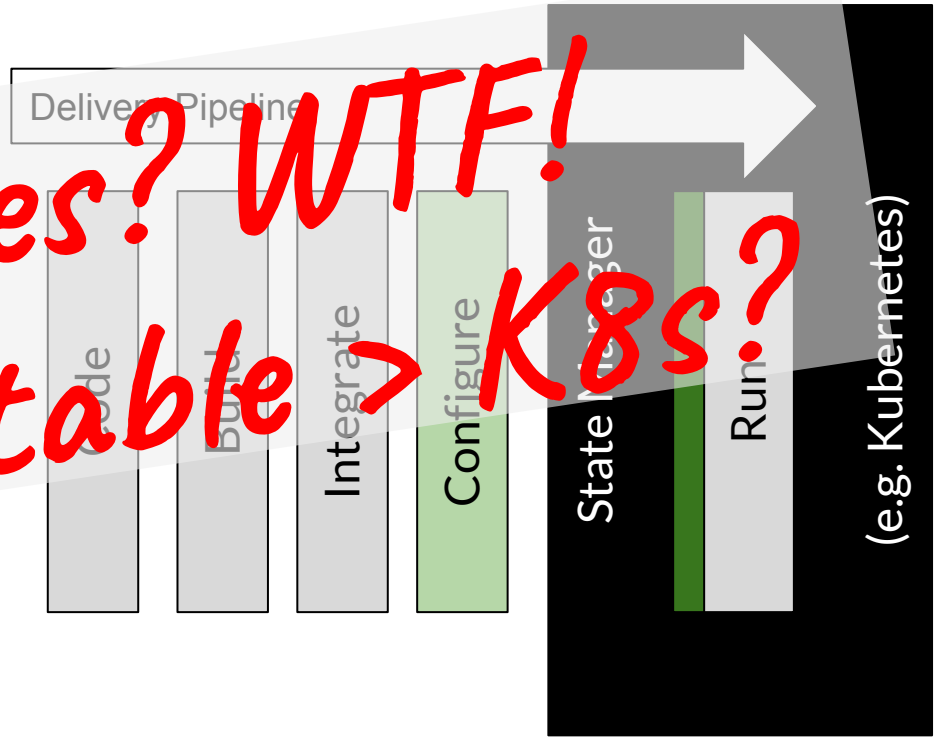

Kubernetes? WTF!
Is Immutable > K8s?

Immutable is a DevOps Pattern

<<< Shift Left & Create/Delete

Immutability <<< Shifting Left

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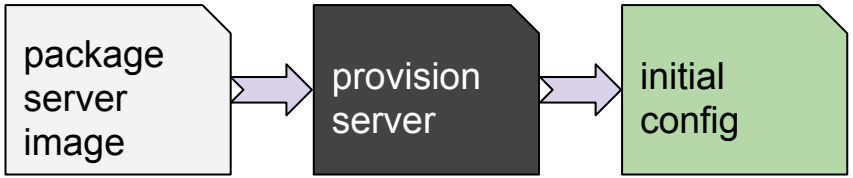
The Problem



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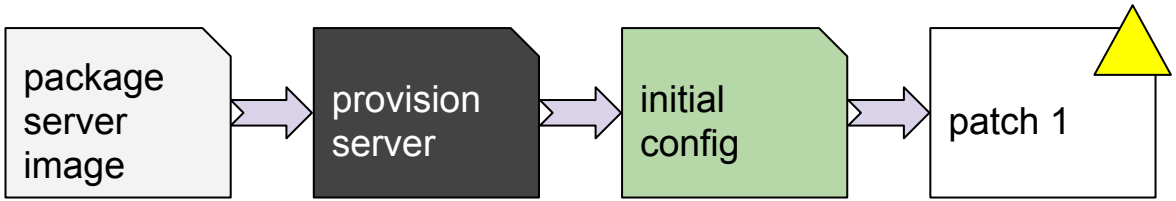

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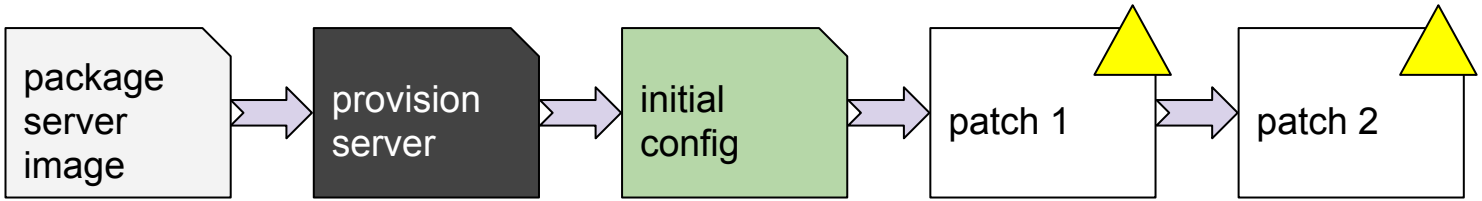

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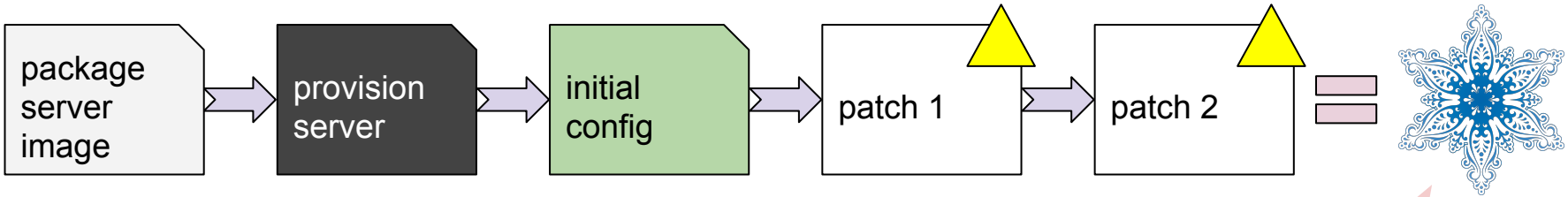

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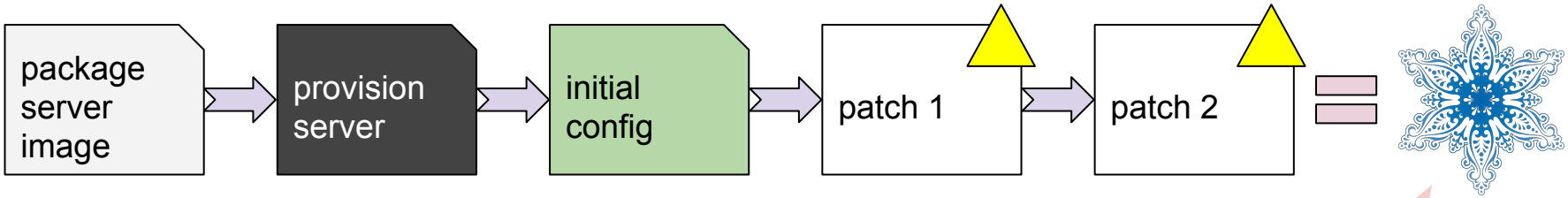

What Madness?

- We have to maintain root access
- Patches assume system state
- Patches create dependency graphs
- Coordination? Should we halt work?
- Drift is inevitable!

the madness doesn't stop at patch 2!

Immutability <<< Shifting Left

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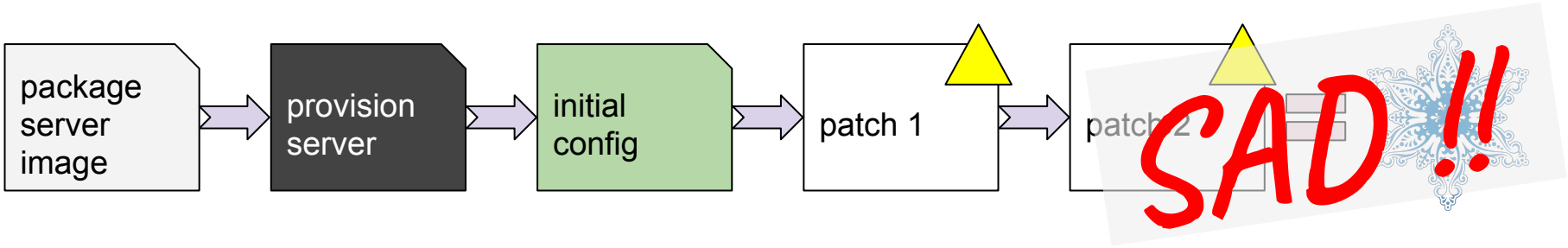
The Problem



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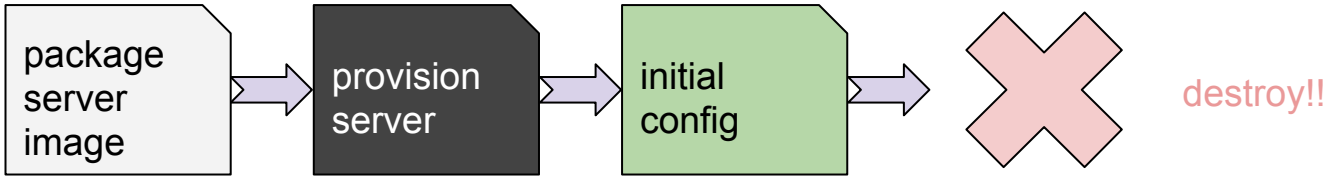
Apply cloud and container lessons to our Bare Metal …



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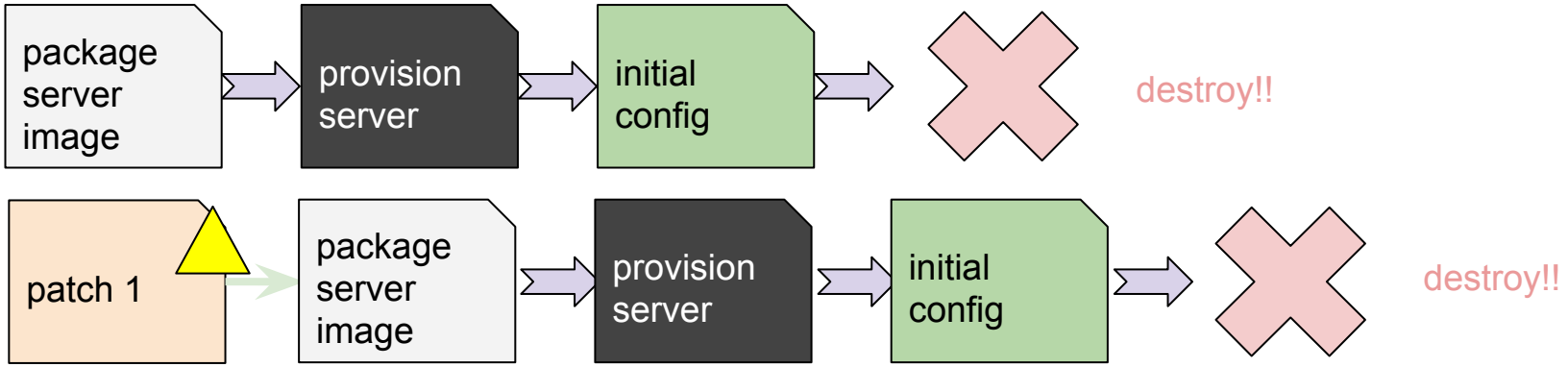

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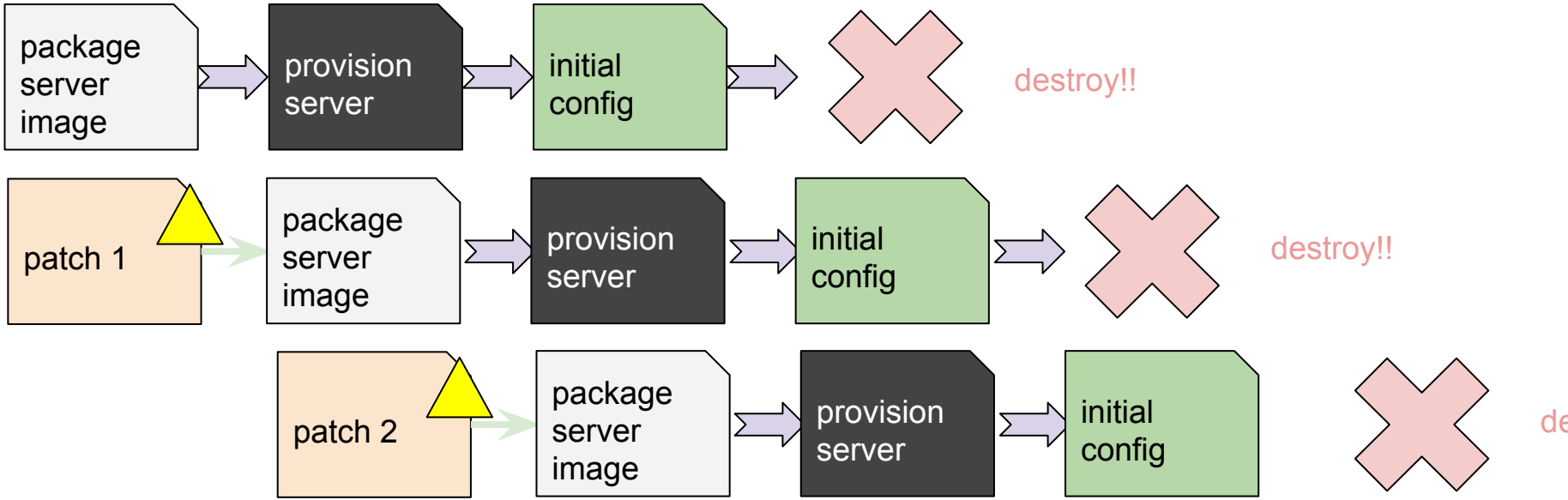

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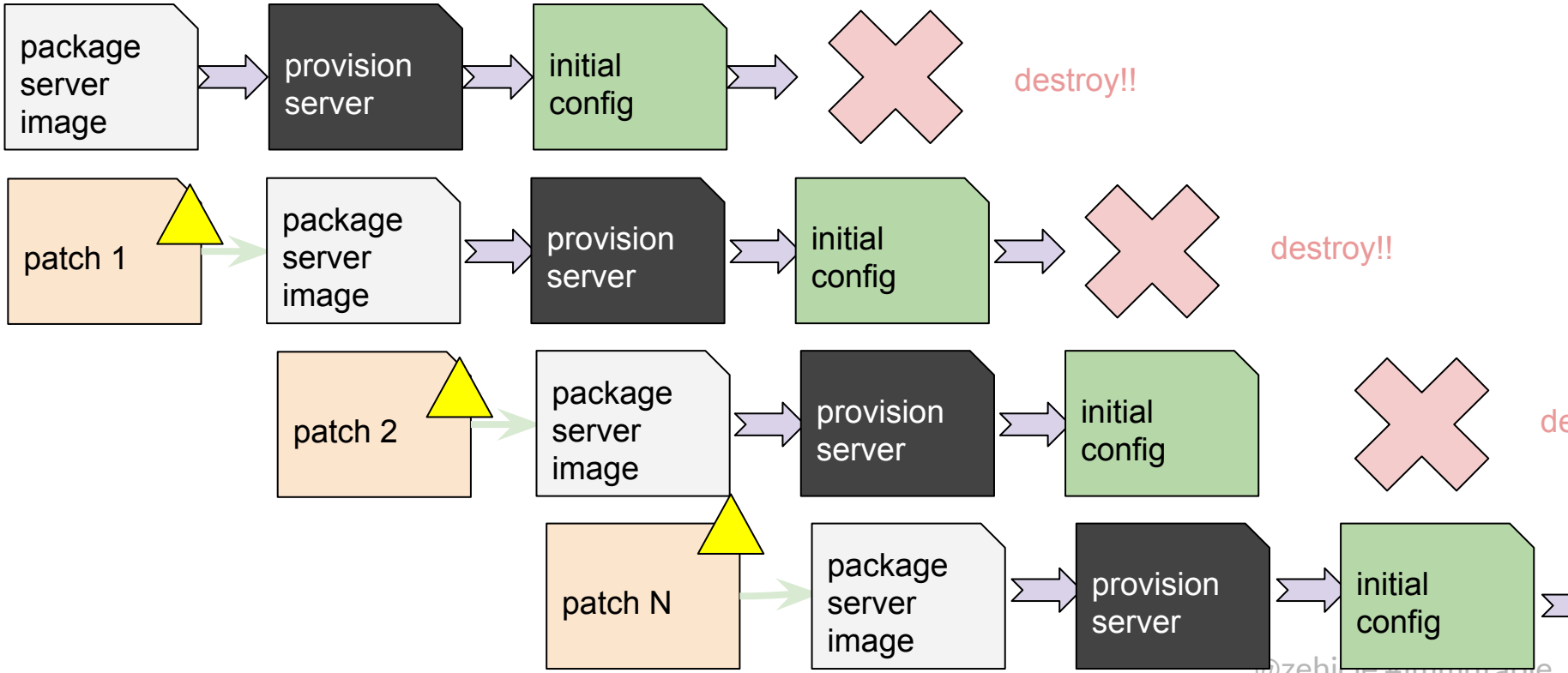

Cloud like behavior …

Cloud-like Integration and Staged Workflow

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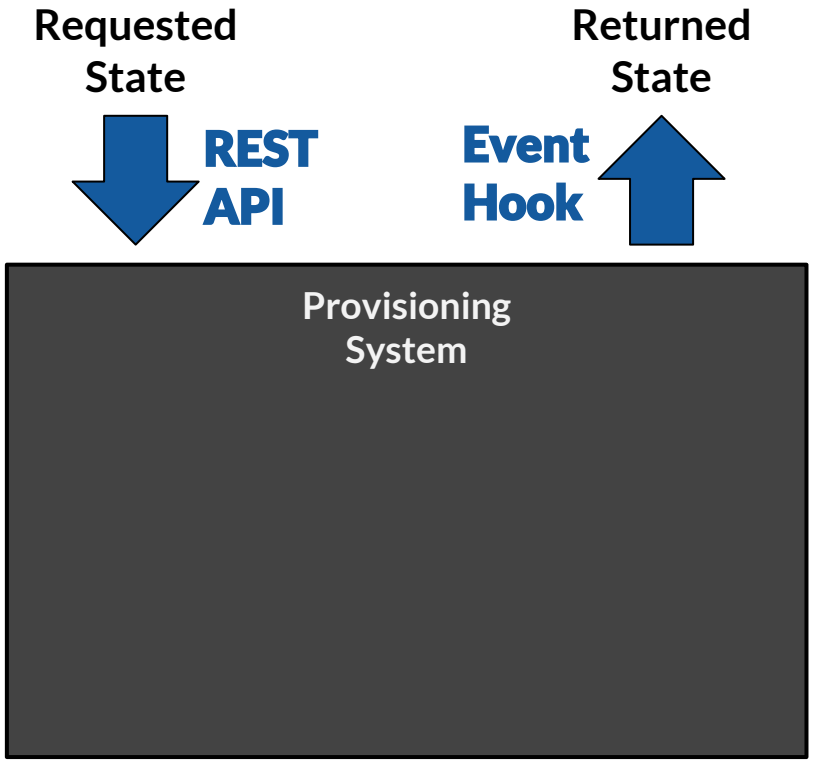

Immutable Provisioning systems treat infrastructure as a black box

Cloud-like Integration and Staged Workflow

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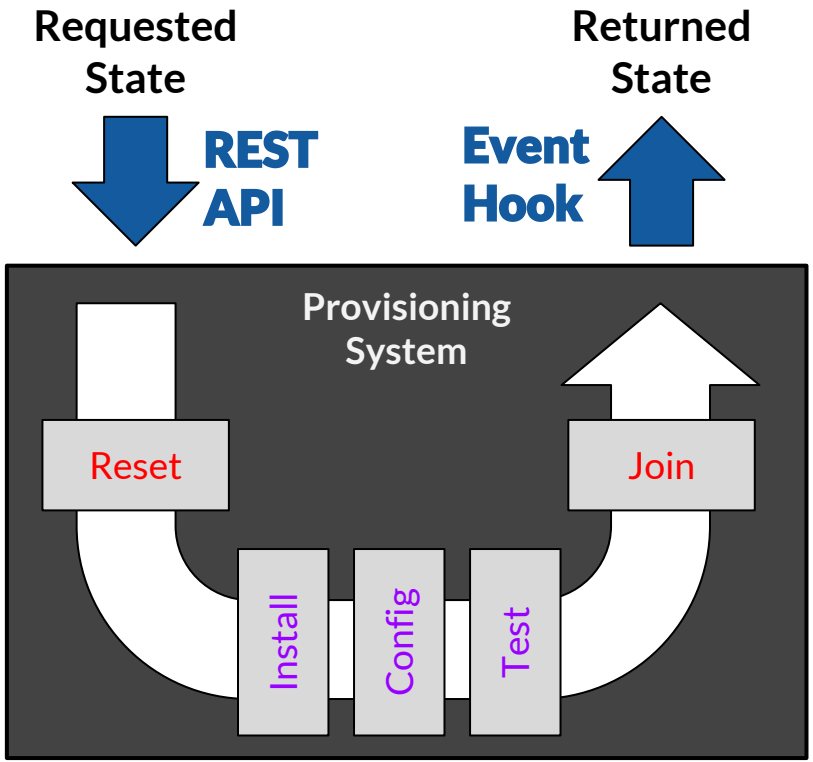

Immutable Provisioning systems treat infrastructure as a black box

Provision requests are for a system state with optional parameters.

The intermediate changes to achieve the state are *not exposed* to the requester.

Cloud-like Integration and Staged Workflow

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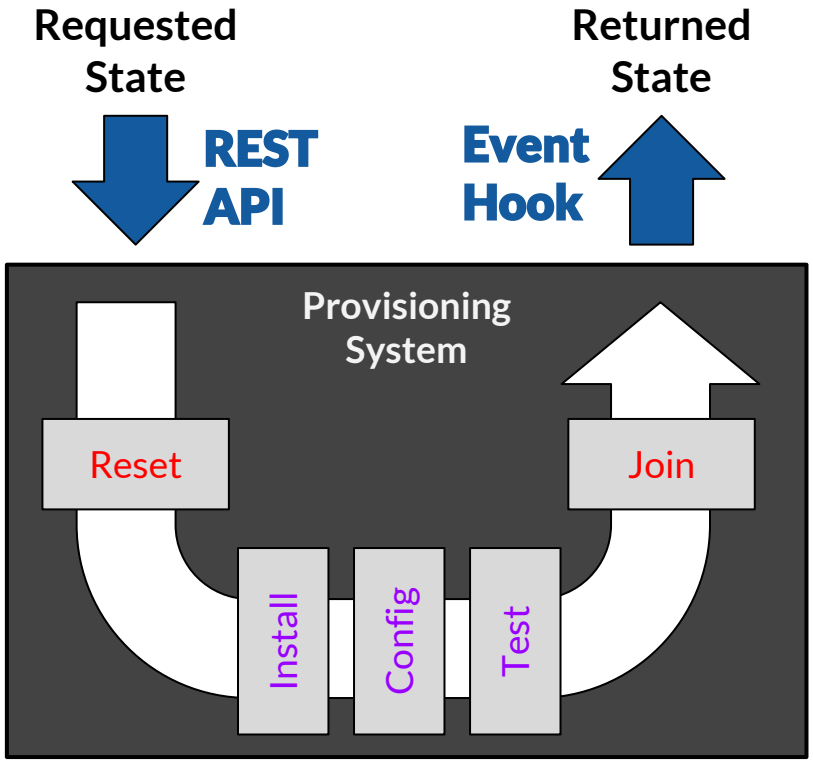

Immutable Provisioning systems treat infrastructure as a black box

Provision requests are for a system state with optional parameters.

The intermediate changes to achieve the state are *not exposed* to the requester.

No hidden operations!

REMEMBER: Operators of the provisioning system require high transparency, stages and control.

Immutable Patterns

1) Baseline + Configuration
2) Live Boot + Configuration
3) Image Deploy

1: Baseline + Configuration

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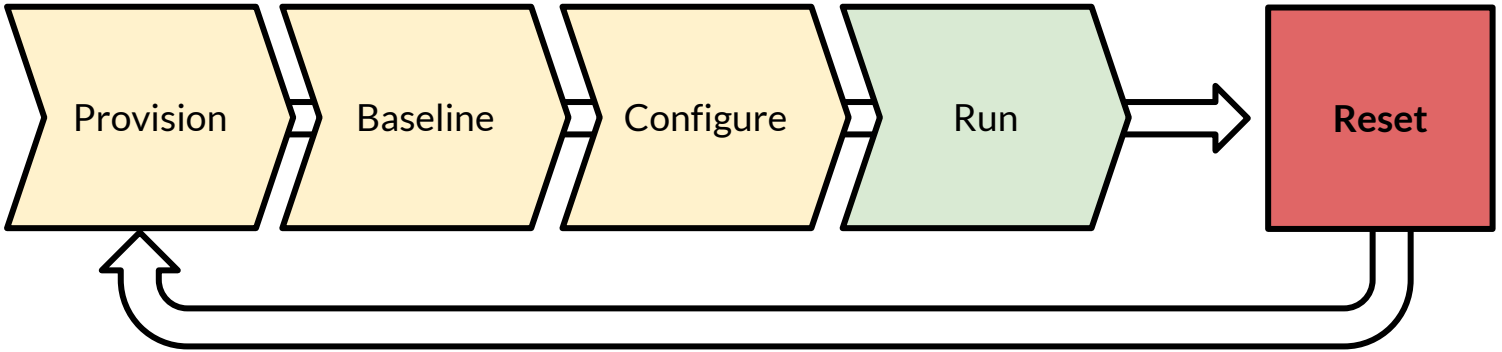
Benefit: Easiest to achieve with current tools, Safer than Patching
Challenge: Lots of Post-Configuration, Not Really "Immutable", Slow

Instead of relying on patches, rely on starting from a pristine image



Additional Reference https://thenewstack.io/immutable-hardware-ops-hygiene-security-efficiency/

2: Live Boot + Configuration

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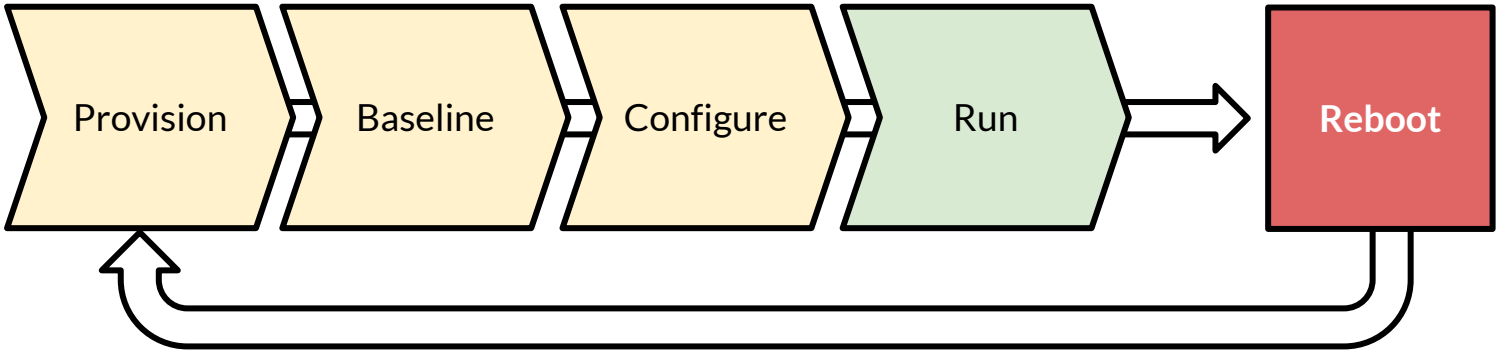
Benefit: Fast reset times, forces good behavior

Challenge: Provisioning becomes critical path, still have dependency graph

Like #1 but clean-up is simply a reboot. Favors smaller footprint O/S.



3: Image Deploy

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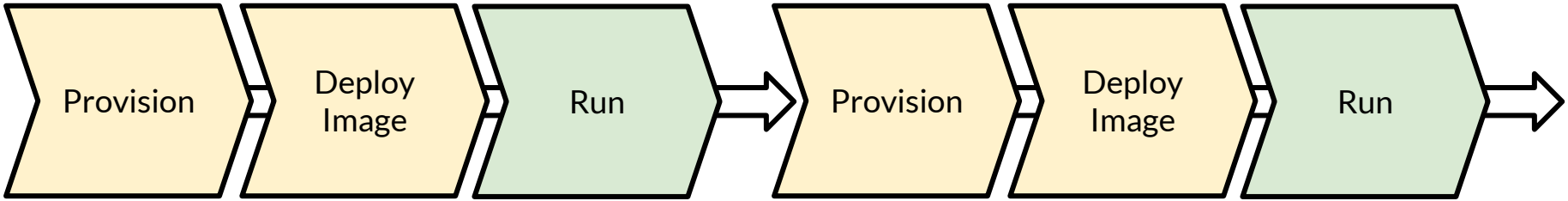
Benefit: Shorter time to ready, highly controlled (“shift left”), rollback
Challenge: Harder to create and deploy images

Image is deployed from source instead of Baseline + Configure



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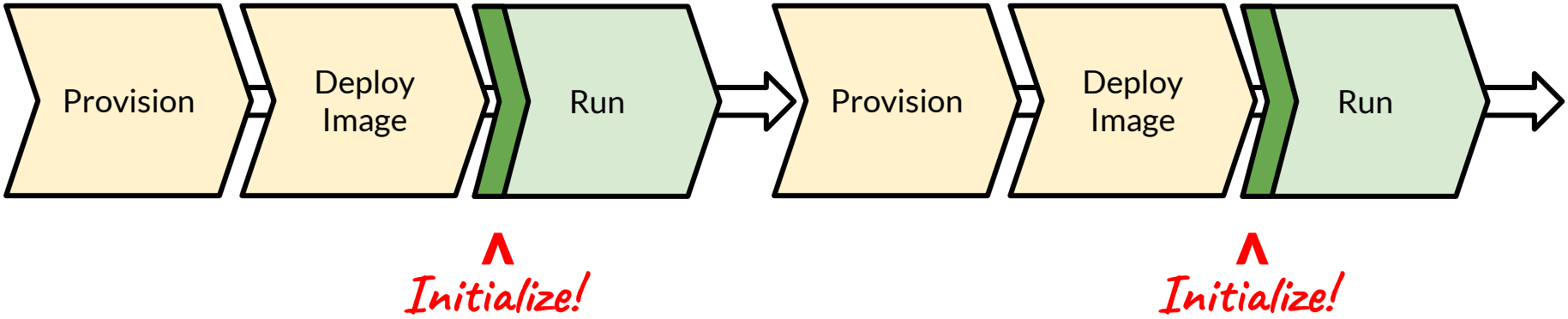

So… Let's talk Image Creation

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Ideally in an automation build process.

You DO THE CONFIGURATION on a live system (so you still need configuration tools) and then capture the image into a portable format.

Tools like Hashicorp Packer, Image Builder, WBIC or raw images are used to create source files (e.g. AMI, OVS).

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Tools like Hashicorp Packer, Image Builder, VMDK or raw images are used to create source files (e.g. AMI, OVS).

That sounds like a lot of work & really slow!

Yes, But...

It's faster, safer & more scalable.

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Immutable Demo

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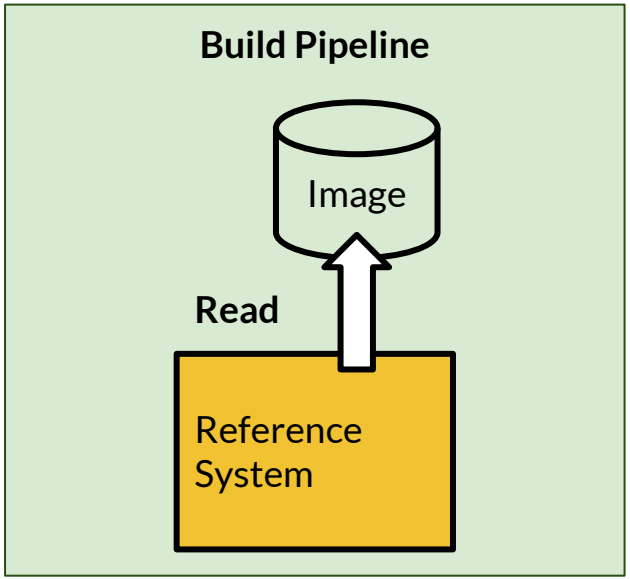
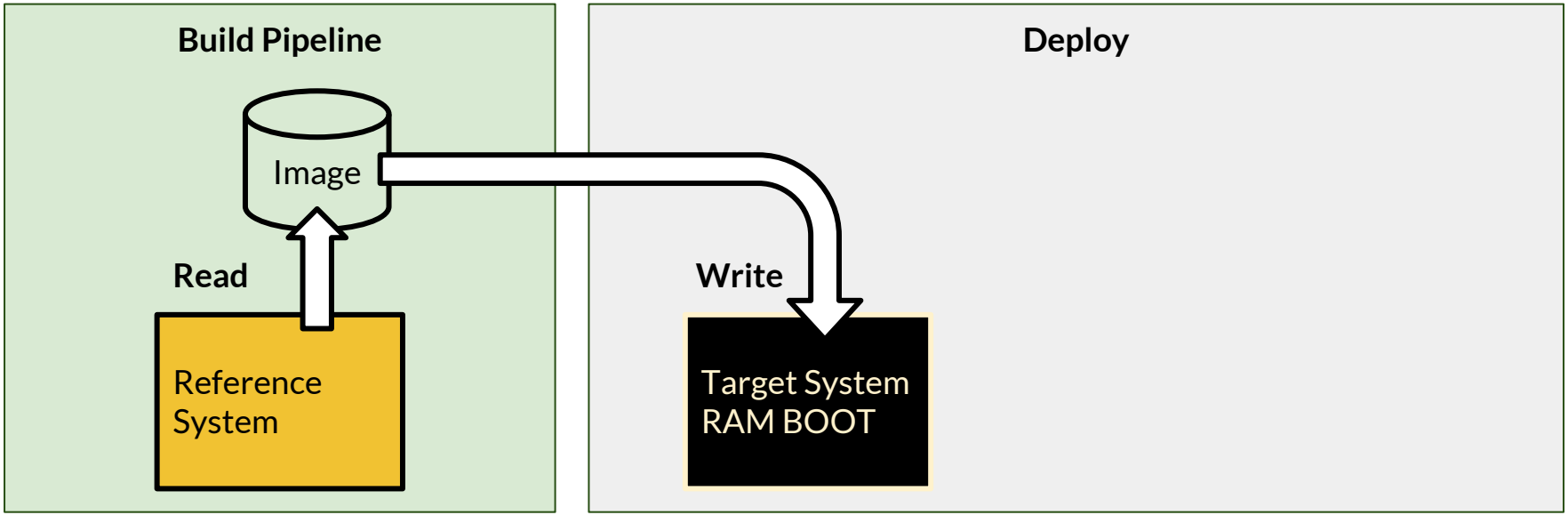
Prep: Image is pre-created from reference system.



Immutable Demo

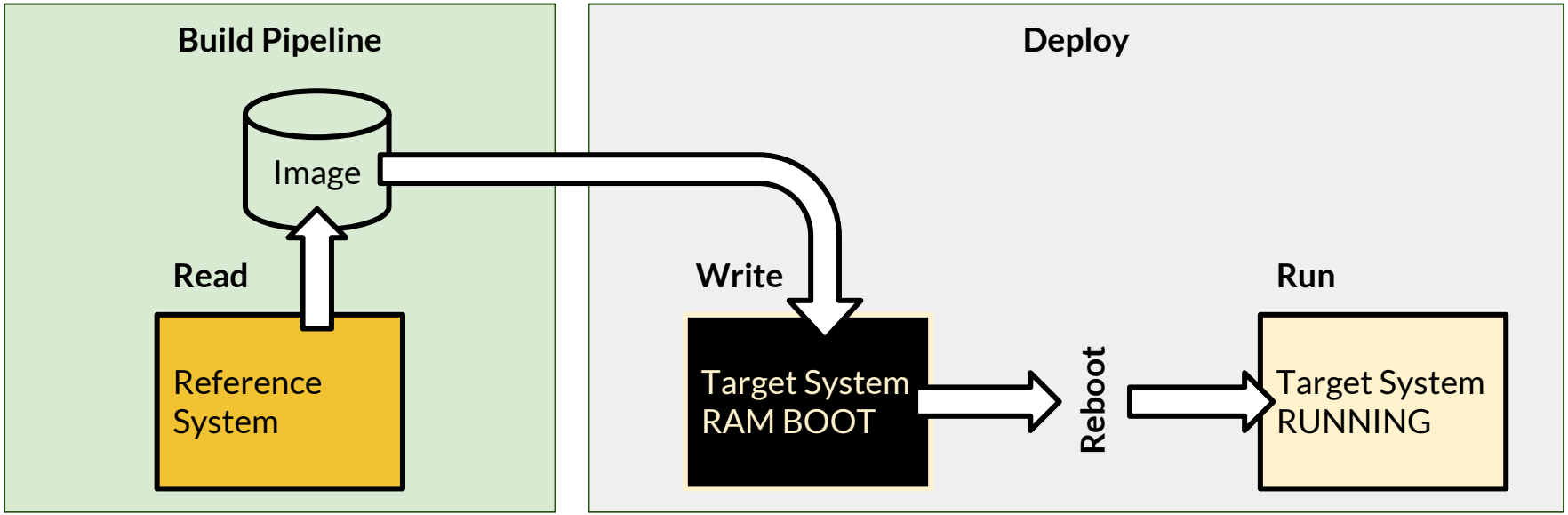
Prep: Image is pre-created from reference system.

Stage: Boot RAM image and write image to disk(s)



Immutable Demo

Prep: Image is pre-created from reference system.
Stage: Boot RAM image and write image to disk(s)
Deploy: Reboot and run



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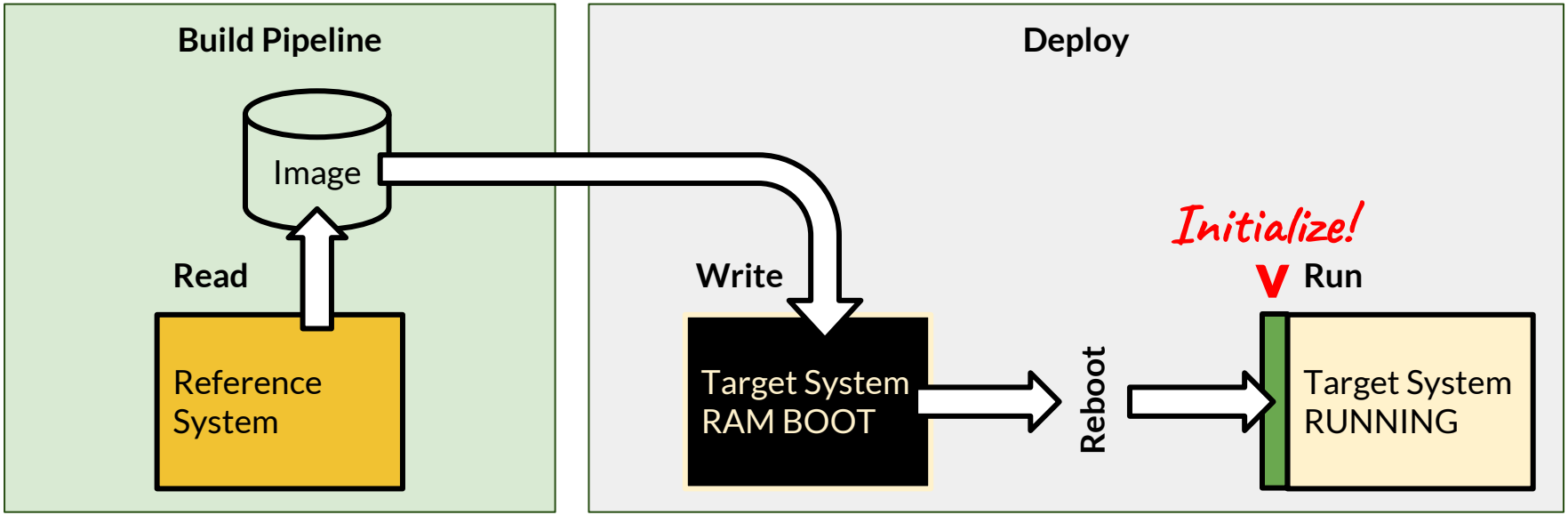

Thank you!

Questions?

Interested in IMMUTABLE METAL?

It's complicated, but we can get you there.

Start at http://portal.rackn.io

- Quickstart takes about 30 minutes
- Use your own hardware, VirtualBox or Packet.net account
  - `use "RACKN100" on Packet.net for credit`

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