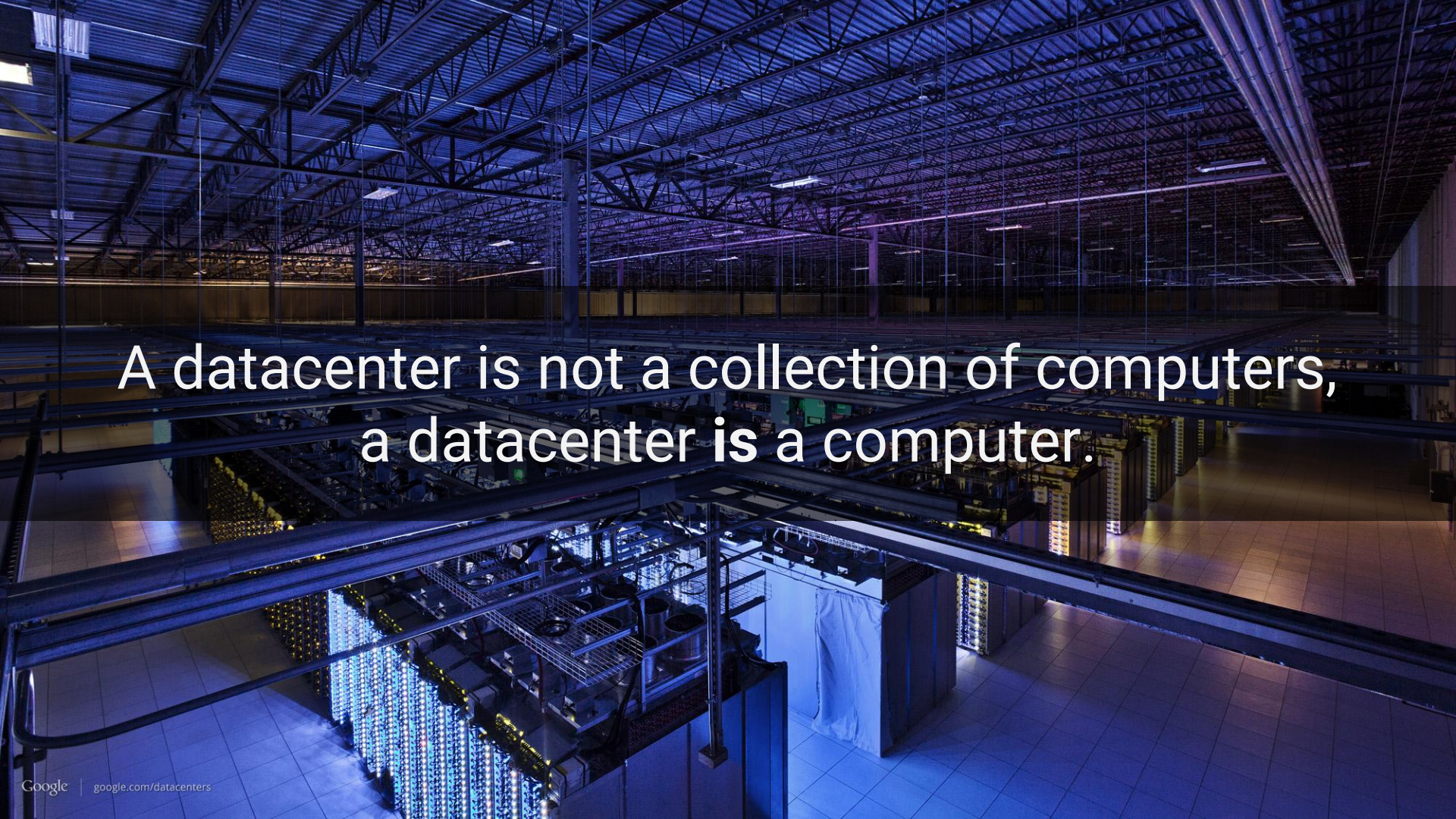
From Borg to the Future.latest

Andreas and Panos, Google Cloud


A datacenter is not a collection of computers,
a datacenter **is** a computer.
Google | google.com/datacenters

Everything at Google runs in containers:

- Gmail, Web Search, Maps, ...
- MapReduce, batch, ...
- GFS, Colossus, ...
- Even GCE itself: VMs in containers

Shipping Containers At Clyde, by Steve Gibson

Everything at Google runs in containers:

- Gmail, Web Search, Maps, ...
- MapReduce, batch, ...
- GFS, Colossus, ...
- Even GCE itself: VMs in containers

We launch over **2 billion** containers **per week**.

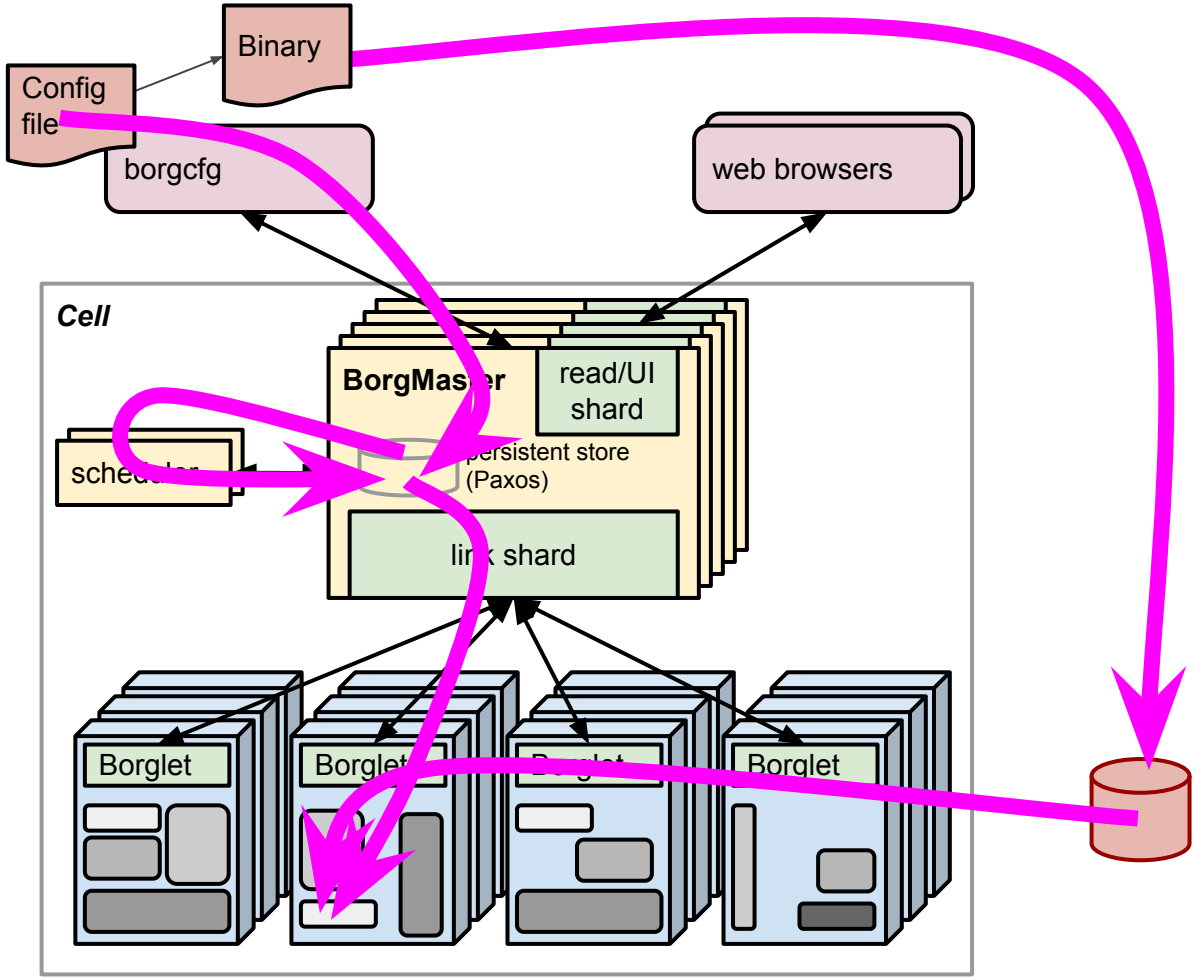
Shipping Containers At Clyde, by Steve Gibson

User view

```
job hello_world = {
   runtime = { cell = 'ic' }                // Cell (cluster) to run in
   binary = '.../hello_world_webserver'     // Program to run
   args = { port = '%port%' }               // Command line parameters
   requirements = {      // Resource requirements (optional)
     ram = 100M
     disk = 100M
     cpu = 0.1
   }
   replicas = 10000      // Number of tasks
}
```

User view

What just happened?



User view

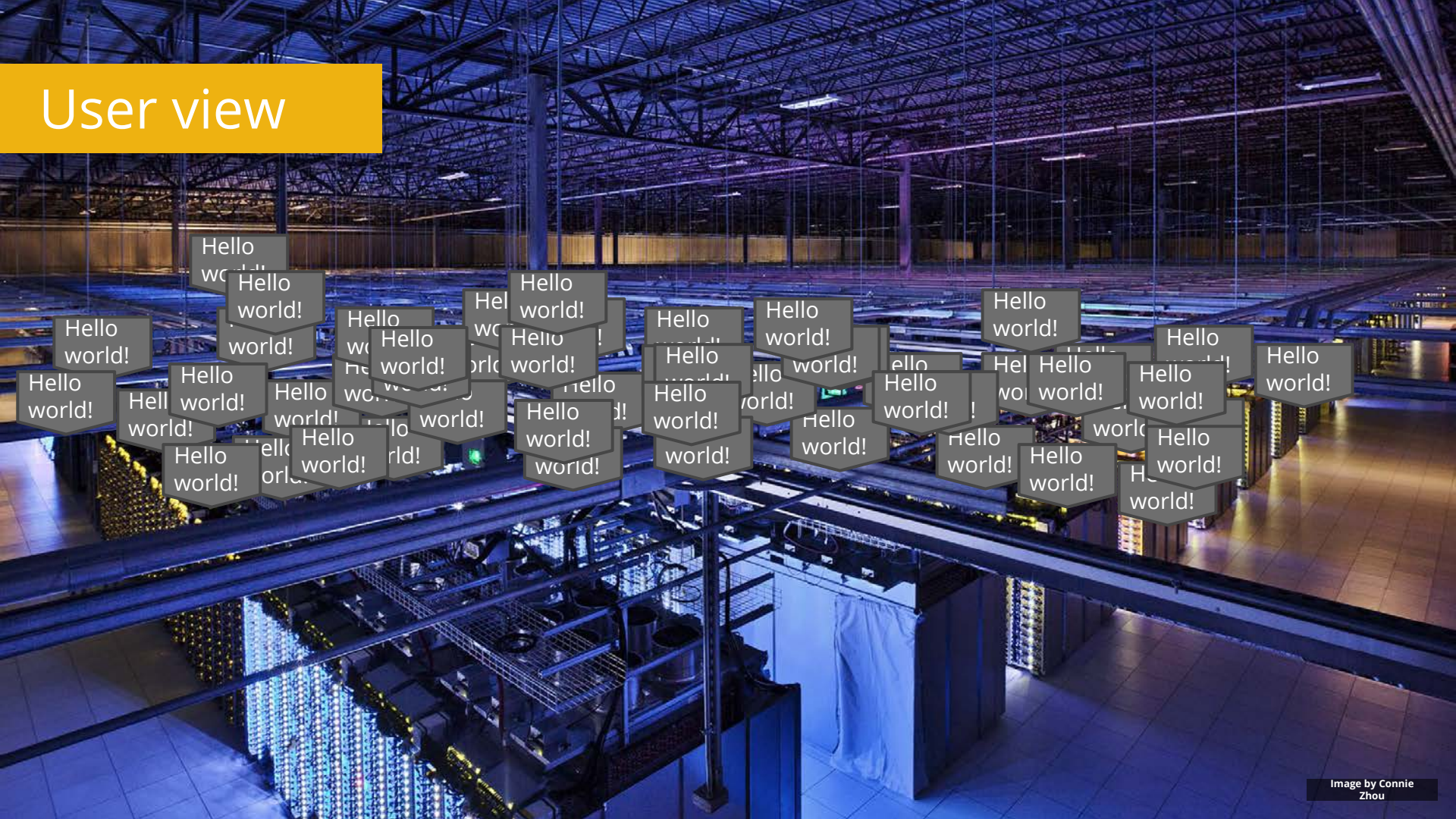
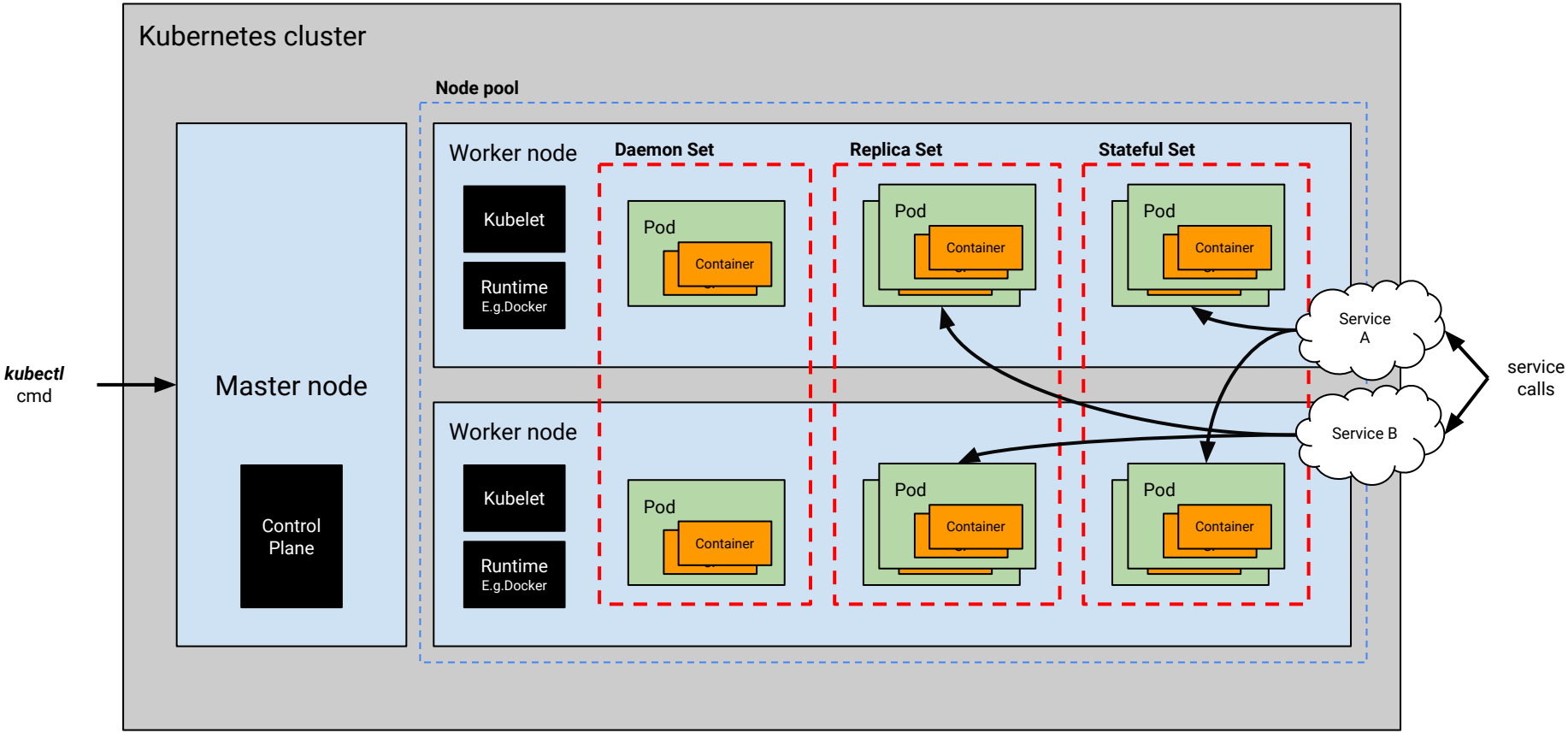
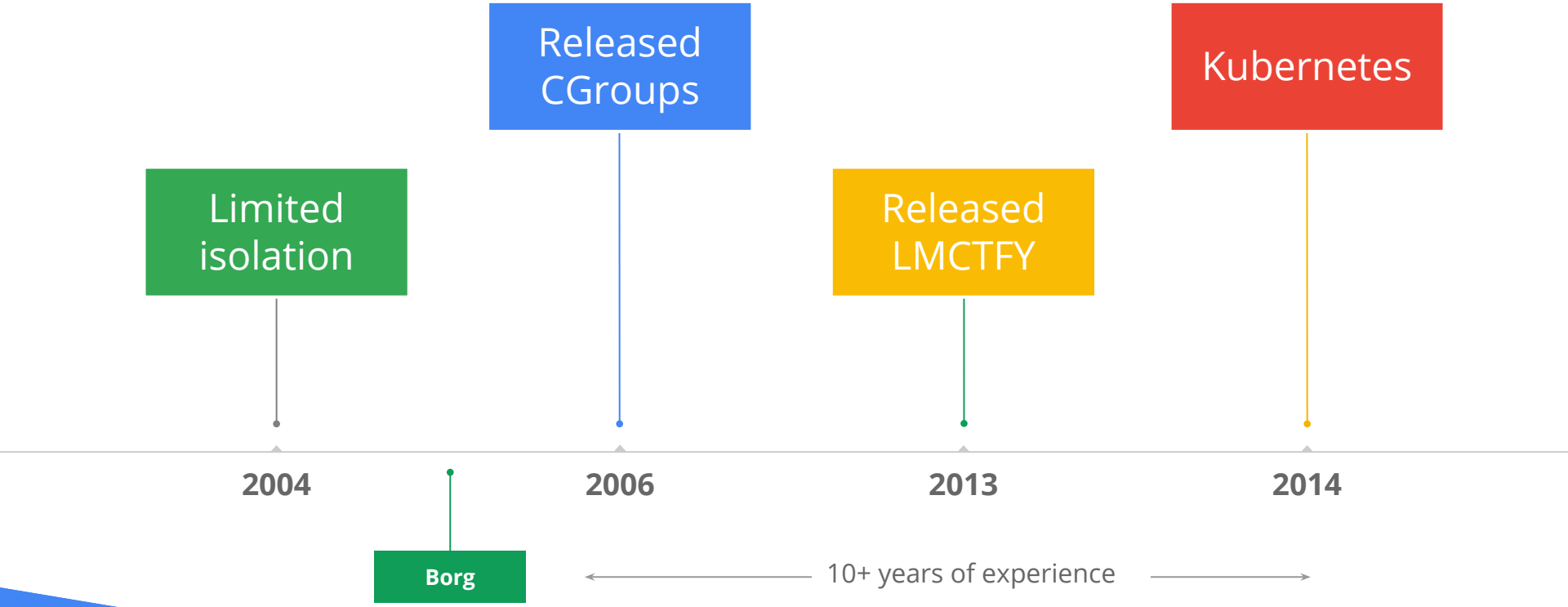


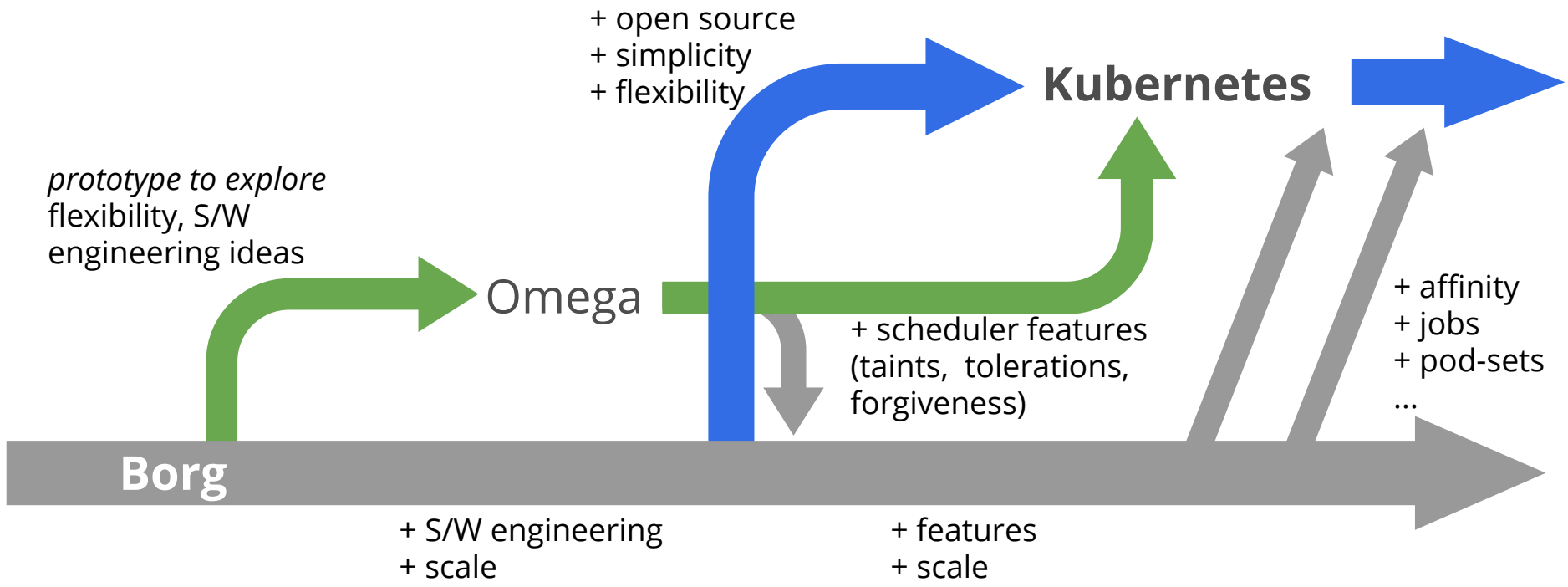
Image by Connie Zhou


Kubernetes cluster
Node pool
Master node
Control Plane
Worker node
Kubelet
Runtime E.g.Docker
Daemon Set
Replica Set
Stateful Set
Pod
Container
Worker node
Kubelet
Runtime E.g.Docker
Service A
Service B
kubectl cmd
service calls

Google and container technology



Borg, Kubernetes, Omega: a short history



Kubernetes

κυβερνήτης *Greek for “pilot” or “helmsman of a ship”*

Production-grade container orchestration
Automated container deployment, scaling, and management

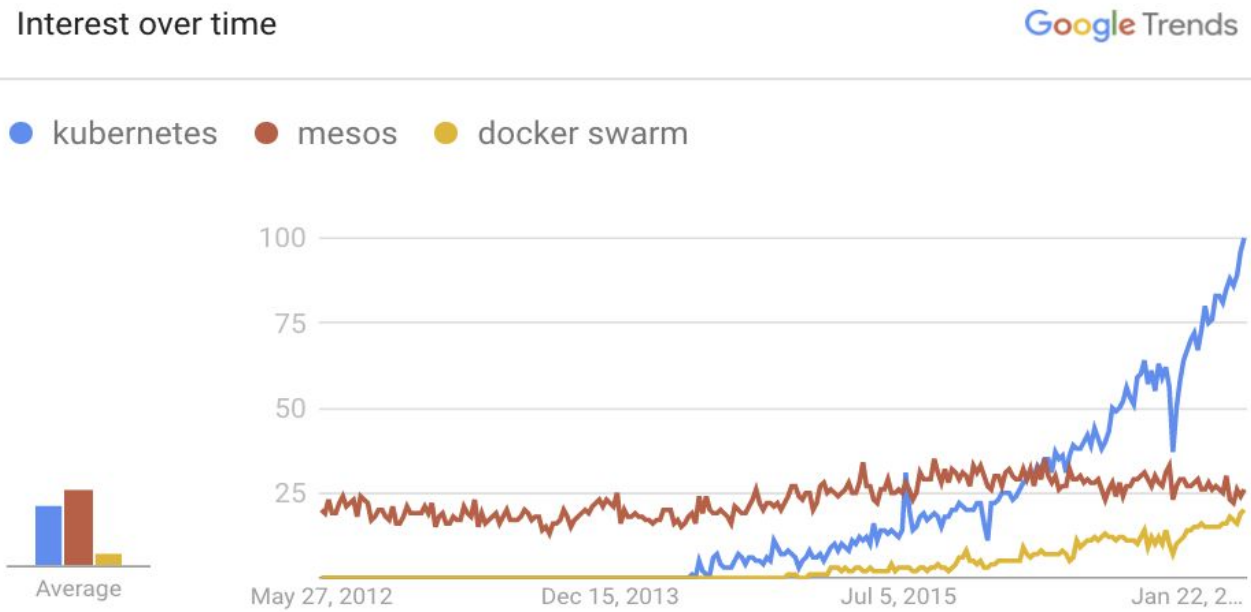
kubernetes.io

Kubernetes

One of the fastest moving projects in the history of open source

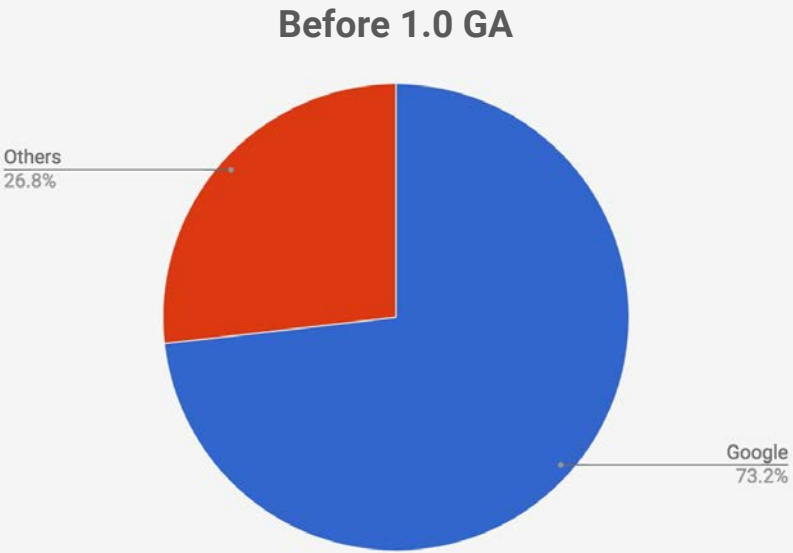
49,000	**1,250**	**400**	**2016**
commits	contributors	~ years of effort	1 commit per 33 minutes
<0.01%	**5,000**	**300**	**2017-Apr**
top GitHub project	projects based on Kubernetes	meetups worldwide	1 commit per 25 minutes

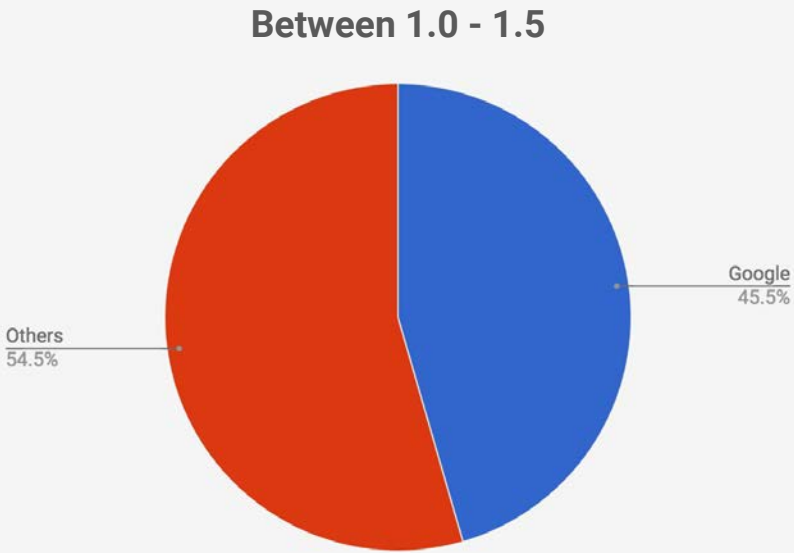
*Source: COCOMO Model


Interest over time
Google Trends
kubernetes
mesos
docker swarm
100
75
50
25
Average
May 27, 2012
Dec 15, 2013
Jul 5, 2015
Jan 22, 2...
Worldwide. Past 5 years.

CLOUD NATIVE
COMPUTING FOUNDATION

Community composition





Community composition

Welcome!

NUTANIX What We Do Solutions Products Support & Services Partners Resources Company

Nutanix Teams Up with Google Cloud to Fuse Cloud Environments for Enterprise Apps

Strategic Alliance Between Industry Innovators Aims to Simplify Hybrid Cloud

WASHINGTON D.C. – June 28, 2017 – Nutanix® (NASDAQ: NTNX), a leader in enterprise cloud computing, announced a strategic alliance with Google® Cloud today at the Nutanix .NEXT Conference 2017. As a result of the partnership, joint customers will be able to deploy and manage both cloud-based and traditional enterprise applications as a unified public cloud service, while blending the Nutanix environment with Google Cloud Platform™ (GCP). Google and Nutanix will work together to address the technology opportunities for building and operating hybrid clouds that combine the best of private cloud architectures and scalable public cloud environments.

Enterprise customers will be able to leverage the combined power of Nutanix and the Google Cloud Platform for:

- **One-Click Hybrid Operations with Nutanix Calm™ for GCP** enabling a single control plane for managing applications between GCP and Nutanix cloud environments. Traditional and cloud-native applications can be provisioned into GCP or Nutanix cloud environments with a single click, and migrated between the two cloud environments seamlessly. With Nutanix Calm, applications are modeled as simple, repeatable application blueprints that can be triggered with a single click and easily migrated

MESOSPHERE

Announcing: Kubernetes on DC/OS

Tobi Knaup
September 6, 2017

Announcing the beta availability of Kubernetes on DC/OS. Learn why this is the first step towards making DC/OS the best place to run K8s.

Mesosphere was founded with a simple mission: to take the amazing tools used by the brightest and most innovative technology brands to build and scale world changing technology, and make them easy to adopt and use by mainstream enterprise IT teams and startups alike.

Concepts like microservices, containerization, "fast data" analysis and response, distributed computing, and edge data collection and response were groundbreaking concepts when the company began in 2013. Building on top of Apache Mesos, Mesosphere sought to bring together all of the tools needed to operate data-intensive modern applications such as container orchestration, distributed databases, message queues, data streaming and processing, machine learning, monitoring and management capabilities, security tools, deployment automation, and more. Since it's launch in 2015, the Mesosphere DC/OS "operating system" has made it easy to deploy, connect, and elastically scale over 100 open source and commercial services with a single click, and underpins everything from web-scale applications, to IoT and autonomous cars, to banking and trading systems.

CONTAINER ORCHESTRATION DEV TOOLS DATA SERVICES, MACHINE LEARNING & AI

GOOGLE CLOUD

Cisco and Google partner on a new open hybrid cloud solution spanning on-premises environments and Google Cloud Platform

Nan Boden
Head of Global Technology Partners, Google Cloud

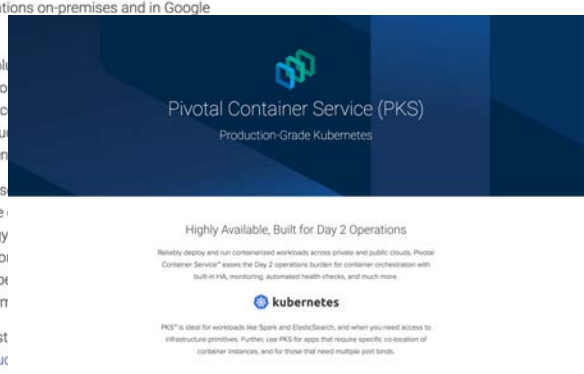
Published Oct 25, 2017

Today, we're announcing a new partnership with Cisco to help our customers improve agility and security in a hybrid world with a fully supported, open solution for developing and managing applications on-premises and in Google Cloud.

Together, we're working on a complete sol
monitor workloads, enabling customers to
plan their cloud migration at their own pac
able to create new applications in the clou
the same tools, runtime and production en

At the heart of this architecture are open s
Istio. Customers will be able to accelerate
ing a Kubernetes-based container strategy
technology. On-premises, Cisco's hyper-co
will provide a cloud-ready solution for Kube
ment tools to enforce security and consun

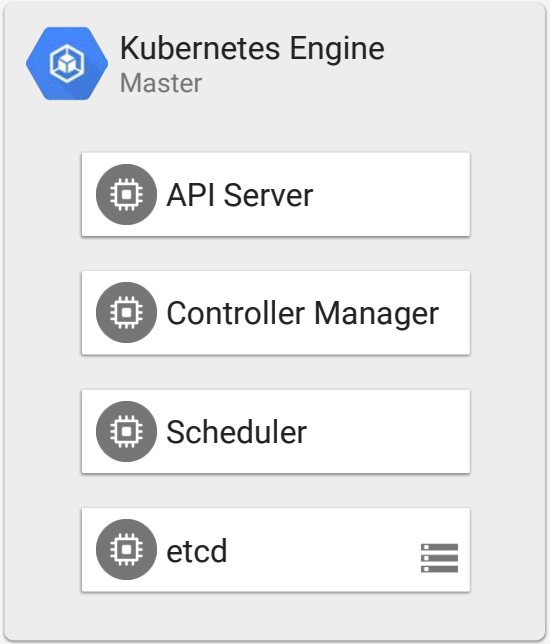
We're working together to deliver a consist
on-premises Cisco Private Cloud Infrastruc



Kubernetes Engine

“Let Google be part of your SRE team”

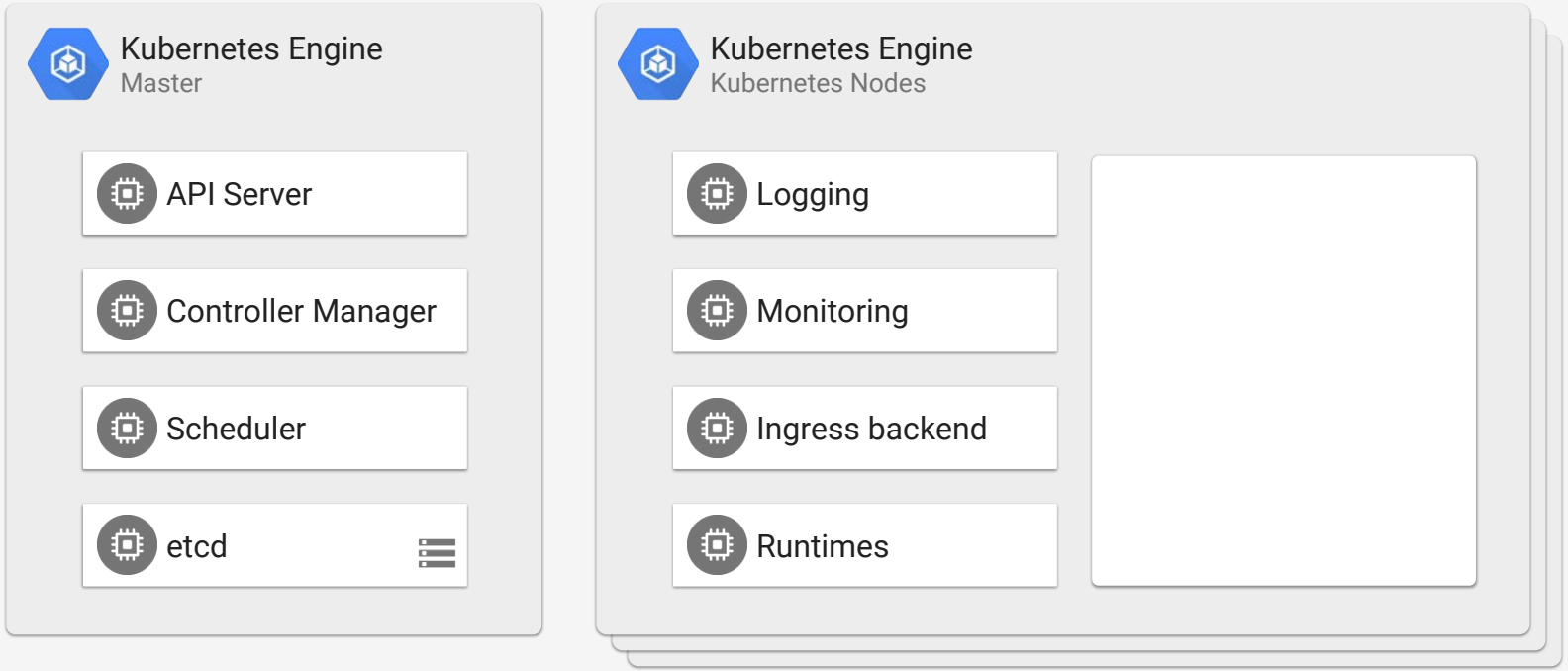
Google manages your control plane



- Backups
- Monitoring
- Restarts
- HA Master
- Resizing for larger clusters
- Master free of charge

- **99.5% SLA**

...and system components on your nodes



Node management features

Node upgrade:

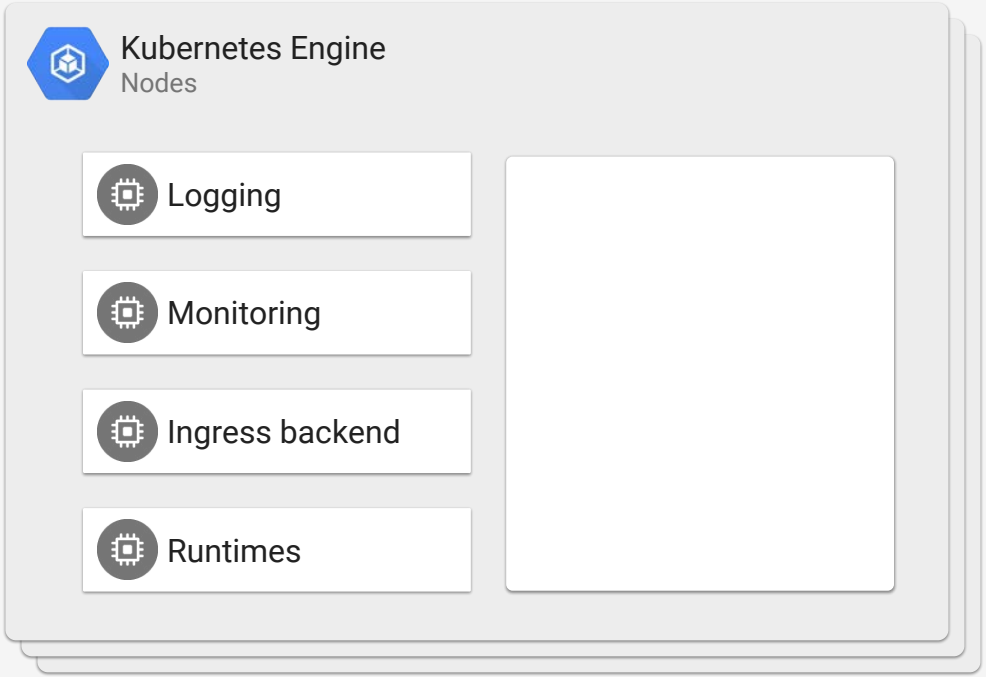
- Update Kubernetes version
- Update node OS

Node repair:

- Automatically repair broken nodes

Performant hardware (GCE):

- Accelerators Alpha (GPUs today, TPUs tomorrow)
- Preemptible machines Beta
- Cluster Autoscaler



Container Engine

Container clusters
Workloads
Discovery & load balancing
Configuration
Storage

Workloads BETA

REFRESH

Workloads are deployable units of computing that can be created and managed in a cluster.

Is system object : False

Name	Status	Type	Pods	Namespace	Cluster
buttonmasher-aggregator	Ok	Deployment	1/1	default	gcp-us-central1
buttonmasher-aggregator	Ok	Deployment	1/1	default	gcp-europe-west1
buttonmasher-aggregator	Ok	Deployment	1/1	default	gcp-asia-east1
buttonmasher-backend	Ok	Deployment	6/6	default	gcp-asia-east1
buttonmasher-backend	Ok	Deployment	6/6	default	gcp-us-central1
buttonmasher-backend	Ok	Deployment	6/6	default	gcp-europe-west1
buttonmasher-frontend	Ok	Deployment	2/2	default	gcp-us-central1
buttonmasher-frontend	Ok	Deployment	2/2	default	gcp-europe-west1
buttonmasher-frontend	Ok	Deployment	2/2	default	gcp-asia-east1
buttonmasher-visualizer	Ok	Deployment	1/1	default	gcp-us-central1
buttonmasher-visualizer	Ok	Deployment	1/1	default	gcp-europe-west1
buttonmasher-visualizer	Ok	Deployment	1/1	default	gcp-asia-east1
kube-pw-apiserver	Ok	Deployment	1/1	federation-system	gcp-us-central1
kube-pw-controller-manager	Ok	Deployment	1/1	federation-system	gcp-us-central1
load-bots	Ok	Deployment	1/1	default	gcp-us-central1
load-bots	Ok	Deployment	2/2	default	gcp-europe-west1
load-bots	Ok	Deployment	0/0	default	gcp-asia-east1


zulily

ocado

Porch

wepay

shopify

fuboTV

The New York Times

PHILIPS

Descartes
Labs

ORBITERA

poki

ebay

groupby

NIANTIC

Pokémon
GO

ODEN
TECHNOLOGIES

PicnicHealth

Meetup

bq

smyte.

CANACCORD Genuity

LOOTCRATE

Jelly Button
Games

What about Devops?

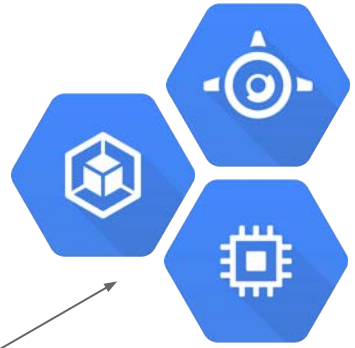
Push code to revision control, e.g. Cloud Source Repositories

Run Continuous Integration (CI) steps and build containers, e.g. using Container Builder

Store containers in a Docker registry, e.g. Container Registry

Use a Continuous Deployment (CD) tool, e.g. Spinnaker, to orchestrate and deploy deployments

Run, auto-scale and heal your app, e.g. using Kubernetes Engine



Monitor, logging (inc. full audit trail) and debugging for your app, e.g. using Stackdriver

Problems

How do I keep track and monitor all my micro services?

What about hybrid cloud and inter-op with other platforms?

How do I achieve service-to-service auth?

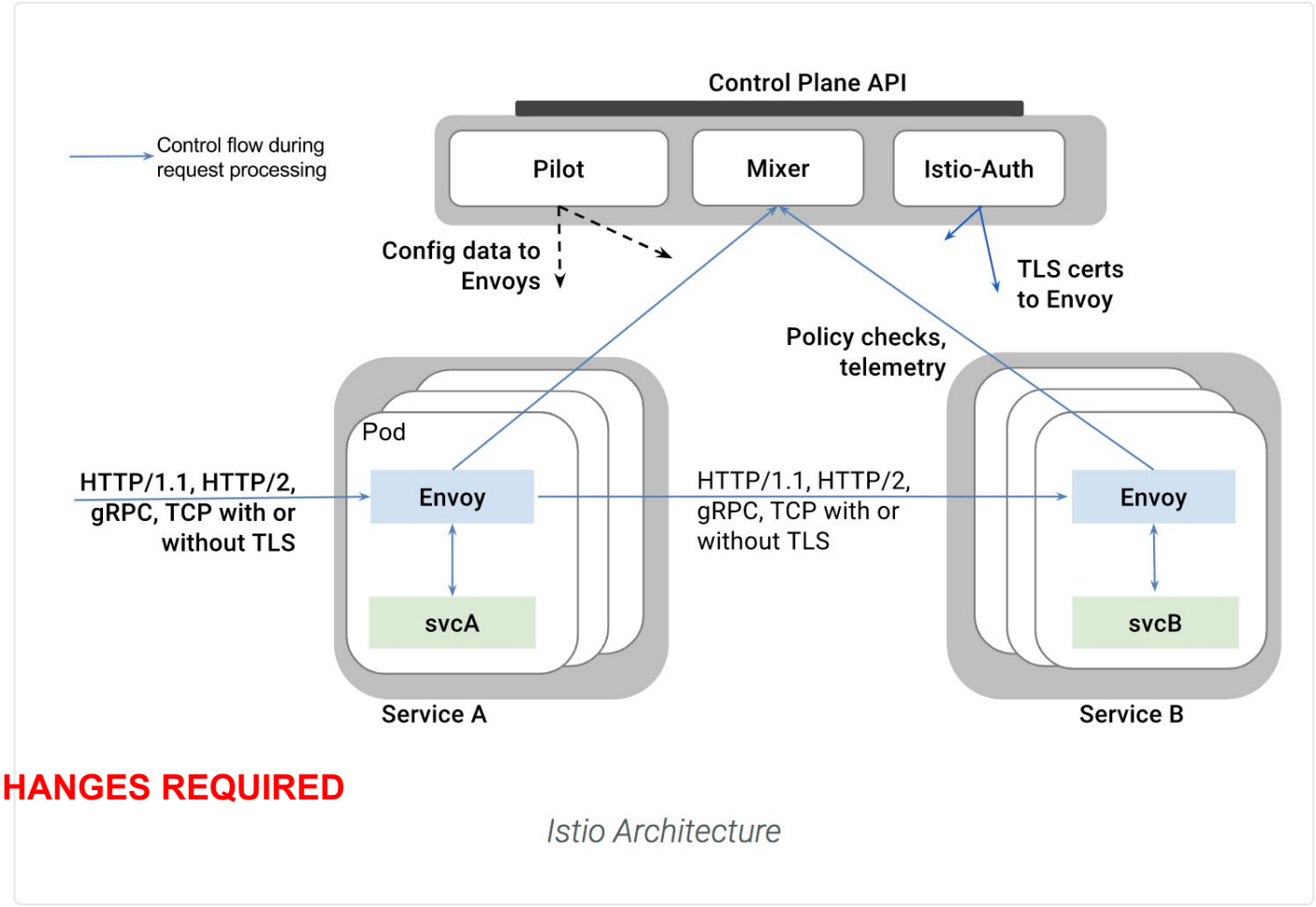
How do I implement more granular canary testing?

The Istio service mesh

- A complete framework for **connecting, securing, managing and monitoring** services
- Secure and monitor traffic for microservices **and** legacy services
- An **open platform** with key contributions from Google, IBM, Lyft and others
- **Multi-environment and multi-platform**

The Istio service mesh

- **Connect**
  Resiliency, discovery, load balancing
- **Manage**
  Traffic control, policy enforcement
- **Monitor**
  Metrics, Logging, Tracing
- **Secure**
  End-to-end Authentication and Authorization



NO APP CHANGES REQUIRED

Istio Architecture

Learn more

- Try it out free: https://cloud.google.com/free $300 trial for 12 months
- Learn more about Kubernetes and GKE
  - https://codelabs.developers.google.com/, search ‘kubernetes or istio’
  - https://cloud.google.com/kubernetes-engine/
- Istio: https://istio.io/
- Get help
  - ‘kubernetes’ and ‘google-kubernetes-engine’ tags on http://stackoverflow.com
  - http://slack.k8s.io/ and https://gcp-slack.appspot.com/

Thank you