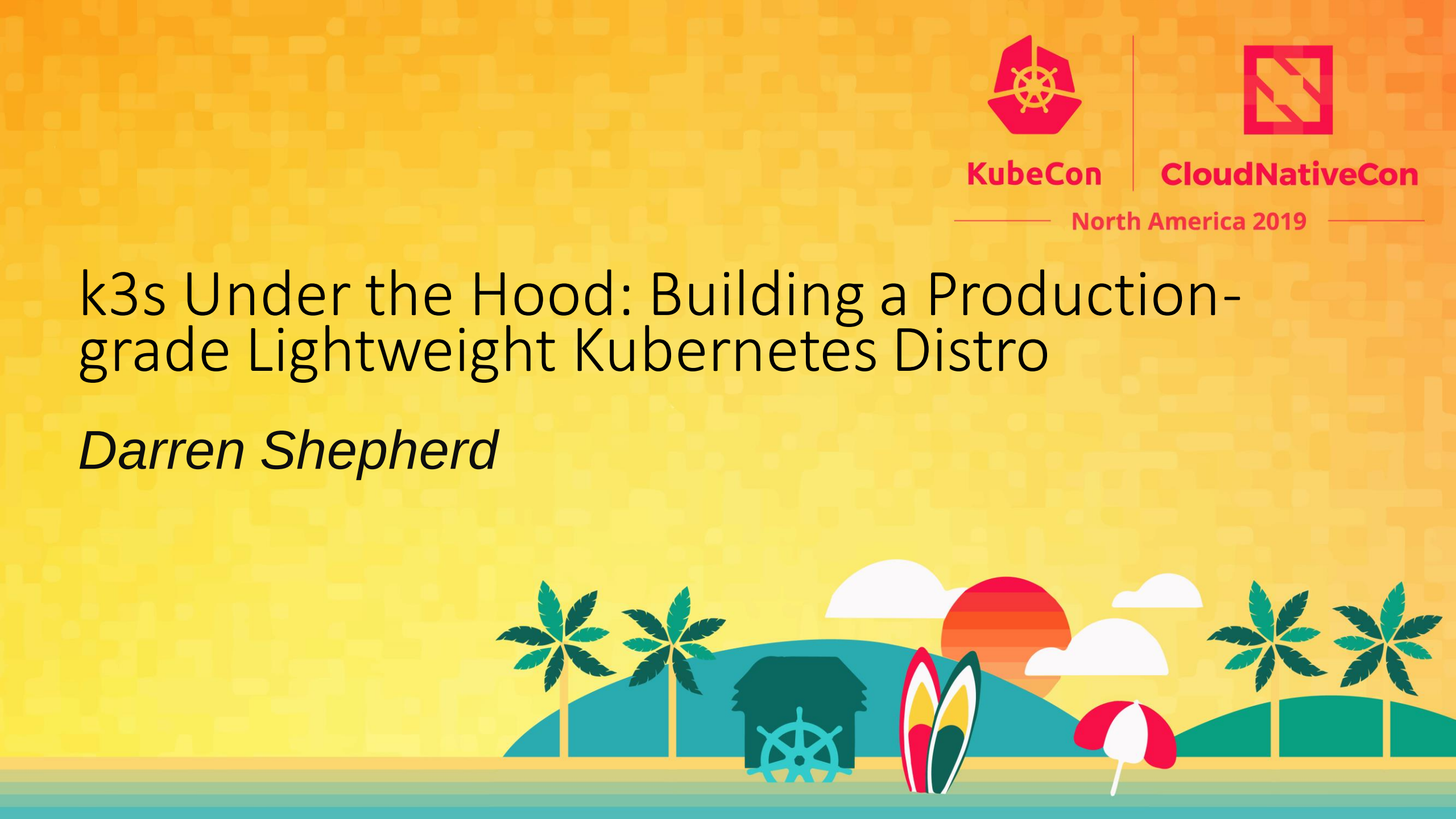

k3s Under the Hood: Building a Production-grade Lightweight Kubernetes Distro

Darren Shepherd

Darren Shepherd - Speaker

- Chief Architect and Co-Founder at Rancher Labs
- @ibuildthecloud on
- Creator of k3s (and many other Rancher projects)
- Been doing cloud orchestration for 15+ years.

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What is k3s

Lightweight Kubernetes

- Single Binary Size (~50mb)
- Memory Size (~300mb)
- Low Cognative Load (🤯)
- Perfect for the Edge
- Used just about everywhere

Designed for production

- Fully CNCF Certified
- Secure by default
- Best practice defaults

Kubernetes Distribution

- Opinionated
- Complete
- Strong focus on simplicity

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Short History of k3s

1. Total fluke
2. Came from developing Rio (hey check out https://rio.io)
3. Wanted to make running k8s simple so we embedded k8s in Rio
4. Figured out Rio was the easiest way to run k8s
5. The internet somehow saw what I was doing and liked it
6. Spun out into separate project
7. Turns out edge is a perfect use case and massive market

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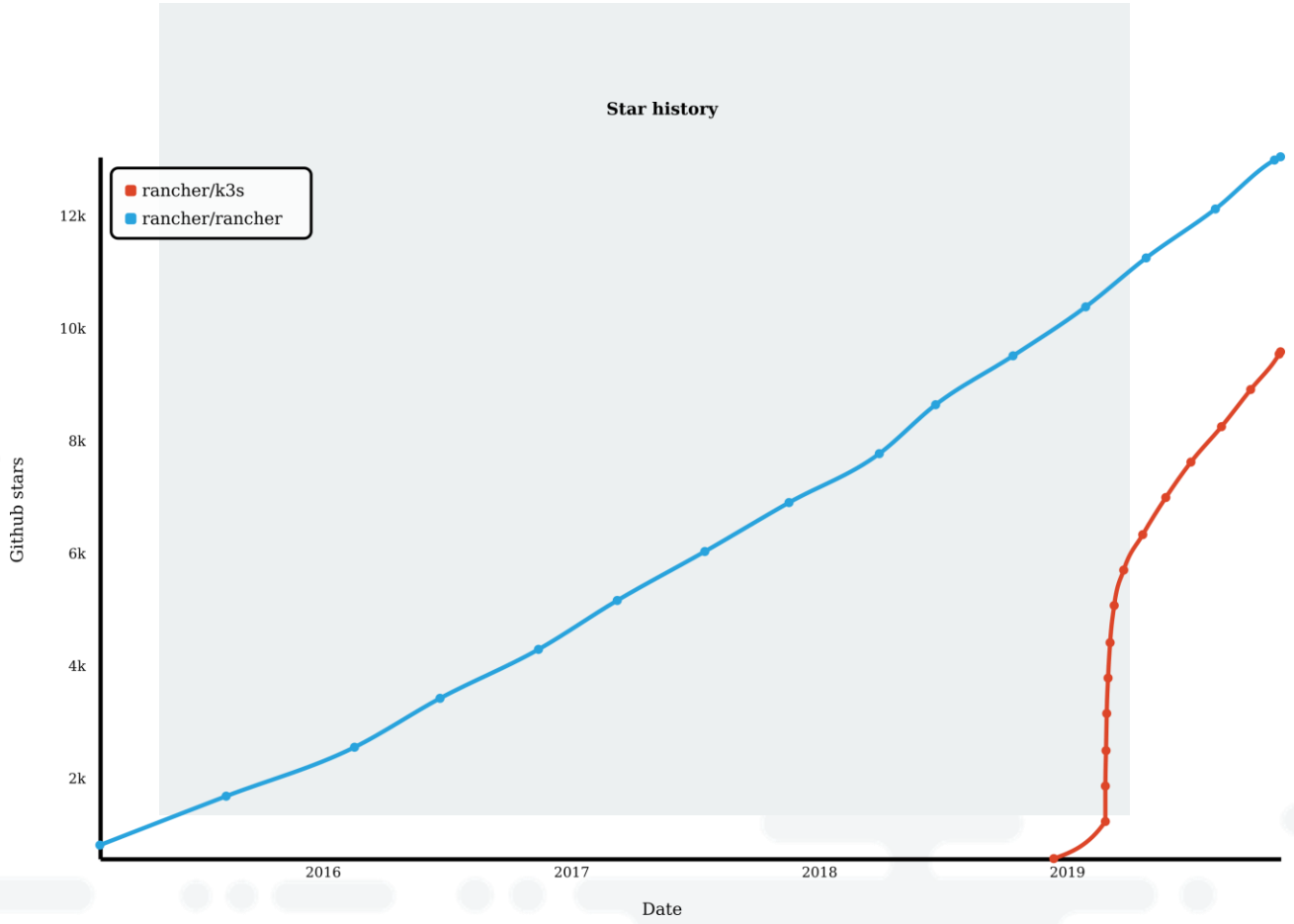
Vanity Metrics

- Initial Release: v0.1.0 Feb 26 (9 months ago)
- v1.0 GA Nov 19, 2019
- 10k+ GitHub Stars
- 500k+ Binary Downloads
- 700k+ Image Pulls
- 800k+ Nodes launched
  - *based on pull count of rancher/klipper-lb



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Some nomenclature

Server

Runs
- Control plane (api server, controller-manager, scheduler)
- "master worker" (kubelet)

Agent

Runs
- "worker" (kubelet)

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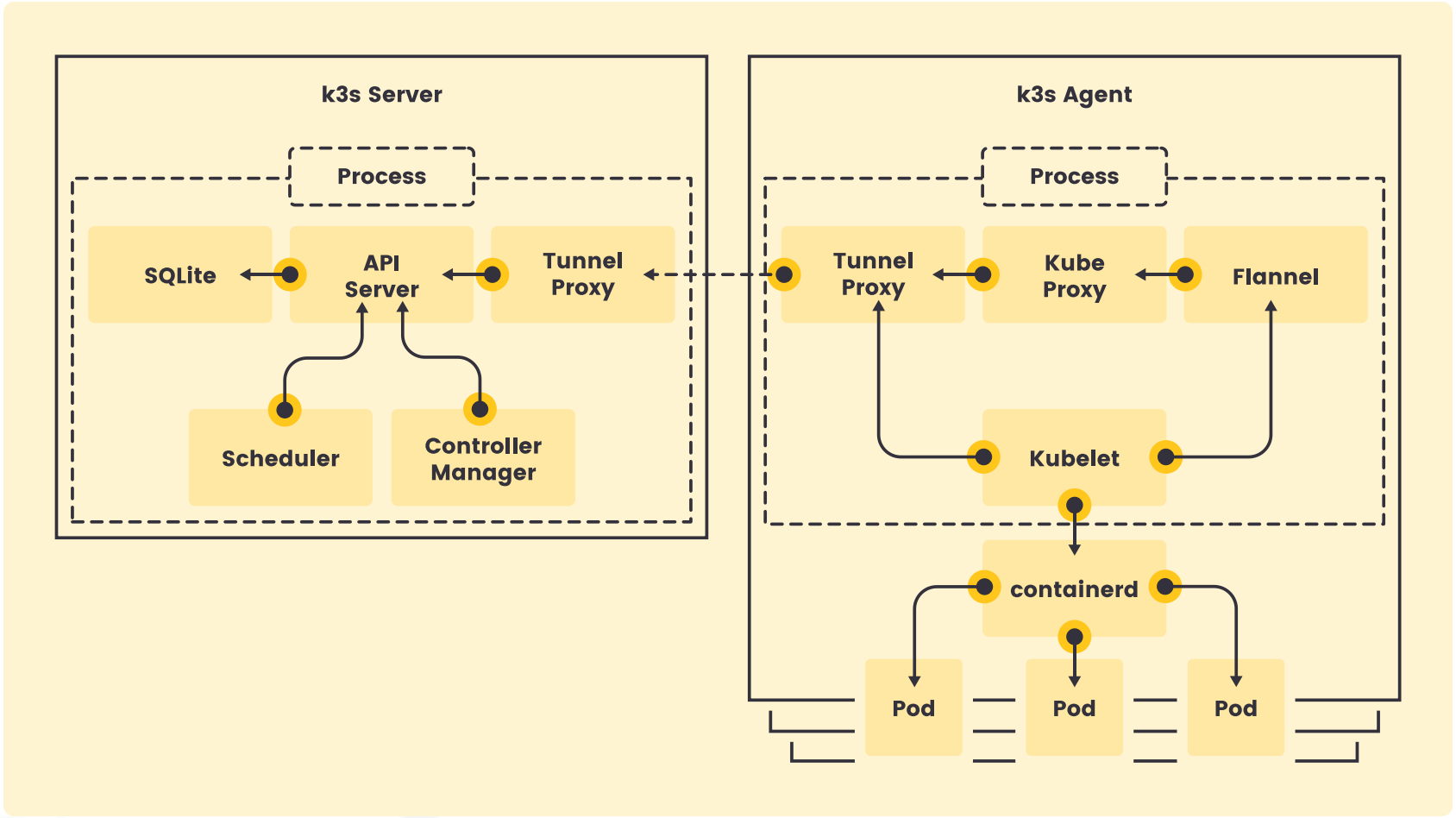
Process Architecture



Server and Agent process are combined into one when ran on the same machine

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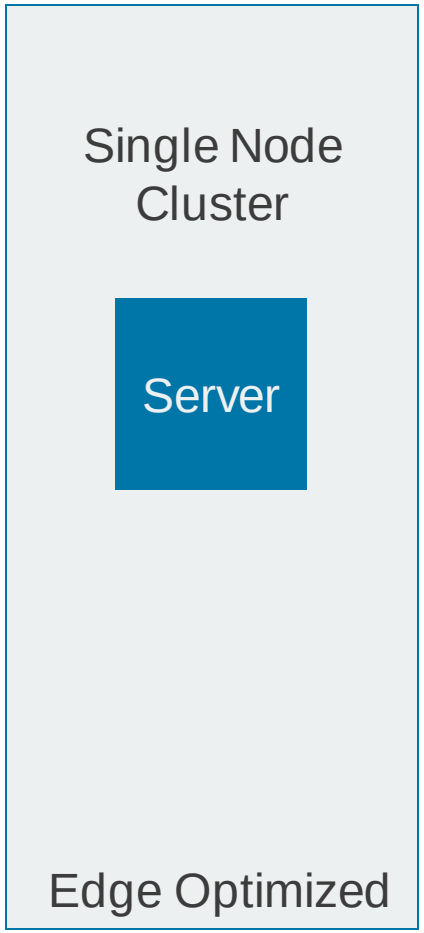
Deployment Architectures



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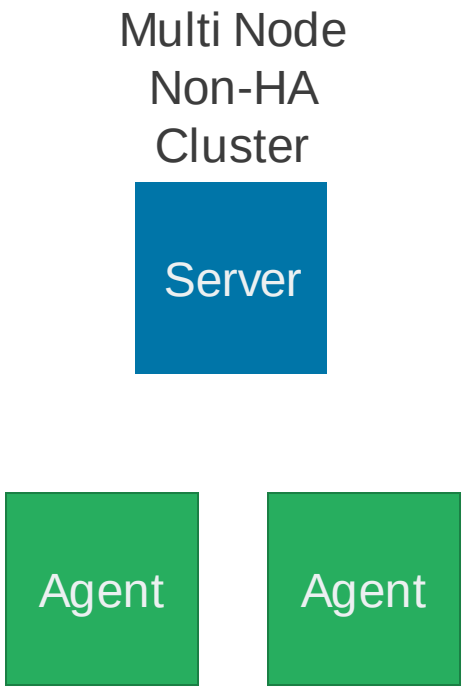
Deployment Architectures



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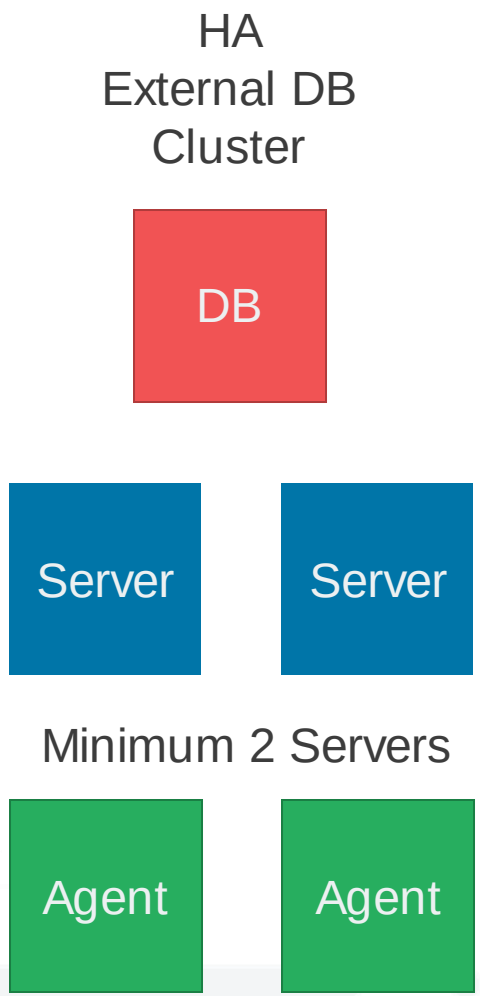
Deployment Architectures



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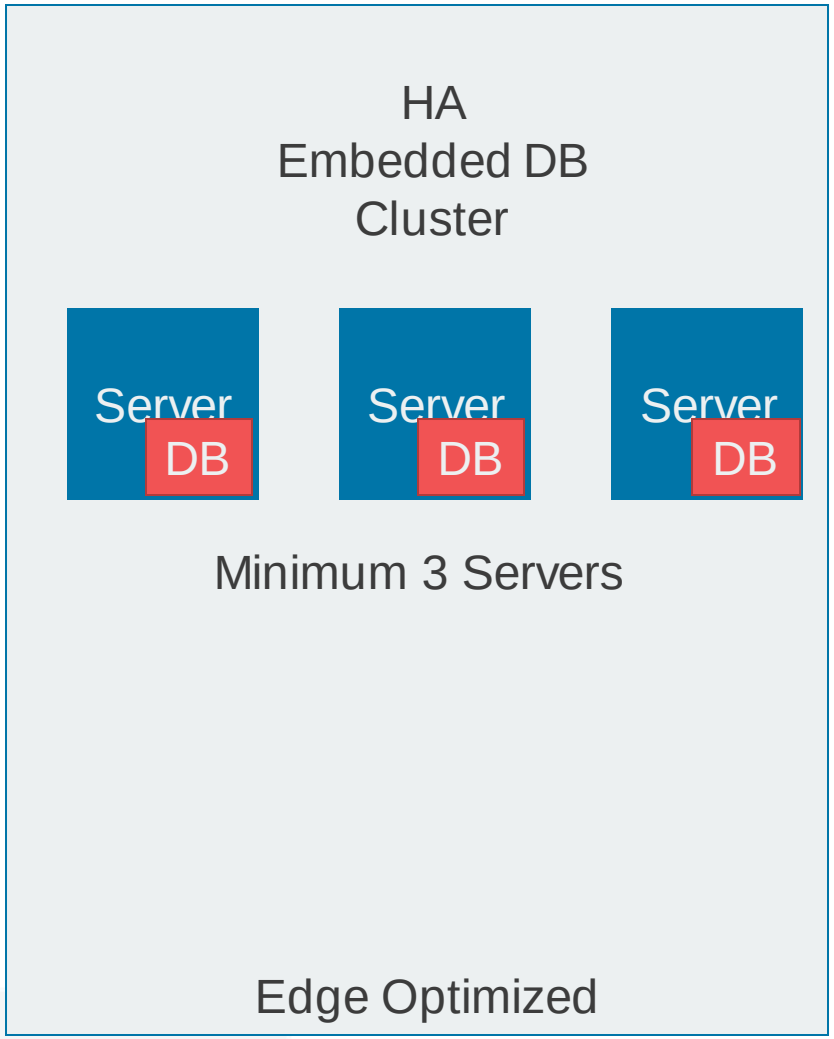
Deployment Architectures



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Commands

- Run server

```
k3s server -t ${TOKEN}
```

- Join agent

```
k3s agent -s https://server:6443 -t ${TOKEN}
```

- Join server

```
k3s server -s https://server:6443 -t ${TOKEN}
```

${TOKEN} is a user chosen random string

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Breakdown

1. How Kubernetes is modified
2. What we develop and added
3. What is packaged

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Kubernetes Modifications

Not a fork and much less changes than you'd think.

A lot of effort has been put into ensuring long-term upstream support.

k3s - v0.1.0 over 3 million lines changed
k3s - v0.11.0 less than 1000

Patches at https://github.com/rancher/kubernetes look at *-k3s* tags

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Kubernetes Modifications

- Add rootless support (all credit goes to Akihiro Suda from NTT)
- Drop all third-party storage drivers (CSI is supported and preferred)
- Drop cloud provider and dependencies on cloud SDKs (adds a lot of bloat to binary)
- Backported bug fixes
- Changed to allow embedding k8s

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Things we've developed

1. Reverse Tunnel Proxy for kubelet – kubelet only makes outbound connections, makes network firewalling easier
2. kine – etcd shim that translates etcd api to sqlite, Postgres, Mysql, dqlite
3. dqlite integration – secure transport, discovery, handle failure scenarios
4. busybox userspace – iptables, du, find, socat, ipset, etc.
5. k3s binary archive – k3s is really a self extracting archive
6. Certificate generation and rotation
7. Server bootstrap

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Things we've developed continued

1. Manifest auto deploy
2. Image auto deploy
3. Integrated helm chart management (helm chart CRD and controller)
4. Server bootstrap
5. Kubelet client side load balancer
6. k3s cloud provider – manage external IP
7. Embedded host port based Service Load Balancer
8. Local storage provider

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What's included

1. Everything embedded can be disabled and replaced
2. Flannel is compiled into agent (vxlan, ipsec, wireguard support)
3. Network Policy Controller from KubeRouter
4. containerd
5. runc
6. cni binaries
7. Strongswan

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What's included continued

1. Traefik for Ingress
2. CoreDNS
3. Metrics Server
4. Busybox user space (k3s can run with an empty root and only proc, sys, dev)
5. And all this works out of the box on amd64, arm64, armhf

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Kine (Kine is not etcd)

1. Can be ran standalone so any k8s (not just k3s) can use Kine
2. Implements a subset of etcd API (not usable at all for general purpose etcd)
3. Translates etcd TX calls into the desired API (Create, Update, Delete)
4. Backend drivers for dqlite, sqlite, Postgres, MySQL
5. https://github.com/rancher/kine
6. Performance seems sufficient if not better than etcd – tested 1000's of nodes with no issue.
7. In theory can outperform etcd for k8s.

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Where is k3s headed

1. Users have asked for k3s to run everywhere
2. Cloud Provider support
3. WSL2 First Class
4. Windows (POC k3s.exe works)
5. Continue to build ecosystem of easy to install packages on k3s

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k3s community projects

1. k3d – k3s in docker, following the style of kind
   https://github.com/rancher/k3d

```
k3d create cluster
export KUBECONFIG=$(k3d get-kubeconfig)
```


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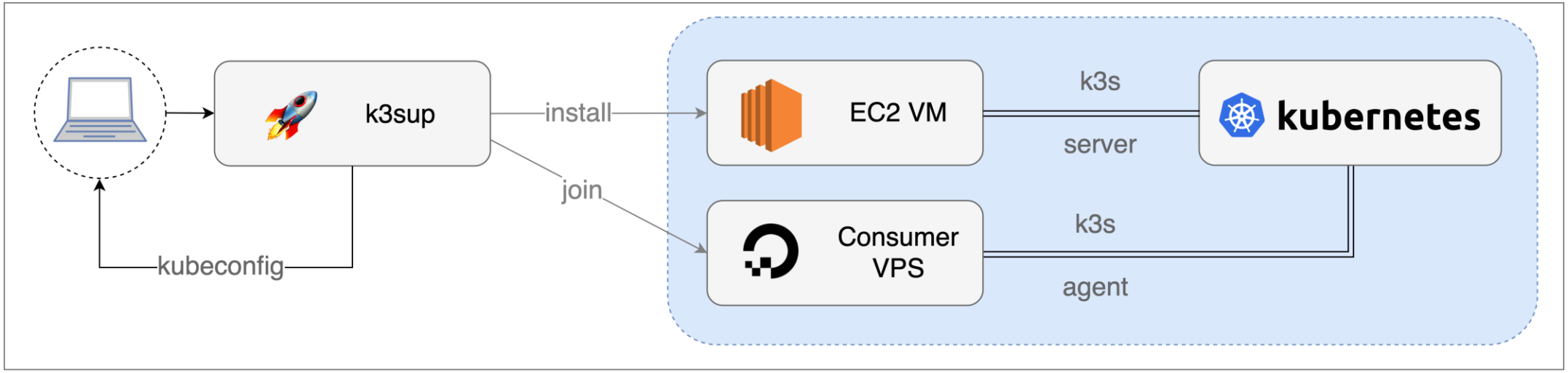
k3s community projects

1. k3sup – provision k3s clusters remotely ("from Zero to KUBECONFIG in < 1 min")



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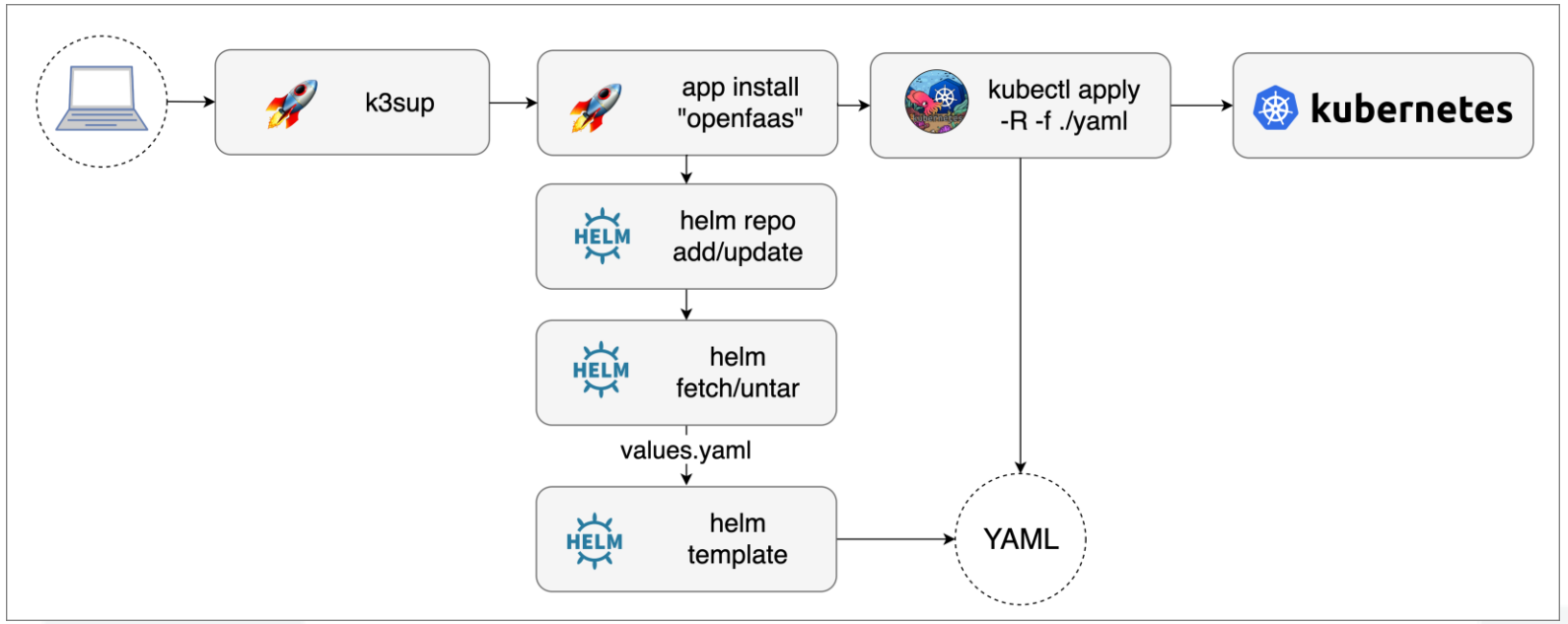
k3s community projects

1. k3sup – easily install apps



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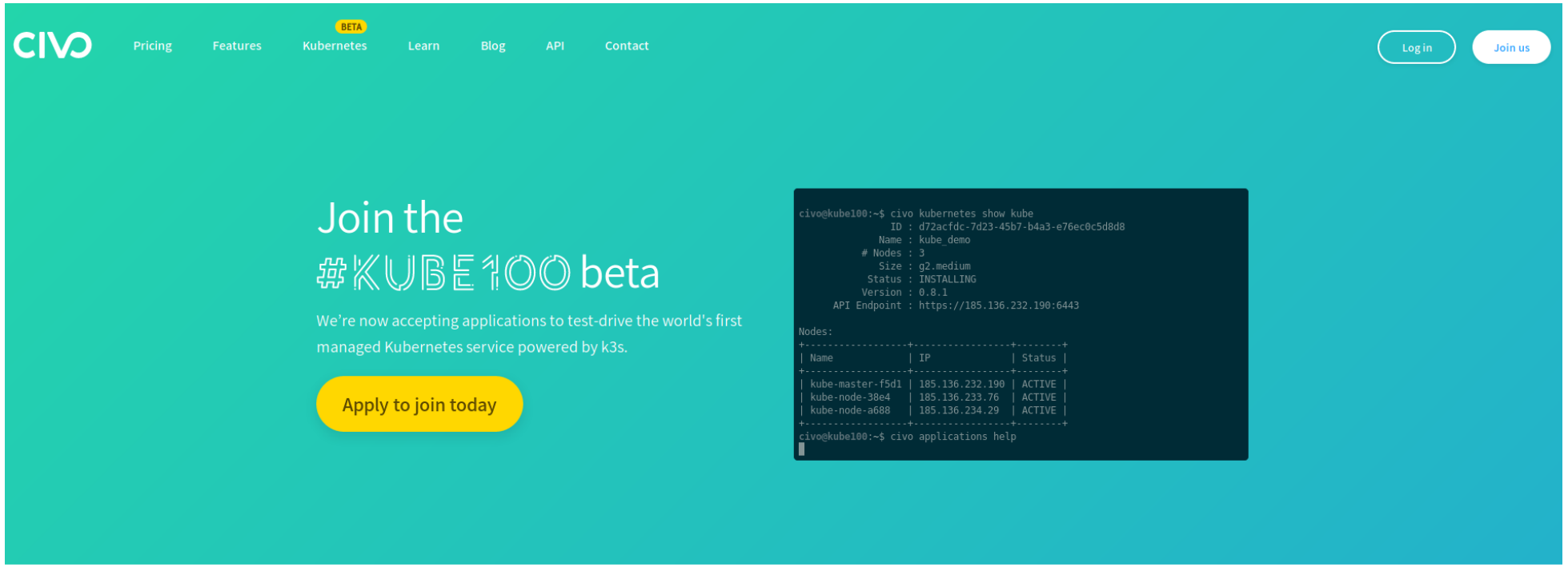
k3s community projects

Civo Cloud Kubernetes – Manage Kubernetes using k3s https://civo.com



The world's first managed k3s service,
built with simplicity in mind

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